STORMWATER MANAGEMENT PLAN FOR THE TOWN OF ENOSBURGH AND VILLAGE OF ENOSBURG FALLS

FINAL REPORT

Stone Project ID 112475-W

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1. INTRODUCTION

Water knows no political boundaries. As such, evaluations of water quality tend to be undertaken along watershed boundaries and involve land areas in multiple towns. From a strict 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 site or local levels.

A Stormwater Management Plan ensures that issues related to land use, surface water quality, and stormwater management are not viewed independently. Rather, localized stormwater problems are examined at a larger scale (e.g., town-wide) to determine their relative contribution. A Town-wide Stormwater Management Plan is responsive to existing landscape characteristics, connecting 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. Furthermore, 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., Tyler Branch, 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 recent 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 Enosburgh Town Plan states: *The Northwest Region of Vermont is home to many types of surface waters. They offer sustenance, scenic beauty, recreational opportunities, and livelihood to the residents and vistors of Franklin County and Grand Isle County. Water is one of the basic necessities of life; and because of that, it must be appropriately respected, managed, enhanced, and preserved to ensure the future vitality of the Region and its inhabitants* (Town of Enosburgh 2008).

The ultimate goal of this project is to provide the Town of Enosburgh and Village of Enosburg Falls with a list of high priority water resource concerns, including conceptual solutions, which will 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 Enosburgh.

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 Enosburgh and Enosburg Falls;
- Develops recommendations to address stormwater problems, including:
    - A list of problem areas that can assist stakeholders in directing resources to high priority projects; and
    - Conceptual solutions for high-priority problem areas (Section 4.3 and Appendix E), and
    - Potential revisions to local regulations and ordinances needed to encourage location-specific management activities.

2. GENERAL DESCRIPTION OF THE STUDY AREAS

The Town of Enosburgh and the Village of Enosburg Falls are located in Franklin County, in the northwestern corner of Vermont. The Village of Enosburg Falls is located in the northeast corner of the Town. Together, the Town and Village cover approximately 48.7 square miles. The total population of the Town was 2,781 as of the 2010 census; the Village population was 1,329 at that same time (U.S. Census Bureau 2011).

A key point to mention is the relationship between the Town of Enosburgh and the Village of Enosburg Falls. Although the Village is the primary social and commercial center for the Town, Enosburg Falls has its own Municipal Plan and Planning Commission and conducts its own business separate from that of the Town. However, the Village is included as part of the Town for purposes of the Town Plan. Every effort has been made to make this important distinction between the two government entities.

The Town of Ensoburgh and Enosburg Falls both lie wholly within the Lake Champlain basin, and have a number of surface water features within their boundaries. The Town and Village include portions of the Missisquoi River; two major tributaries, Trout River and Tyler Branch, join with the Missisquoi River in the Town. In addition, several smaller brooks—including Giddings Brook and Trout Brook—confluence with the Missisquoi River in the Village. Each of the watersheds is described below, and watershed boundaries are shown on Map 1 in Appendix A.

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, QC. The river then returns to Vermont at East Richford and flows south into Berkshire and ultimately west, through northern portions of Enosburgh and the center of Enosburg Falls, to Missisquoi Bay—for a total length of approximately 88 miles. There are five major subwatersheds that drain into the Missisquoi River: Hungerford Brook, Black Creek, Tyler Branch, Trout River, and Mud Creek. A significant portion of the Tyler Branch watershed and a smaller portion of the Trout River watershed fall within the Town of Enosburgh's boundaries. 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, likely from agricultural land uses, loss of riparian vegetation, and streambank erosion. However, no specific impairment cause or remedial action has yet been identified by the state.

2.2. Tyler Branch

The Tyler Branch and its major tributaries – Beaver Meadow Brook, Bogue Branch, and The Branch – drain the southern half of the town before joining with Missisquoi just west of Enosburgh. The Tyler Branch drains a total area of more than 58 square miles, and the watershed is largely forested (74%), with smaller portions in agricultural (14%) and urban use (4%). The Tyler Branch between West Enosburg and Cold Hollow Brook has been identified as a "water in need of further assessment" due to concerns related to agricultural runoff and morphological instability (VTDEC 2012).

2.3. Trout River

The Trout River watershed encompasses approximately 86 square miles across the towns of Berkshire, Richford, Montgomery, Westfield and easternmost portions of the Town of Enosburgh. Along the main stem of the Trout River, agricultural land use predominates, while the upper reaches (above Montgomery Center) are dominated by forest. The Trout River joins with the Missisquoi in Berkshire just before the Missisquoi crosses into Enosburgh.

2.4. Other Watersheds in Enosburgh

Several smaller brooks in Enosburgh flow directly to the Missisquoi River, including two which drain the northern half of Enosburg Falls. Giddings Brook flows south from Berkshire into Enosburg Falls; its confluence with the Missisquoi is just west of the Village center. Trout Brook also flows south from Berkshire into Enosburg Falls and empties into the Missisquoi east of the Village center.

The Samsonville Brook watershed is located primarily in the Town of Berkshire, with a small amount of land in the southern portion of the watershed located in Enosburgh. A 4.5 mile stretch of Samsonville Brook, measured upstream from the mouth, is considered to be “impaired” by high bacteria levels. A TMDL for Samsonville Brook was developed as part of the Statewide Bacteria TMDL completed in 2011 (VTANR 2011).

3. EXISTING PLANS AND DATA

Numerous and varied groups and individuals have invested considerable effort in evaluating different components of Enosburgh and Enosburg Falls water resources, and the important interface between water resources and local land use decisions. Some evaluations have followed watershed boundaries, while others have followed political boundaries. The following sections identify evaluations completed over the past ten years, with emphasis on work most relevant to future efforts to develop a list of strategic, prioritized projects that could be undertaken to improve water quality in and around Enosburgh and Enosburg Falls. A detailed review of each assessment is included as Appendix B of this report.

3.1. Watershed-Based Assessments

The assessments described below 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 Enosburgh and Village of Enosburg Falls. 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 the Tyler Branch and its major tributaries, as well as the Trout River.
- Water quality monitoring, including biological assessments. Assessment data have been collected along the mainstem of the Missisquoi River, as well as in Samsonville Brooks in Enosburgh.
- 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 U.S. EPA is in the process of the revising the Phosphorus TMDL for Lake Champlain; as mentioned in Section 2, a bacteria TMDL was completed for Samsonville Brook.

3.2. Town-Wide Assessments and Programs

In addition to the watershed-based assessments, a number of pieces of data are developed on a municipality-by-municipality basis that are important to any effort to develop a list of strategic, prioritized projects that could be undertaken to improve local water quality. These include direct feedback from the Town and Village, work by the Vermont Agency of Transportation (VTrans), and past and current planning initiatives, specifically:

- During meetings with the Village Manager and Public Works Director, as well as with the Town Road Foreman, a list of potential problem areas was identified. These include both areas with current concerns, such as localized flooding or erosion, and areas of future concerns, focusing on areas where new development may be concentrated. The identified areas were investigated and documented, as appropriate, in Appendix C.
- VTrans-sponsored programs, including routine inspections of bridges and culverts, have identified a number of potential projects to protect existing infrastructure whose implementation would also improve stormwater management.
- Enosburgh's Town Plan recognizes both the important recreational opportunities that the Town's surface water resources provide, and that problems of pollution continue.

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 location of any concerns related to stormwater
- Engagement with local officials, including:
  - March 29th kick-off meetings with the Enosburg Falls Village Manager and Public Works Director, as well as the Town of Enosburgh Road Foreman
  - October 24th follow-up meetings Enosburg Falls Public Works Director and Enosburgh Road Foreman to review identified priority projects
- .Targeted site visits to verify problems areas (July-September 2012)
- 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. Approximately 25 potential problem areas were identified and geo-located. The data sheets for all of the problem areas 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, and any observations about the source or cause were recorded.

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. Scores were assigned as follows:

Level	Classification
1	Outside of project scope.
2a	Stable, no urgency.
2b	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

The 12 problem areas that were assigned a Level 3 or 4 classification 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, five conceptual solutions were developed that address seven of the problem areas assigned a Level 3 or 4 classification. Each of the conceptual solutions is described in the report sections that follow, and the complete analyses are presented in Appendix E.

4.3.1. Road Maintenance Garage (Town)

The Enosburg Town road maintenance facility includes 1.5 acres of treatable impervious surface, including 0.2 acres of roof top and 1.3 acres of compacted gravel utilized for parking, equipment storage, and winter road-sand stockpiling. The road-sand stockpile is a persistent source of sediment, and a significant amount of material is mobilized and washed off site during every rain event. Currently, stormwater flows south across the property toward the Tyler Branch. A berm at the top of the river bank directs flow to the southwest corner of the property where stormwater drains directly to the Missisquoi River.

Covering the road-sand stockpile is the best way to prevent the erosion of material. Recently, the town was awarded a grant for approximately $50,000 for this specific purpose. An engineer's cost estimate, however, approximated the total cost for a suitable structure to be $250,000. A lower cost alternative would be to locate a stormwater treatment practice (STP) at the southwest corner of the property to reduce stormwater and sediment loads to Tyler Branch.

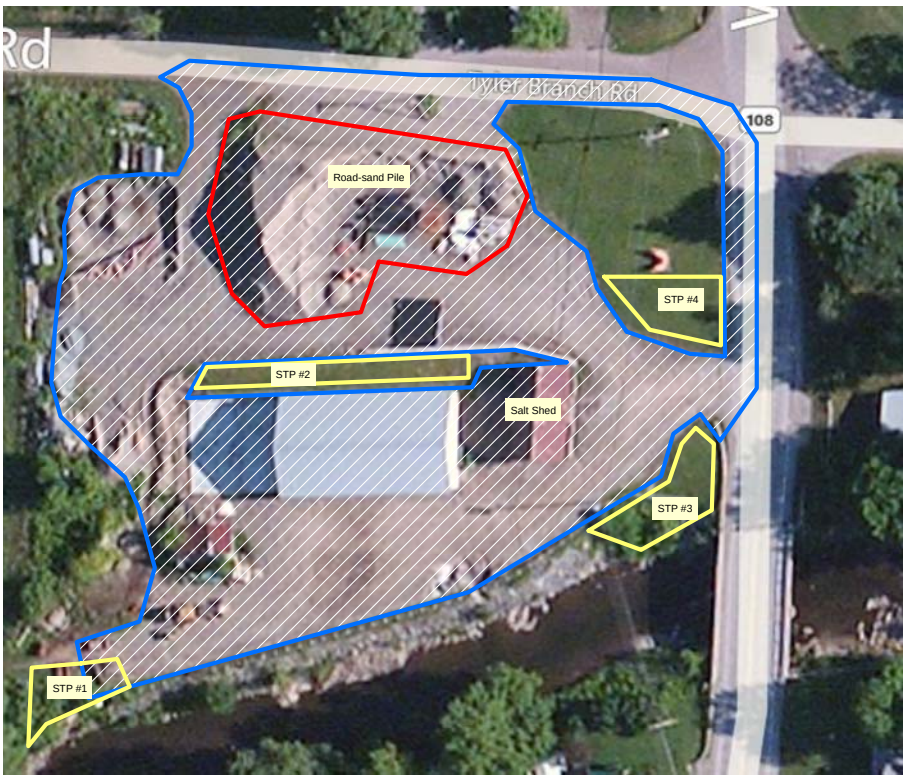

Figure 1. The Enosburg town road maintenance facility includes 1.5 acres of treatable impervious surface (outlined in blue). Potential STP locations are outlined in yellow.

4.3.2. Dairy Center (Town)

The Dairy Center is a five acre development that includes a bowling alley, restaurant, and lodging. This complex on Rt. 105 includes a large expanse of buildings and asphalt pavement. Nearly 3.6 acres of treatable impervious area were identified on the property, including a number of rooftops and much of the asphalt pavement. The property is immediately across the road from the Missisquoi River. Several potential STP locations were identified and are shown in Figure 2.

Soils at the Dairy Center appear to be Missisquoi loamy sand (HSG A). Infiltration would likely be effective at all potential STP sites. The asphalt pavement at the Dairy Center is expansive, and stormwater impacts could be greatly reduced by "de-paving" the existing pavement and replacing portions of it with vegetation or stormwater treatment practices. Pervious pavement may also be an option to reduce stormwater runoff, given the flat topography and well-drained soils underlying the parking lot.

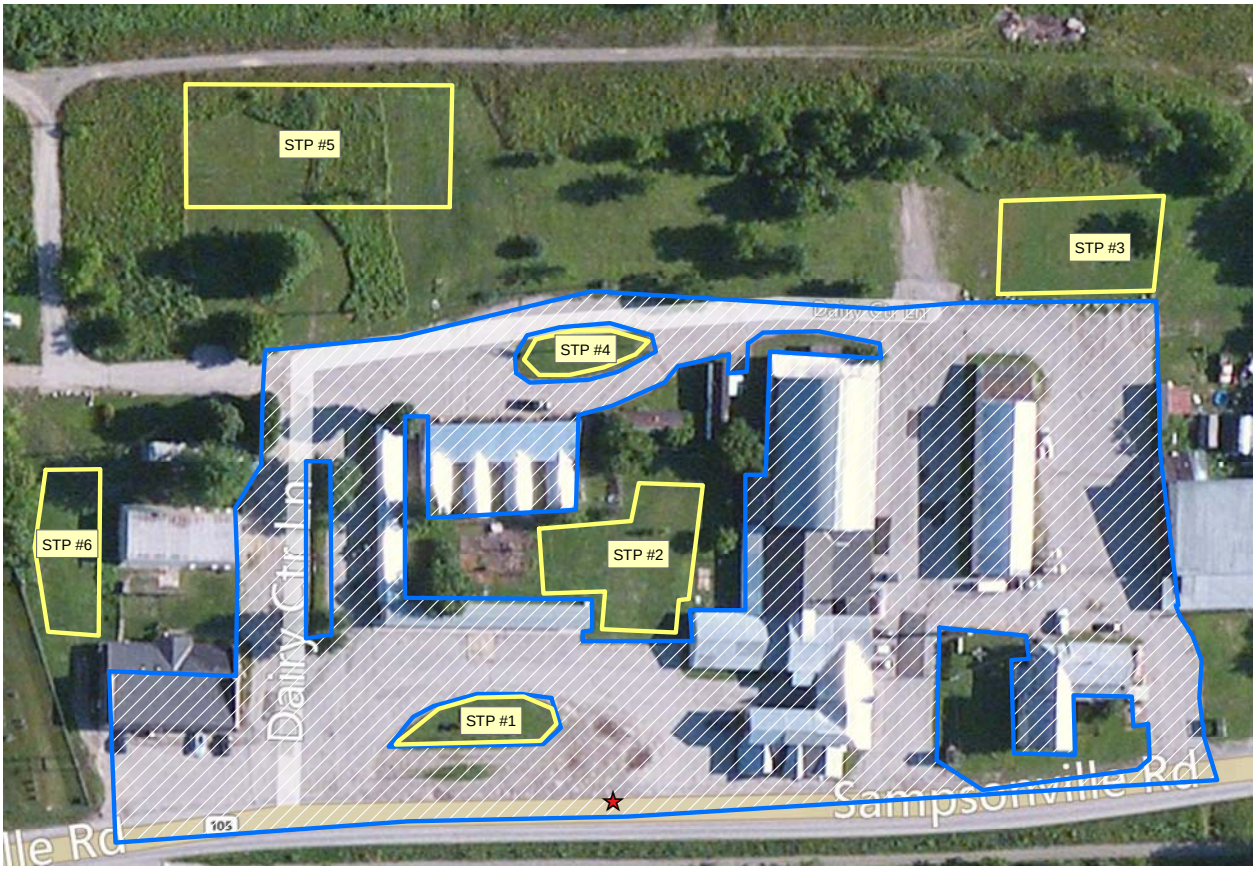

Figure 2. 3.6 acres of treatable impervious area were identified (highlighted in blue) at The Dairy Center. A number of STP location options exist (highlighted in yellow).

4.3.3. Enosburg School Campus (Village)

Stormwater from the Enosburg school campus and much of the surrounding Dickinson Avenue neighborhood is collected in a storm sewer and is discharged, untreated, at two locations in the floodplain of the Missisquoi River. Stormwater then drains directly to the Missisquoi River via vegetated swales. This neighborhood includes significant impervious areas in the form of rooftops and asphalt pavement.

A two-pronged approach is recommended to treat stormwater from the Enosburg school campus and Dickinson Avenue neighborhood.

- A number of retrofit opportunities exist at stormwater catch basin locations around the school property.
- A larger end-of-pipe treatment practice, such as micro-pool detention, could feasibly be constructed between the outlet to the storm sewer (at the southeast corner of Dickenson Ave.) and the Missisquoi River.

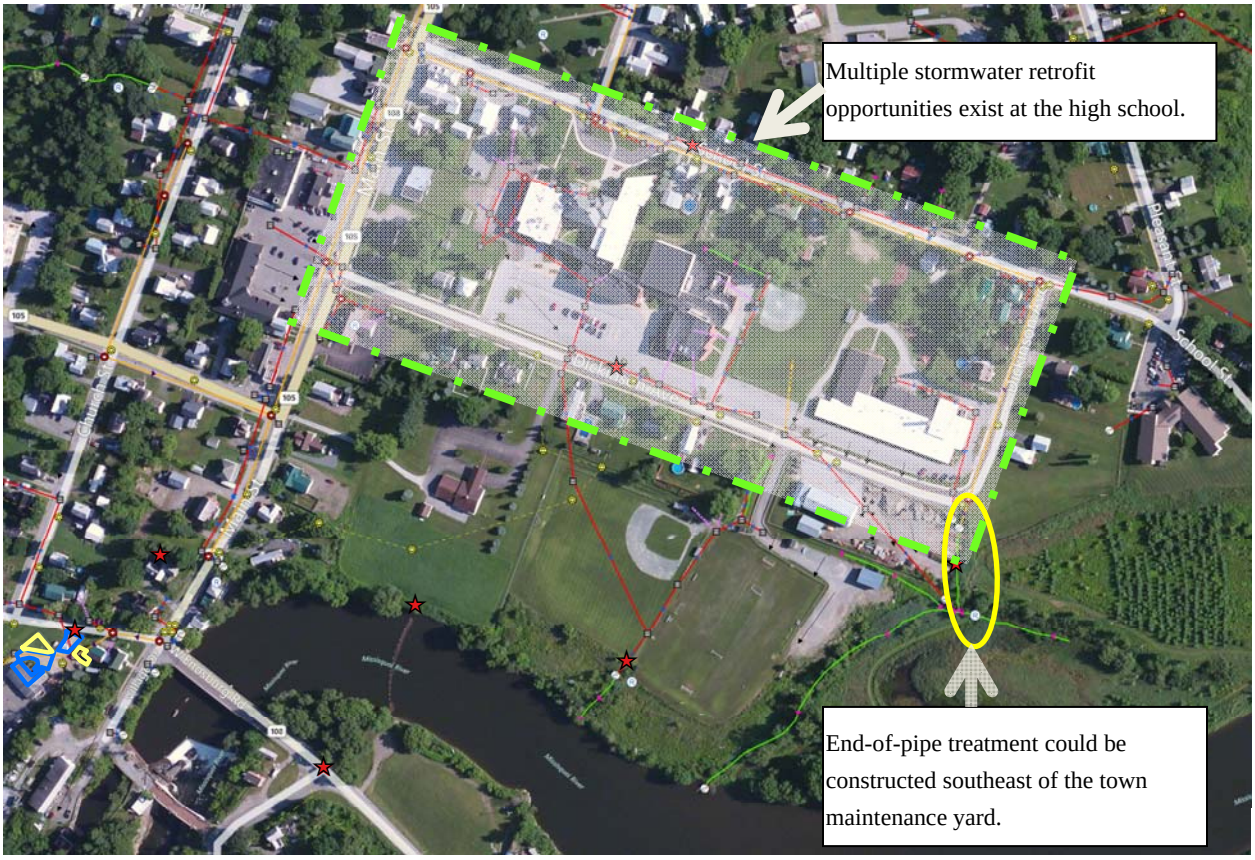

Figure 3. The Enosburg school campus and surrounding Dickinson Avenue neighborhood both include multiple stormwater improvement opportunities.

4.3.4. Wastewater Treatment Plant (Village)

The Enosburg Falls Wastewater Treatment Plant property on St. Albans Street has two catch basins that could be easily retrofitted to treat stormwater. Runoff from portions of two building roofs and two sections of the asphalt drive could be captured and slowly released to the existing stormwater infrastructure through retrofit-bioretention basins. One-tenth of an acre of treatable impervious surface was identified. Figure 4 shows conceptual locations for the proposed STPs. Soils at these locations appear to be Eldridge loamy fine sands. This soil type (HSG C) drains slowly when thoroughly wet, so infiltration-based practices are not expected to be effective.

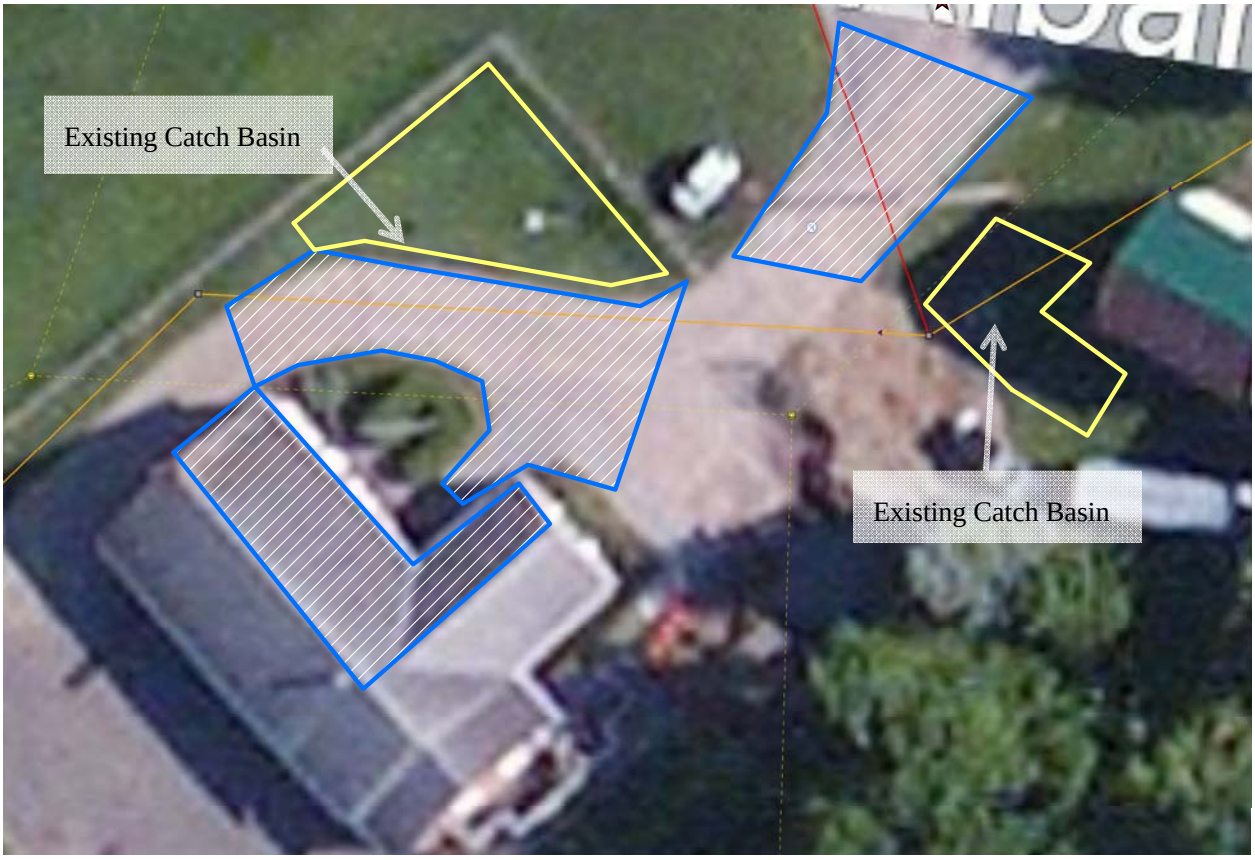

Figure 4. Two STPs could be built around two well-located catch basins at the wastewater treatment plant.

4.3.5. Perley Road (Town)

Perley Road is a gravel-surfaced road that runs from Nichols Rd. in Enosburg to Montgomery Rd. in Berkshire. A significant amount of work was recently completed, most notably the lining of ditches with crushed stone. However, two substantial stormwater improvement opportunities were found along the Enosburg portion of this route:

- A section of roadside ditch is clogged and has caused erosion of the road surface and of an adjacent property.
- Replacement of aging corrugated metal pipe culvert that is too short.

4.3.5.1. Roadside Ditch Maintenance

A portion of the road side ditch appears to be in need of cleaning (see Figure). In the ditch's existing condition, water has been diverted down and across the road, causing damage to the road surface and to a neighboring property. At the time of inspection, recent repairs have been made to the eroded section of road and adjacent property but the ditch had not been cleaned.

Figure 5. Ditch along Perley Road has become filled in. Diverted water is eroding the road surface.

4.3.5.2. Undersized Culvert Replacement

The ditch-relief (cross drain) culvert located near 2982 Perley Road is too short for the current width of the road. The short culvert forces the road embankment to be too steep. The resulting approximately 1:1 (horizontal to vertical) slope has created unstable conditions at both the inlet and the outlet to this 36” culvert (Figure). Generally, vegetated slopes should be limited to 2:1 to maintain stable conditions. The erosion of this over-steepened slope is resulting in deteriorating road conditions and impacts to water quality.

In addition, the existing culvert pipe is significantly corroded. It is likely that this culvert was of adequate length for the width of road when it was installed. Over time, through routine grading and re-surfacing, the road width may have increased, leading to over-steepened banks. Given the deteriorating condition of the culvert, it is a good candidate for replacement. The replacement culvert should be long enough to accommodate 2:1 slopes at the inlet and outlet of the culvert.

Figure 6. This culvert near 2982 Perley Rd. is too short, resulting in steep, erodible banks. Culvert inlet shown on left; Outlet is on the right.

5. NEXT STEPS

This document represents an extensive effort to identify and evaluate potential stormwater problem areas throughout the Town of Enosburgh and Village of Enosburg Falls. Several high priority potential stormwater improvement projects were identified that the Town or Village could either pursue directly, or could work with local landowners to address. Detailed information about these high priority projects can be found in Appendix E.

In addition to exploring opportunities to address current stormwater management needs, Enosburgh and Enosburg Falls can take steps to prevent future stormwater problems by expanding how stormwater management is addressed in zoning regulations. Specifically, consideration should be given to incorporating one or more of the following elements into the zoning regulations:

- Requiring a certain amount of stormwater runoff be treated as part of all development and redevelopment projects; and.
- Articulating 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.

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.
    - Enosburg Falls's current land use and development regulations (Enosburg Falls Village, 2009) require a right-of-way including "any driveway serving or intending to serve more than two single family units" conform to "the dimensional and geometric design standards for local roads and streets contained within the Vermont State Standards for the Design of Transportation Construction, Reconstruction, and Rehabilitation on Freeways, Roads, and Streets." This means all roads will be a minimum of 24 feet wide.
        - Consider reducing the minimum travel width for a private right-of-way serving up to four houses to 9 feet.
- Revising parking standards to encourage minimal use of impervious surface. For example:
    - Changing the definition of a "parking space" to be a 9' by 18' space, as opposed to a minimum length of 20'.
    - Recommend or require smaller stalls for compact cars, up to 30% of the total number of parking spaces.
    - Re-evaluate specified parking minimums to prevent the creation of surplus parking. This could involve establishing maximum parking requirements that closely mirror or are slightly less than current minimum parking requirements, and providing a maximum parking

requirement that is 20-80% of the current maximum, depending on the associated property use. Using a minimum and a maximum effectively creates a range of acceptable parking requirements, providing the development community a chance to be more flexible and efficient in site design.

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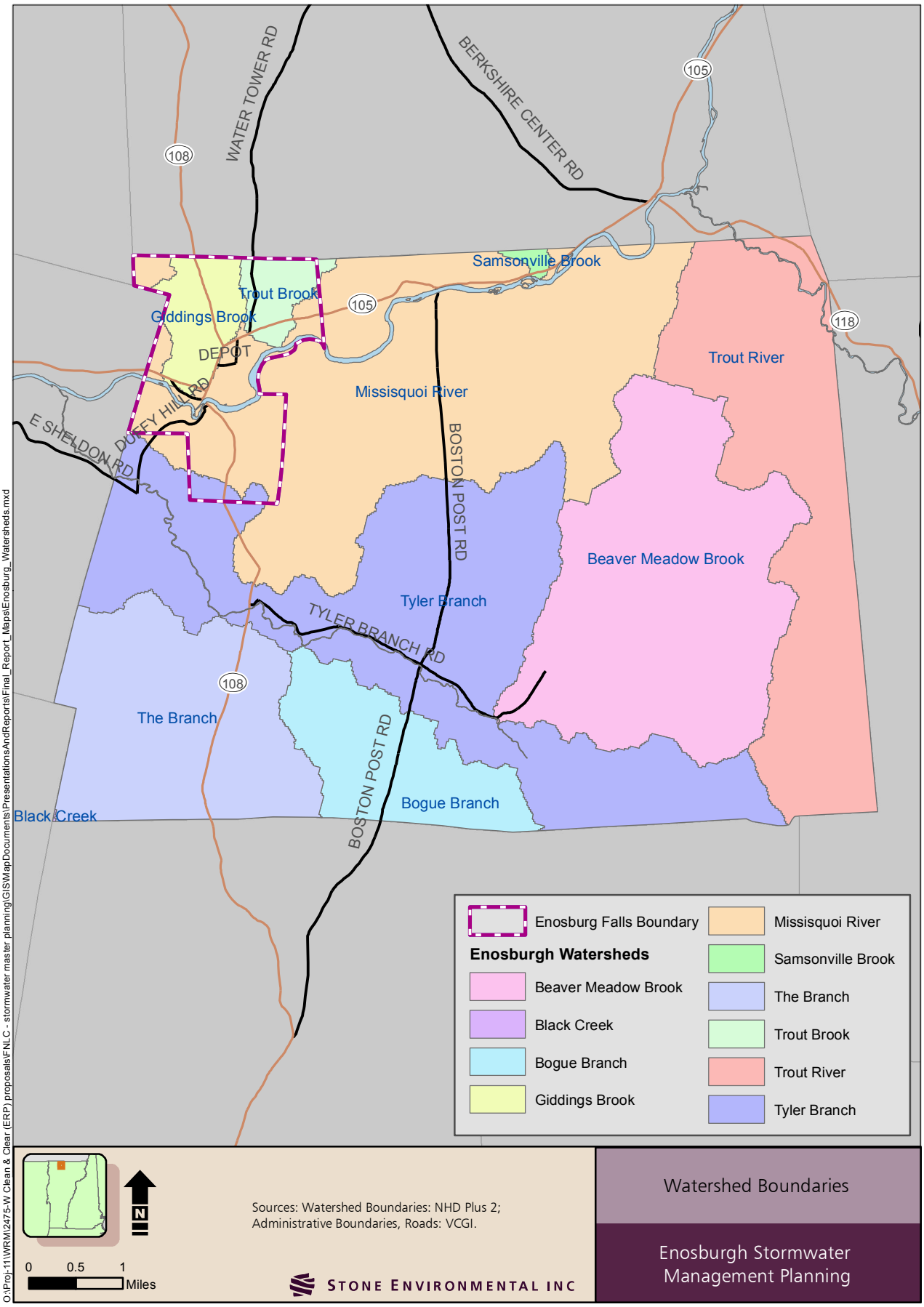
APPENDICES

APPENDIX A: WATERSHED MAPS


WATER TOWER RD
BERKSHIRE CENTER RD
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108
118
Samsonville Brook
Trout Brook
Giddings Brook
DEPOT
DUFFY HILL RD
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BOSTON POST RD
Trout River
Beaver Meadow Brook
Tyler Branch
TYLER BRANCH RD
The Branch
Bogue Branch
Black Creek
Enosburg Falls Boundary
Enosburgh Watersheds
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Sources: Watershed Boundaries: NHD Plus 2;
Administrative Boundaries, Roads: VCGI.
STONE ENVIRONMENTAL INC
Watershed Boundaries
Enosburgh Stormwater
Management Planning
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APPENDIX B: STORMWATER MANAGEMENT PLANNING LIBRARY

STORMWATER MANAGEMENT PLANNING LIBRARY

ENOSBURG FALLS AND ENOSBURGH TOWN

July 13, 2012

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STONE ENVIRONMENTAL INC

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1. BACKGROUND

Water knows 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 Missisquoi River, 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 Enosburgh and the Village of Enosburg Falls, 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 an Enosburg-specific list of strategic, prioritized projects that could be undertaken to improve water quality.

2. INTRODUCTION

The Town of Enosburgh and the Village of Enosburg Falls are located in Franklin County in northwest Vermont. The town has a total area of 48.7 square miles while Enosburg Falls has an area of 3.7 square miles. As of the 2010 census the population of the town was 2,781, with 1,329 of that total residing in the village[1]. Enosburgh has a number of rivers, streams and ponds within its borders, including portions of the Missisquoi River, the Tyler Branch, Bogue Branch, the Branch, Beaver Meadow Brook, Samsonville Brook, and a short section of the lower Trout River. Development in the area is primarily concentrated in Enosburg Falls.

The Tyler Branch and the Branch (tributary to Tyler Brach) drain the southwest 1/3 of the town, eventually meeting the Missisquoi River and flowing out to Lake Champlain. Beaver Meadow Brook drains the eastern 1/3 of the town and flows into the Tyler Branch. Adam's Pond is located along the flowpath of Beaver Meadow Brook. The mainstem of the Missisquoi River flows along the northern border of the town, draining adjacent areas. The Village of Enosburg Falls straddles the mainstem of the Missisquoi River. The Trout River flows through the northeast corner of Enosburgh before entering Berkshire and eventually draining into the Missisquoi River.

Enosburgh Zoning Regulations require a minimum twenty five foot buffer from the edge of intermittent or seasonal streams and a fifty foot buffer from the edge of waterways at least 10 feet in average channel width. The buffer width also increases with an increase in slope in the adjacent landscape.

Numerous and varied groups and individuals have invested considerable effort in evaluating different components of Enosburgh'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

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

out the pieces 1) most relevant to Enosburgh Town and Enosburg Falls 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 Enosburgh.

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 Enosburgh is within the Missisquoi Basin, last updated in 2004[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 Enosburgh: the Missisquoi River, Tyler Branch, and Trout River.
- In-stream water quality assessment work, including the watershed load monitoring program 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 Enosburgh or Enosburg Falls, the document also includes information on wastewater treatment plants. The specifications for the Enosburg Falls wastewater treatment facility from the time of this document (2005) are described below:

- Permit Flow Limit: 0.450 mgd (1,703 m^3/d)
- Permit Phosphorus Concentration Limit: 0.8 mg/L
- Waste Load Allocation: 0.373 mt/yr
- 2003 Actual Load: 0.150 mt/yr

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

The Missisquoi River Basin Water Quality Management Plan identifies water resource concerns within the more than 619 square miles of Vermont that drain to the Missisquoi River, and identifies opportunities for sustaining and improving water quality and aquatic habitat. In addition to the plan, ANR also published a draft set of preliminary strategies to address water quality and aquatic habitat concerns in the Missisquoi River

[2] http://www.vtwaterquality.org/mapp/docs/mp_basin6assessmntrpt.pdf

[3] http://www.lcbp.org/PDFs/MissisquoiPLoadMonitoringPlan.pdf

[4] http://www.anr.state.vt.us/dec/waterq/planning/docs/pl_basin6plan.pdf

Basin. The primary focus of the strategies is addressing nonpoint source pollution threats to surface waters, wetlands, lakes and ponds, and streams throughout the Missisquoi watershed.

In 2010, ANR's Watershed Management Division began revising basin plans to include more tactical strategies[5], meaning that plans will be updated to included objectives, prioritized strategies, benchmarks, and tasks in order to facilitate their implementation. Priority will be given to sub-basins for direct remediation actions where there are severe water quality problems or in areas of excellent condition that need more protection. Additional tactical strategies are likely to be incorporated into the Missisquoi Basin Plan as it is moved to completion. The Northwest Regional Planning Commission recently completed a series of edits to the draft plan.

The draft Missisquoi River Basin Plan identifies the following specific 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 streambank erosion.
- A 4.5 mile reach of Samsonville Brook is listed as "impaired" primarily due to bacteria. These waters fail to meet the Vermont Water Quality Standards based primarily on water quality monitoring for E. coli that was last conducted in 2000. The stream is included in the "Vermont statewide TMDL for Bacteria-impaired Waters" completed by FB Environmental Association for VDEC in September 2011 where bacterial load targets were established.
- The Tyler Branch between West Enosburg and Cold Hollow Brook has been identified as a "water in need of further assessment" due to concerns related to agricultural runoff and morphological instability.

3.3. 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.

[5] http://www.vtwaterquality.org/wqd_mgtplan/swms_planningprocessintro.htm

[6] http://www.lcbp.org/PDFs/IJC_MBBP/Missisquoi_Areawide_plan.pdf

3.4. 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.

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 Enosburgh the CSAs identified by the model include:

- Sampsonville Rd/Route 105 from Samsonville to Enosburg Falls
- Village Dr and Duffy Hill Rd, just southwest of Route 108
- The intersection of W. Enosburg Rd/Route 108 and Tyler Branch Rd

3.5. Stream Geomorphic Assessment Final Reports[8]

Stream geomorphic assessments have been completed for two stream/river segments within Enosburgh: Tyler Branch and Trout River. The assessment results are designed to direct future stream corridor restoration and protection measures. See Appendix A, Figures 5 – 7 for SGA maps of Enosburgh-area rivers and streams.

3.5.1. Tyler Branch Corridor Plan[9]

This document uses past Phase 2 stream geomorphic assessments of the Tyler Branch in order to create possible project packets in sensitive or restorable areas. Seven potential project areas were identified in the stream reaches based on the greatest benefits and reestablishment of geomorphic equilibrium conditions. Below is a summary of the projects and their locations:

M01/M02: The project goal is to 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.

T1-03/T1-05: The project goal is to increase sediment/nutrient storage and attenuation and to re-establish geomorphic stability.

[7] http://www.lcbp.org/PDFs/IJC_MBBP/LCBP_CSA_Modeling_Report_EN.pdf

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

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

Project Location: The Branch, following W. Enosburgh Rd/Rt 108 from its intersection with Bordoville Rd one mile north.

T1-02 "Sweet Parcel": The project goal is to increase sediment/nutrient storage and attenuation and to re-establish geomorphic stability.

Project Location: From VT Rt 108 bridge located near intersection with St. Pierre Rd downstream to property boundary with Marcel Parent.

T1-02 "Mongeon Parcel": The project goal is to increase sediment/nutrient storage and attenuation and to re-establish geomorphic stability.

Project Location: Mark Mongeon's former property, east side of Rt 108 at Chet Arthur Rd.

M-04: The project goal is to increase sediment/nutrient storage and attenuation and to re-establish geomorphic stability.

Project Location: intersection of Rt 108 and Tyler Branch Rd downstream to first bridge.

M-07: The project goal is to increase sediment/nutrient storage and attenuation and to re-establish geomorphic stability and floodplain access.

Project Location: intersection of Tyler Branch Rd and Grange Hall Rd upstream to just below large bedrock gorge.

M-09: The project goal is to increase sediment/nutrient storage and attenuation and to re-establish geomorphic stability.

Project Location: The Tyler Branch from the intersection of Ovitt Rd and Tyler Branch Rd half a mile downstream to top of gorge at Vaillancourt farm.

3.5.2. Tyler Branch Corridor Plan[10]

This document has many project ideas for the Tyler Branch watershed including bank stabilization, revegetation, and improving culvert and bridge structural integrity. Due to the current conditions in the Tyler Branch watershed, two factors were given the greatest weight when prioritizing projects:

- Reduction of stream power
- Accommodation of planform adjustments, permitting both full meander development and room for channel avulsions and rapid lateral migrations.

The shortlist of priority projects are as follows:

- Incorporation of fluvial erosion hazard (FEH) zones or other belt-width corridors into town planning processes in order to accommodate stream processes and ensure safety and the protection of investments by avoiding conflicts with these processes. Encroachments in these corridors are currently relatively limited, indicating good possibilities for streams to re-establish equilibrium conditions if further encroachments are prevented.

[10] https://anrnode.anr.state.vt.us/SGA/report.aspx?rpid=55_CPB&option=download

- Beaver Meadow Brook tributary in East Enosburgh: Address elevated flow impacts through:
  - Assessment of the status of historic stream diversion on Horseshoe Circle near Bluto Rd. for potential restoration of wetland attenuation functions (west side of Horseshoe Circle) on a tributary that may be currently diverted to this stream, or incorporate elevated flows into planning (essentially increasing the importance of items b) and c) below as well as the adoption of FEH zones or similar planning to ensure safety and protection of investments by limiting encroachments); and
  - Buffer plantings (especially trees rather than shrubs) near Longley Bridge Rd. bridge, primarily to provide structural diffusion of stream power in flood flows and help moderate the duration of and rate at which elevated flow impacts enter the stream and transfer to downstream; and
  - Corridor protection and/or forest management plan amendments upstream to help maintain the integrity of wooded buffers that are currently providing these benefits (structural diffusion of stream power in flood flows, moderation of the duration and rate at which elevated flows impact the stream), but have experienced some streamside cutting; emphasize retention of woody buffers unless particular trees are critical to the economic viability of a logging job
- Approach landowners in reaches T2S1.04 on Ross Brook (Branon sugarbush) and M14 on Tyler Branch (Wright Farm) about options for arresting headcuts, initiated during 2008 flash flooding, that could undercut private roads (farm and sugarbush roads); higher priority on T2S1.04, where these headcuts may contribute to loss of floodplain that is important for storing flow and sediment loads that will otherwise increase impacts on downstream areas.

A map of stormwater outfalls into the watershed is also available on page 40 of the report.

3.5.3. Trout River Watershed Phase 2 SGA[11]

No priority restoration projects were identified within the Enosburgh reaches of the Trout. It is likely that the reach may continue to widen slightly in some areas, and the aggradational processes will continue to reestablish floodplain connection. Attempts should be made to limit channel management in these areas to allow the channel to move toward geomorphic equilibrium. There are a few areas along the reach where buffers could be widened to improve wildlife habitat and increase resistance to erosion. As with all of the studied reaches, future human encroachments within the river corridor should be avoided to prevent potential flooding and erosion hazards.

3.6. Ambient Biomonitoring Data[12] (1985 – present)

The biomonitoring program evaluates the abundance and composition of the stream insect (macroinvertebrate) community to assess the overall environmental condition of wadable streams and rivers. Assessed streams are given a qualitative ranking, ranging from Poor to Excellent. Data on fish communities is often collected at the

[11] https://anrnode.anr.state.vt.us/SGA/report.aspx?rpid=57_P2A&option=download

[12] Courtesy of Rich Langdon, VT DEC (Rich.Langdon@state.vt.us)

same time. ANR is able to use this data to assess impacts of wastewater treatment plants, acid rain, agricultural practices, and the removal of streamside vegetation. In Enosburg, biomonitoring data has been collected from the Missisquoi River, the Tyler Branch, and Samsonville Brook; the macroinvertbrate data are summarized in the table below. Data for the Tyler Branch was collected more than 20 years ago and so is not included in this summary.

Location	River Mile	Date	Assessment
Missisquoi River	33.3	10/1/2004	Excellent/Very Good
Missisquoi River	33.3	9/2/1999	Very Good
Samsonville Brook	0.2	9/10/2009	Fair
Samsonville Brook	0.2	8/16/2005	Poor
Samsonville Brook	0.2	9/26/2000	Fair
Samsonville Brook	0.2	9/16/1993	Poor
Samsonville Brook	0.2	9/9/1992	Poor

Fish populations in Samsonville Brook were also assessed in 1992 and 2009. The brook received a rating of "Fair" in 1992 and no rating was given for 2009.

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

Water samples were collected by the Missisquoi River Basin Association at five sites in Enosburgh. 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.

Data analysis revealed periods of high pollutant load, particularly in the smaller rivers. The Tyler Branch and The Branch (its tributary) recorded nitrogen, phosphorous, and turbidity levels on 7/9/2008 that were 4 – 6 times greater than their average. Values for the samples before and after the sampling event (taken on 6/25/2008 and 7/23/2008) returned to average levels. 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).

Samples of the Missisquoi show more consistent pollutant loads, averaging between 0.2 and 1 mg/L nitrogen, 5 – 100 ug/L phosphorous, and 0 - 40 NTU turbidity for the 2005 – 2010 sampling period.

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 in to any effort to develop a list of strategic, prioritized projects that could be undertaken to improve water quality in and around Enosburgh. These include direct

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

feedback from the Town and Village, work by the Vermont Agency of Transportation, as well as past and current planning initiatives.

4.1. Town Feedback

See below for a list of priority projects identified by Town and Village officials in meetings with Stone Environmental.

- Construction of a new municipal salt and sand shed at the town garage is the town's highest priority. This would replace the sand pile and salt shed currently in close proximity to the Tyler Branch. The town received a $50,000 grant from the AOT's 2010 Enhancement program for this work, but was unable to secure funding for the remainder of the $245,000 project.
- Upkeep of culverts and ditches on town roads. The town will continue this work using town funds and VTrans grants. 2012 work includes Duffy Hill Rd (with funding from a Better Backroads grant), ditch erosion on Perley Rd, improving drainage at the intersection of Bogue Rd and Chimney Rd, ditch maintenance on Howard Rd, and work along Boston Post Rd at Route 105.
- Additional issues include a landslide on Tyler Branch Rd, and potential septic system problems at the Dairy Center on Sampsonville Rd. The town has applied for a grant to complete a bridge and culvert assessment along Hayes Farm Rd.
- More developed areas are also a target for improvement. Enosburgh's industrial park along Route 105 could have opportunities for employing low-impact development techniques to manage stormwater, as could recent construction on Dickinson St and School St.
- Several buildings in the Village have roof drains that remain connected to the combined sewer system; redirecting these connections to stormwater treatment practices could improve wastewater treatment capacity. Future development in the Village is projected to follow St. Albans St, Water Tower Rd, Duffy Hill Rd, and Orchard St.

4.2. Open Space and Natural Resource Assessment Report[14]

This document provides an analysis of the environmental resources of Enosburg. The sections that pertain to this library are Wetlands (Sec 4.2) and Resources Surrounding Growth Centers (Sec 4.3).

4.2.1. Wetlands

This section summarizes important natural wetlands in terms of local significance and future management. Further characterization and location information can be found in the document.

- Beaver Wetlands Northwest of Bordoville: High degree of plant diversity in this area. The mosaic of wetlands has the added benefit of mitigating the floodwaters that come off Leach Hill during high water events. The beaver ponds may also serve the function of filtering out any sediment that may come off the hills. Threats to this wetland are minor but a 100 ft development buffers should be maintained as well as a 50 ft logging buffer.

[14] http://enosburghvermont.org/NaturalResourceAssessment.php

- Beaver Meadow Brook Wetlands: This wetland complex is one of the most extensive and important complexes in the town. The mosaic of vegetation and the pattern of water flow also make these wetlands important for control of flood waters, filtering of nutrients and sediment, and controlling erosion along Beaver Brook. As a Class II wetland these areas are protected by a 50 ft buffer but since this area is significant to the town a 100ft buffer is recommended.
- Hopkins Bridge Wetlands: This is a broad, flat area that is dominated by willow and speckled alder shrubs. This wetland likely controls floodwaters, absorbs excessive nutrients and sediments and controls erosion along the banks of the tributary. These areas are Class II wetlands so they have the same protection of a 50 ft buffer with a 100 ft buffer recommended.

4.2.2. Resources Surrounding Growth Centers

This section summarizes the resources that surround potentially high growth areas in West Enosburgh and Enosburgh Center. A remote analysis of these areas was done and further assessment may be needed.

- The most significant resource around West Enosburgh in terms of natural communities and ecological functioning appears to be the vegetated stream corridor along the Tyler Branch. This is a Class II wetland and, in some places, a remnant floodplain forest. These stream corridors should be maintained. Where they are especially narrow, a widening of these corridors should be encouraged.
- There are a couple of wetlands in the vicinity of Enosburgh Center that may warrant attention. Lack of landowner permission prevented any field visits to these sites.

4.3. Vermont Agency of Transportation-Sponsored Programs

4.3.1. Vermont Online Bridge and Culvert Inventory Data[15]

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 bridges and culverts in Enosburgh.

4.3.2. Stream Geomorphic Assessment, Failure Modes Data[16]

Failure Modes- Problems and Causes

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

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

This document records the failure modes of a select group of bridges and culverts along the Missisquoi River through Enosburg. 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.

4.3.3. Better Backroads Program[17]

The Town of Enosburgh and Enosburg Falls have 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.

4.4. Vermont DEC Stormwater Permitting Program

4.4.1. 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.

4.4.2. 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 approximately 9 documented stormwater permits that have been issued to sites in the Village of Enosburg Falls or Town of Enosburgh. Depending on the age, style, size, and upkeep of an existing facility, these may be excellent candidates for improvement to enhance stormwater management capabilities.

4.5. 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, 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. Ten high-priority sites were identified

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

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

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

in Enosburgh Falls. These are sites where stormwater treatment structures could be cost-effectively added or improved. See Figure 1 for a list of priority sites in the Village of Enosburgh Falls.

4.6. Illicit Discharge Detection and Elimination (IDDE) in Six Missisquoi River Basin Communities[20]

An assessment of the Village of Enosburg Falls stormwater system for illicit discharges was conducted between July and September 2009. An illicit discharge is defined as any discharge to the municipal separate storm sewer system that is not composed entirely of storm water. These non-stormwater discharges occur due to illegal connections to the storm drain system. Illicit connections may be intentional or unknown to the property owner. As a result of an illicit connection, contaminated wastewater enters into storm drains or directly into local waterways without receiving treatment from a wastewater treatment plant. See Figures 2 – 4 for example IDDE maps.

4.7. Enosburgh Town Plan[21]

Two sections of the 2008 Enosburgh town plan relate directly to stormwater management: Surface Waters (Chapter 8) and Transportation (Chapter 12). The surface waters section contains a map of Critical Areas in Enosburg, including flood zones along the Missisquoi and Tyler Branch. Transportation focuses on town roads, and also provides an inventory of the town's bridges. Included in this inventory is a sufficiency rating—any bridge with a rating less than 50% is eligible for federal replacement funding and any bridge with a rating between 50-80% is eligible for federal rehabilitation funding. 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.

5. OTHER RELATED INFORMATION

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

5.1. NRCS Conservation Practice #558—Roof Runoff Structure[22]

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.

[20] http://www.vtwaterquality.org/erp/news/Missisquoi-IDDE-Report_Final-no-appendices.pdf

[21] http://enosburghvermont.org/Forms/Enosburgh%20Town%20Plan.pdf

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

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 being developed as 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 Enosburgh and Village of Enosburg Falls 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.

APPENDICES

APPENDIX A: FIGURES

Figure 1. Enosburgh 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
21	**1**	CB cleaning		0.22	85.0	3	85
22	**1**	CB cleaning		0.08	86.7	3	87
23	**1**	CB cleaning		0.09	85.3	3	85
24	**1**	CB cleaning		0.41	44.3	2	38
9	**1**	Ext Det. Micro Pool/Combine with 10 & 16		13.00	60.3	2	55
10	**1**	Combine with 9		0.19	66.4	2	61
16	**1**	Combine with 9		3.97	48.1	2	42
20	**1**	Sedimentation Tank/Sand Filter/ High Flow Bypass via Outfall 27		8.30	35.8	2	29
27	**1**	Combine with 20/Stabilize outfall		32.29	62.8	2	58
11	**1**	Constructed Wetland		10.83	63.7	2	59
12	**2**	Ext Det. Micro Pool		4.29	62.2	2	57
8	**2**	Ext Det. Micro Pool		1.93	20.7	1	9
1				1.67	69.8	4	55
3				1.35	68.8	4	53
7				9.60	35.4	2	29
19	**2**	Pocket Pond		10.88	35.2	1	21
30	**3**	Pocket Pond	4522-9010	2.14	24.5	1	12
17				3.02	60.1	2	55
29	**3**	Ext Det. Micro Pool		3.20	13.3	1	5
6	**3**	Ext Det. Micro Pool		8.49	47.7	2	41
32	**3**	Constructed Wetland/ Combine with 13		10.10	30.1	2	24
13	**3**	Constructed Wetland/ Combine with 32		3.18	68.9	2	64

Figure 2. Enosburgh Outfall EN-100

Sources: VCGI/ANR IT GIS: imagery; DEC: stormwater infrastructure; VCGI/ANR IT GIS: roads
Creator: Collin Smythe - VT DEC, Date: 3/11/2011

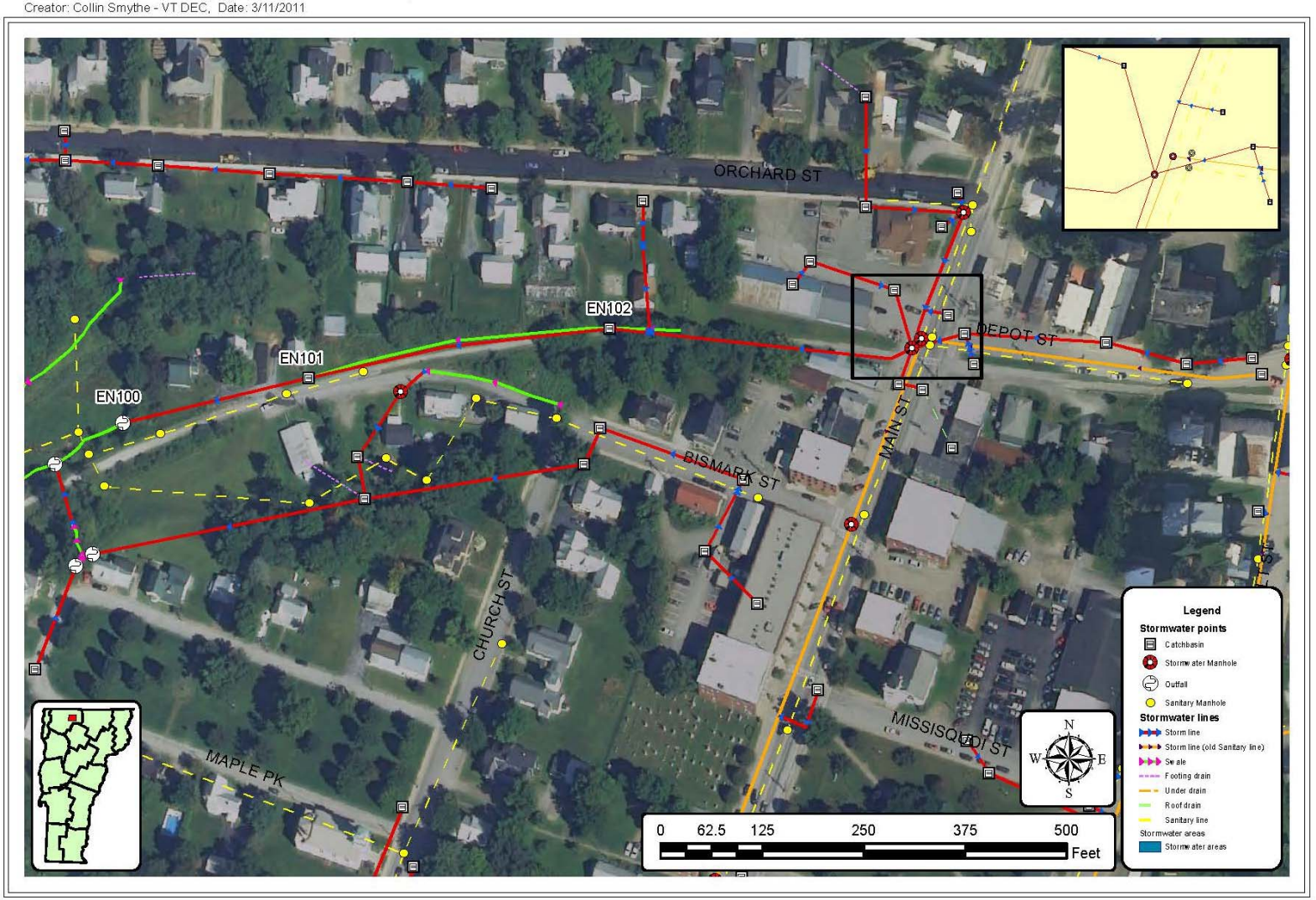


Figure 1. Stormwater drainage system discharging at outfall EN-100
Enosburg Falls, VT

Figure 3. Enosburgh Outfall EN-210

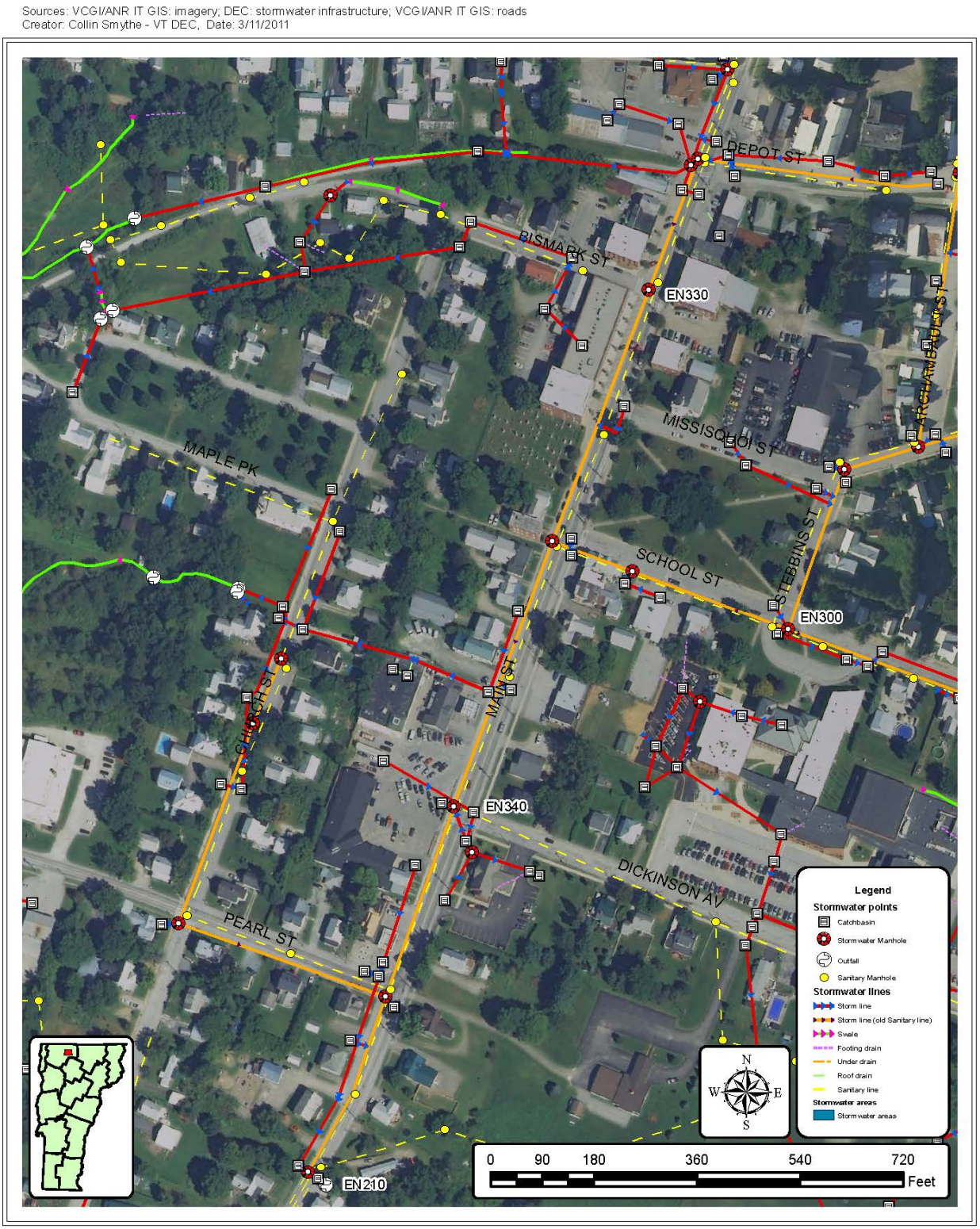


Figure 2. Stormwater drainage system discharging at outfall EN-210
Enosburg Falls, VT

Figure 4. Enosburgh Outfall EN-360

Figure 3. Stormwater drainage system discharging at outfall EN-360
Enosburg Falls, VT

Figure 5. Missisquoi River from Black Creek to Trout River

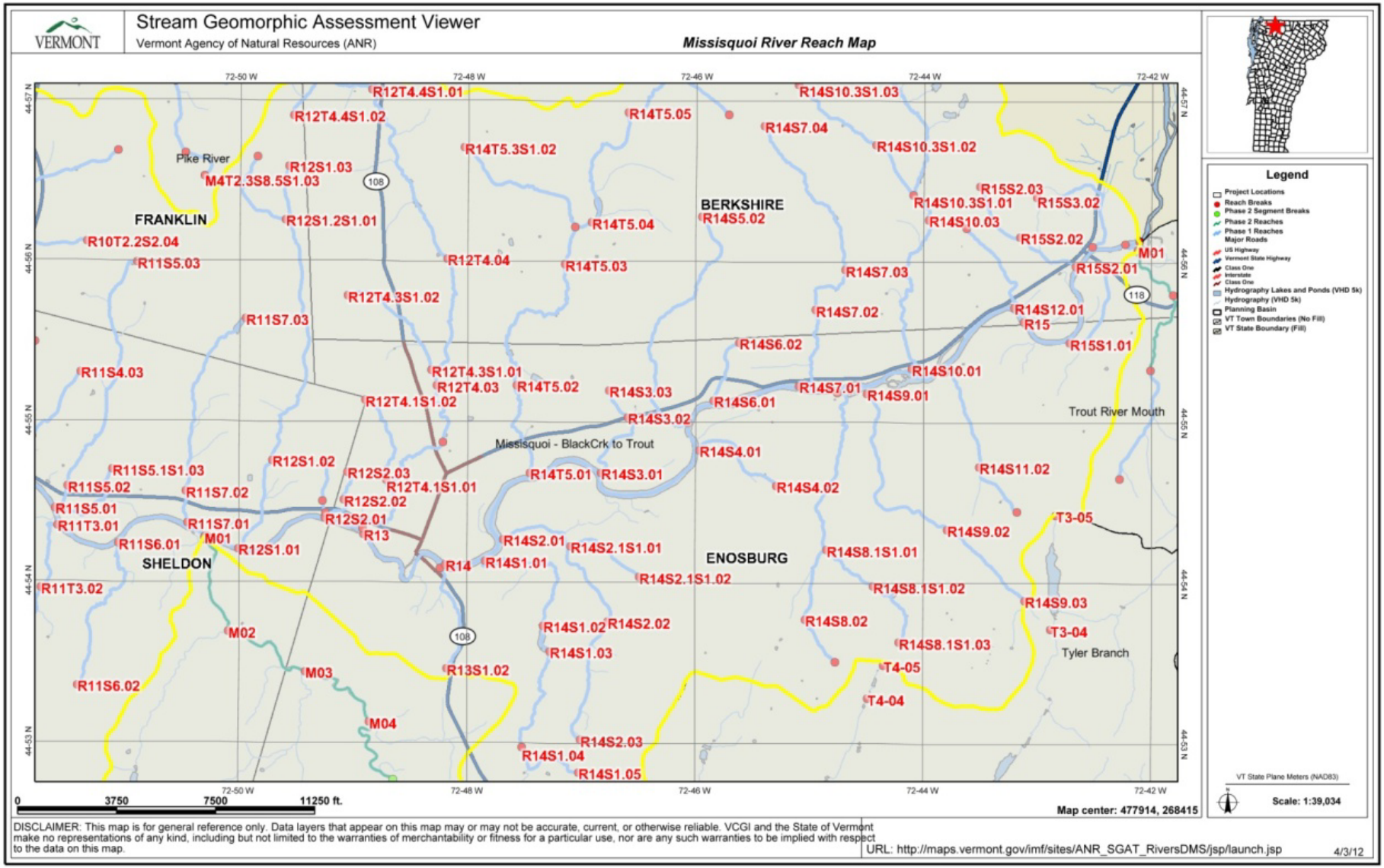


Figure 6. Tyler Branch

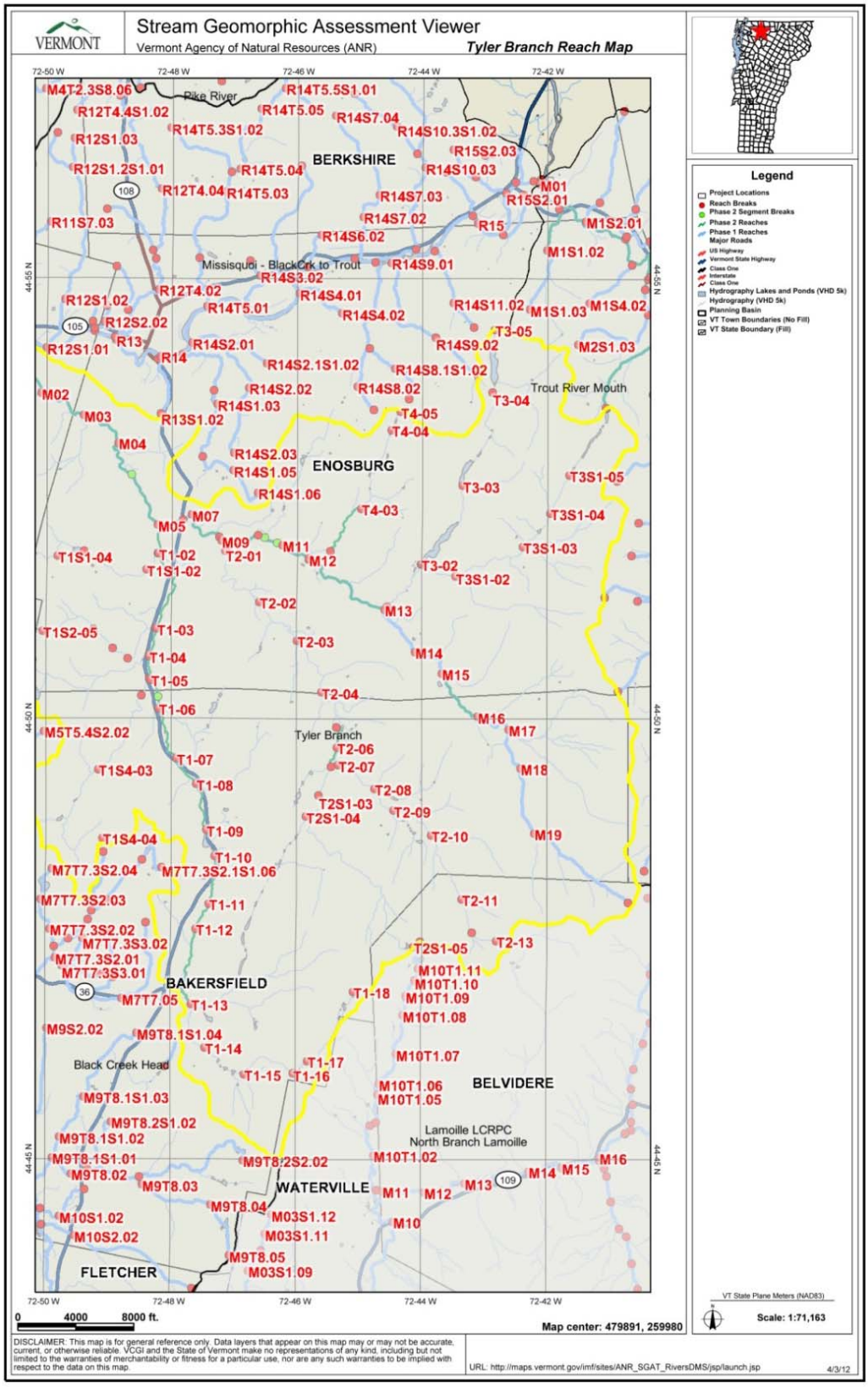
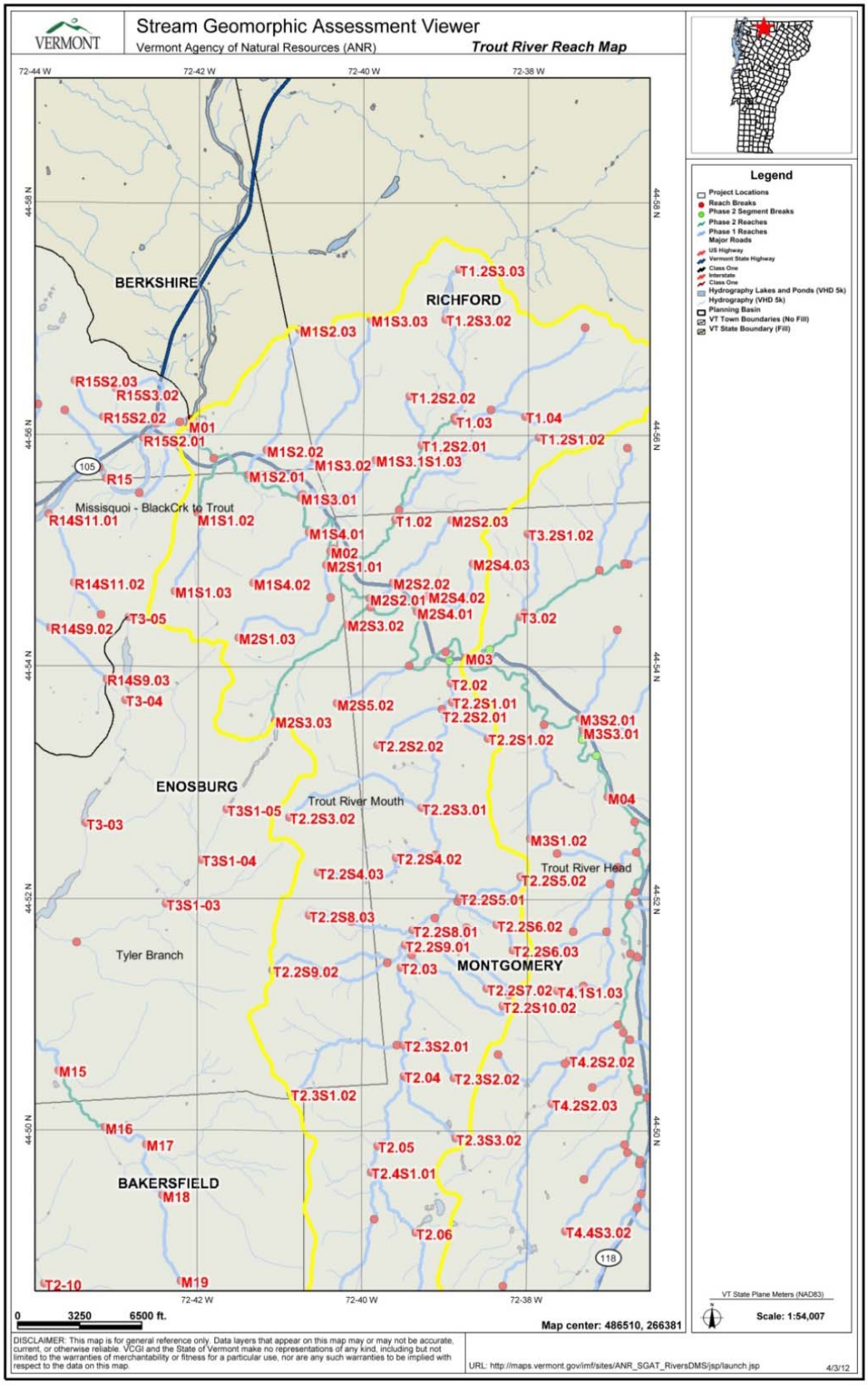


Figure 7. Trout River Mouth



APPENDIX C: PROBLEM AREA DATA SHEETS

MEMO

STONE ENVIRONMENTAL INC

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SEI No. 112475-W, task 2
Re: Stormwater Problem Areas in the Town of Enosburg and the Village of Enosburgh Falls

Stone Environmental has reviewed existing reports and also worked directly with the Town and Village 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
  - March 29th kick-off meetings with the Enosburg Falls Village Manager and Public Works Director, as well as the Town of Enosburgh Road Foreman
  - October 24th follow-up meetings Enosburg Falls Public Works Director and Enosburgh Road Foreman to review identified priority projects.
- Targeted site visits to verify problems areas (July-September 2012)
- 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 Enosburgh are attached to this memo. Each problem area was given a preliminary classification according to the following system:

Level	Classification
1	Outside of project scope.
2a	Stable, no urgency.
2b	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 into 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.

Problem Area Data Sheet

Problem Area ID:	**BM-1**	Latitude: 44°51'43.62"N	Longitude: 72°44'3.60"W
Watershed:	Beaver Meadow Brook		
Location:	Nichols Rd, between Courser Rd and Tyler Branch Rd		
Problem Type:	Bridge/Culvert Issue		
Identification Source:	VTrans Bridge/Culvert Report		
Ownership:	Local		
Classification Level:	3		

Problem Description:

Bridge on Nichols Rd causing scour pools and channel constrictions.

Date of Field Data Collection: 7/13/2012

Field Photos

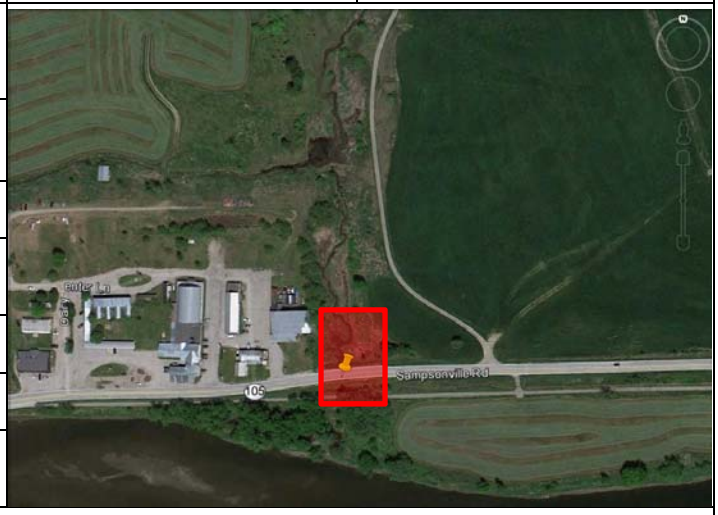
Photo 1. Sediment build up

Photo 2. Ledge constricting channel

Description of Observed Conditions:

Bridge is at bottom of a steep section of gravel road; sediment transported down the hill is deposited on the bridge and subsequently washed into the stream. Bridge drains are clogged with sediment, preventing water from running-off properly. Channel appears to be constricted by ledge along banks, not from the bridge itself.

Problem Area Data Sheet

Problem Area ID:	**MQ-1**	Latitude: 44°55'15.98"N	Longitude: 72°44'59.07"W
Watershed:	Missisquoi River		
Location:	VT Route 105, just east of the Dairy Center		
Problem Type:	Bridge/Culvert Issue		
Identification Source:	VTrans Bridge/Culvert Report		
Ownership:	Local		
Classification Level:	2b		

Problem Description:

VT Route 105 culvert failing due to erosion and scouring.

Date of Field Data Collection: 7/13/2012

Field Photos

Photo 1.

Photo 2.

Description of Observed Conditions:

Culvert inlet is partially obstructed. No signs of failure upstream. Minimal bank scouring at entrance, some armor is present.

Problem Area Data Sheet

Problem Area ID:	**MQ-2**	Latitude: 44°54'8.05"N	Longitude: 72°48'22.84"W
Watershed:	Missisquoi River		
Location:	Intersection of Duffy Hill Rd and Route 108		
Problem Type:	Drainage Issues		
Identification Source:	CSA, Lake Champlain Basin Program		
Ownership:	Local		
Classification Level:	3		

Problem Description:

Road run-off at the intersection of Village Dr. and Duffy Hill Rd and Route 108 was identified as potential critical source area because of the amount of water draining to this location and its proximity to the Missisquoi River.

Date of Field Data Collection: 7/13/2012

Field Photos

Photo 1. Duffy Hill Rd/Route 108

Photo 2. Village Dr/Route 108

Description of Observed Conditions:

Run-off at the intersection of Duffy Hill Road and Route 108 is causing erosion and both corners. On Route 108 bridge over Missisquoi River there are eight drainage pipes that discharge directly into river. Intersection of Village Dr. and Route 108 stormwater drains into two basins (one by the bridge and the other in front of town offices sign) then directly into river. Concentration of stormwater outfalls in a single location may offer opportunity for comprehensive solution. Recent infrastructure improvements at this intersection included the installation of a storage tank to address/eliminate combined sewer overflows, on the west side of the Rte. 108 bridge at the intersection of St Albans Street and Main St on municipal land.

Problem Area Data Sheet

Problem Area ID:	**MQ-3**	Latitude: 44°54'56.88"N	Longitude: 72°47'0.23"W
Watershed:	Missisquoi River		
Location:	Route 105, near Choquette Rd		
Problem Type:	Drainage Issues		
Identification Source:	CSA, Lake Champlain Basin Program		
Ownership:	State/Local		
Classification Level:	3		

Problem Description:

Road run off, Sampsonsville Rd/Route 105 from Samponsville to Enosburg Falls was identified as potential critical source area because of the amount of water draining to this location and its proximity to the Missisquoi River.

Date of Field Data Collection: 9/21/12

Field Photos

Photo 1. Fields that drain to stream, cows seen above

Photo 2. Outlet to the Missisquoi River

Description of Observed Conditions:

VT Route 105 follows the Missisquoi River. With farm fields lining the uphill side of the road, large amounts of stormwater run-off is possible during rain events. Road is identified as a critical source area hotspot, in part because the road effectively concentrates overland flow headed towards the Missisquoi River into a series of culverts. Field investigations suggest that a key location is where the stream just west of Choquette Rd meets the Missisquoi River.

Problem Area Data Sheet

Problem Area ID:	**MQ-4**	Latitude: 44°55'15.78"N	Longitude: 72°45'6.42"W
Watershed:	Missisquoi River		
Location:	Dairy Center on Route 105		
Problem Type:	Local Drainage		
Identification Source:	Town Feedback		
Ownership:	Private		
Classification Level:	3		

Problem Description:

The Town indicated concern about both stormwater and wastewater management (septic) at the Dairy Center on Sampsonville Rd/Rt. 105.

Date of Field Data Collection: 9/21/12

Field Photos

Photo 1. Dairy Center impervious area

Photo 2. Stream outlet to Missisquoi

Description of Observed Conditions:

Significant amount of untreated impervious surface present; there is no obvious stormwater infrastructure (e.g., catch basins) at the Dairy Center. Stormwater appears to flow overland to small drainages on either side of the parcel, which pass through culverts under Route 105 and the rail trail before discharging directly to the Missisquoi River. Once across Route 105, flow from the eastern half of the Dairy Center is obstructed by debris (old stone foundations, etc) before joining the Missisquoi. No septic issues were observed.

Problem Area Data Sheet

Problem Area ID:	**MQ-5**	Latitude: 44°54'52.23"N	Longitude: 72°47'16.76"W
Watershed:	Missisquoi River		
Location:	Route 105, just east of the intersection with Camp Rd		
Problem Type:	Future Development		
Identification Source:	Town Feedback		
Ownership:	Private		
Classification Level:	2a		

Problem Description:

Town highlighted plans for future development at the Enosburg Industrial Park.

Date of Field Data Collection: 7/13/2012

Field Photos

Photo 1. Overview of Industrial Park development

Photo 2. Large building visible in orthophoto, above

Description of Observed Conditions:

Stormwater drainage system in place at future sites within industrial park. All drainage flows to Tyler Branch through culverts and drainage ditches. Signs of erosion at a few culvert crossings that have been unmaintained due to a lack of development in the park.

Problem Area Data Sheet

Problem Area ID:	**MQ-6**	Latitude: 44°54'19.15"N	Longitude: 72°48'10.92"W
Watershed:	Missisquoi River		
Location:	Dickenson Ave near the intersection with School St		
Problem Type:	Local Drainage		
Identification Source:	Town Feedback		
Ownership:	Local		
Classification Level:	3		

Problem Description:

Unmanaged stormwater runoff along Dickenson Ave and School St is causing erosion along the road shoulder.

Date of Field Data Collection: 7/13/2012

Field Photos

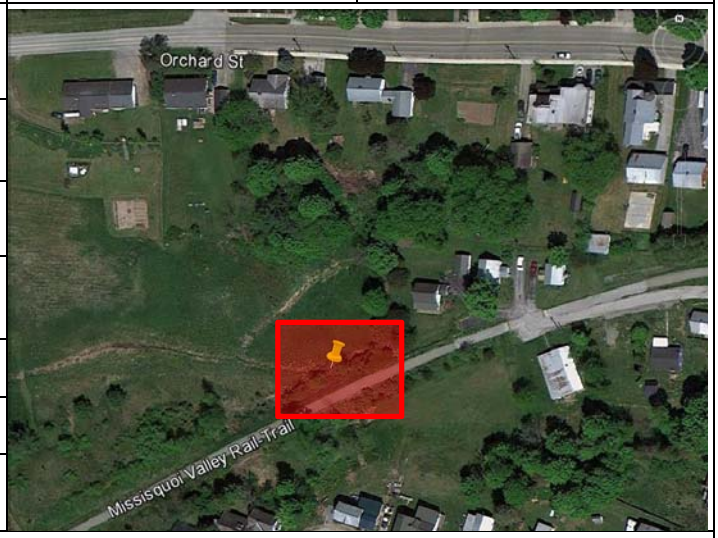
Photo 1. Dickenson Ave looking towards Main St

Photo 2. Edge of Dickenson & High School parking lot

Description of Observed Conditions:

Signs of water ponding in green belt in front of the High School; no place for the water to drain, no catch basins or stormwater system in this area. Minor erosion evident at Dickenson Ave and High School parking lot along curbs and pavement curves. Opportunities may exist to more intentionally store/infiltrate stormwater in the existing green space.

Problem Area Data Sheet

Problem Area ID:	**MQ-8**	Latitude: 44°54'28.71"N	Longitude: 72°48'30.84"W
Watershed:	Missisquoi River		
Location:	Missisquoi Valley Rail Trail, near the end of Bismark St		
Problem Type:	Drainage/Future Developments		
Identification Source:	Missisquoi Basin Urban Areas Stormwater Mapping Project		
Ownership:	Local		
Classification Level:	4		

Problem Description:

Active erosion being caused by flows from two storm sewer outfalls.

Date of Field Data Collection: 7/13/2012

Field Photos

Photo 1. Outfalls and rip rap

Photo 2. Bank erosion

Description of Observed Conditions:

Signs of erosion at outfalls coming from Bismark St. Small stream of water coming through outfall even though there had been no rain for at least a week. High amount of water possible in area, signs of erosion in rip rap that was previously placed at the outfall. Bank erosion observed where water discharges from outfall and into drainage ditch. Space exists for a stormwater treatment measure to be installed near the rail trail between the two outfalls.

Problem Area Data Sheet

Problem Area ID:	**MQ-9**	Latitude: 44°54'10.85"N	Longitude: 72°48'30.05"W
Watershed:	Missisquoi River		
Location:	St. Albans St, near the intersection with Main St		
Problem Type:	Local Drainage/Future Development		
Identification Source:	Missisquoi Basin Urban Areas Stormwater Mapping Project		
Ownership:	Local		
Classification Level:	3		

Problem Description:

Stormwater runoff from the impervious surfaces surrounding the Village wastewater treatment facility discharges directly to the Missisquoi River.

Date of Field Data Collection: 7/13/2012

Field Photos

Photo 1. Catch basin outside of WW plant

Photo 2. New catch basin at WW plant

Description of Observed Conditions:

Some recent work has been done at the wastewater facility; interview with Enosburg Village Public Works suggest this was related to the combined sewer system improvements described in MQ-2. Opportunity may exist to install tank and/or sand filter using existing infrastructure in front of town wastewater facility.

Problem Area Data Sheet

Problem Area ID:	**MQ-10**	Latitude: 44°54'9.80"N	Longitude: 72°48'13.75"W
Watershed:	Missisquoi River		
Location:	School athletic fields, off Dickenson Ave		
Problem Type:	Local Drainage		
Identification Source:	Missisquoi Basin Urban Areas Stormwater Mapping Project		
Ownership:	Local		
Classification Level:	3		

Problem Description:

Erosion occurring at outfall from storm sewer that carries flows from the Enosburgh schools under the athletic fields. Incised channel is forming as flows make their way to the Missisquoi River.

Date of Field Data Collection: 7/13/2012

Field Photos

Photo 1. Outfall at end of system

Photo 2. Looking towards fields, near start of system

Description of Observed Conditions:

System of stormwater pipes from High School parking lots and Dickenson Ave (east end) flow under ball fields towards river. 2' black corrugated plastic culverts directing flow to a channel that is becoming incised and eroding as it approaches the river. High amount of sediment and trash in channel as it nears the river; potential retrofit opportunity to address sediment and trash loading. Space exists for potential stormwater treatment practice(s); access for routine maintenance could be challenging.

Problem Area Data Sheet

Problem Area ID:	**TB-01**	Latitude: 44°52'17.71"N	Longitude: 72°47'49.92"W
Watershed:	Tyler Branch		
Location:	Intersection of Route 108 and Tyler Branch Rd.		
Problem Type:	Drainage Issues		
Identification Source:	CSA, Lake Champlain Basin Program		
Ownership:	Local		
Classification Level:	3		

Problem Description:

Road run-off from intersection of VT. Rt. 108 and Tyler Branch Rd, identified as potential "critical source area" in LCBP Missisquoi Bay Basin model because of the amount of water draining to this location and its proximity to the Tyler Branch.

Date of Field Data Collection: 7/13/2012

Field Photos

Photo 1. Looking north on Route 108

Photo 2. Looking south on Route 108

Description of Observed Conditions:

Two segments of road are steeply sloping as they approach this intersection. Stormwater from intersection and area around it discharges directly to Tyler Branch; some roadside scour is visible.

Problem Area Data Sheet

Problem Area ID:	**TB-3**	Latitude: 44°51'59.88"N	Longitude: 72°47'0.31"W
Watershed:	Tyler Branch		
Location:	Tyler Branch Rd, between Ovitt Rd and Grange Hall Rd		
Problem Type:	Geomorphic Stability		
Identification Source:	Tyler Branch Corridor Plan		
Ownership:	Private		
Classification Level:	1		

Problem Description:

Geomorphic instability in the Tyler Branch from the intersection of Ovitt Rd and Tyler Branch Rd, to a half-mile downstream.

Date of Field Data Collection: 7/13/2012

Field Photos

Photo 1.

Photo 2. Farm crossing in reach

Description of Observed Conditions:

Some evidence of direct access by farm equipment and cattle in this area. Signs of aggradation also present in this stream reach. Bridge structure is undersized as compared to channel width (Photo 2) and scour pools have formed.

Problem Area Data Sheet

Problem Area ID:	**TB-7**	Latitude: 44°52'16.39"N	Longitude: 72°47'53.04"W
Watershed:	Tyler Branch		
Location:	Town Garage on Route 108		
Problem Type:	Local Drainage		
Identification Source:	Town Feedback		
Ownership:	Local		
Classification Level:	4		

Problem Description:

Stormwater management at the Town Garage needed is problematic, including areas around both current salt and sand storage.

Date of Field Data Collection: 7/13/2012

Field Photos

Photo 1. Parking lot run-off

Photo 2. Salt shed

Description of Observed Conditions:

Erosion from Town Garage parking lot and salt shed flows directly into Tyler Branch (Photo1). Town has tried to address the issue by placing jersey barriers along the sand pile and access road. While this has helped reduce the amount of sand being washed directly into Tyler Branch, it has caused the stormwater to concentrate and is causing erosion along foundation of salt shed downhill to stream. Entire town lot is sloped downhill toward stream. Sand pile is outside and above salt shed. No nearby land farther away from the stream is owned by the Town.

Problem Area Data Sheet

Problem Area ID:	**TB-10**	Latitude: 44°51'56.91"N	Longitude: 72°45'25.87"W
Watershed:	Tyler Branch		
Location:	Boston Post Rd, north of intersection with Tyler Branch Rd		
Problem Type:	Bridge/Culvert Issue		
Identification Source:	VTrans Bridge/Culvert Report		
Ownership:	Local		
Classification Level:	1		

Problem Description:

Culvert on Boston Post Road causing channel constriction and scour pools.

Date of Field Data Collection: 7/13/2012

Field Photos

Photo 1. Outfall

Photo 2.

Description of Observed Conditions:

Large 6' corrugated metal culvert with moderate scour pool at outfall. Stream does not appear to be constricted upstream.

Problem Area Data Sheet

Problem Area ID:	**TB-11**	Latitude: 44.867492	Longitude: -72.839506
Watershed:	Tyler Branch		
Location:	Duffy Hill Rd, south of the intersection with Tyler Branch Rd		
Problem Type:	Local Drainage		
Identification Source:	Town/Village Feedback		
Ownership:	Local		
Classification Level:	2a, fix is planned		

Problem Description:

Erosion along shoulder of Duffy Hill Rd.

Date of Field Data Collection: 9/21/21

Field Photos

Photo 1. Road falling into ditch

Photo 2. Duffy Hill Rd. slope

Description of Observed Conditions:

Significant erosion observed on Duffy Hill Rd, south of the Tyler Branch Rd intersection. Most evident between 2181 and 2246 Duffy Hill Rd. Town received a Better Backroads grant and plans to implement a fix this field season.

Problem Area Data Sheet

Problem Area ID:	**TB-12**	Latitude: 44.848269	Longitude: -72.77185
Watershed:	Tyler Branch		
Location:	Bogue Rd, at intersection with Chimney Rd		
Problem Type:	Local Drainage		
Identification Source:	Town/Village Feedback		
Ownership:	Local/Private		
Classification Level:	3		

Problem Description:

Ditch erosion and drainage concerns.

Date of Field Data Collection: 9/21/12

Field Photos

Photo 1. View from the top of Chimney Rd.

Photo 2. Check dam on west side of Chimney Rd.

Description of Observed Conditions:

Ditches along Chimney Rd drain to Bogue Rd. A check dam on the west side of Chimney Rd is buried in sediment. An undersized culvert that takes flow to the east side of the road. Given the slope of Chimney Rd, significant flow is likely. The combined effect of the steep slopes and undersized culvert suggests that during high flow events flow may overtop Bogue Rd at the intersection. Check dam appears to have been installed by adjacent landowner, presumably in attempt to "create" more storage in the ditch.

Problem Area Data Sheet

Problem Area ID:	**MQ-11**	Latitude: 44.910575	Longitude: -72.719986
Watershed:	Missisquoi River		
Location:	Perley Rd, between Nichols Rd and Woodward Neighborhood Rd		
Problem Type:	Local Drainage		
Identification Source:	Town/Village Feedback		
Ownership:	Unknown		
Classification Level:	4		

Problem Description:

Ditch erosion and drainage concerns along Perley Rd.

Date of Field Data Collection: 9/21/12

Field Photos

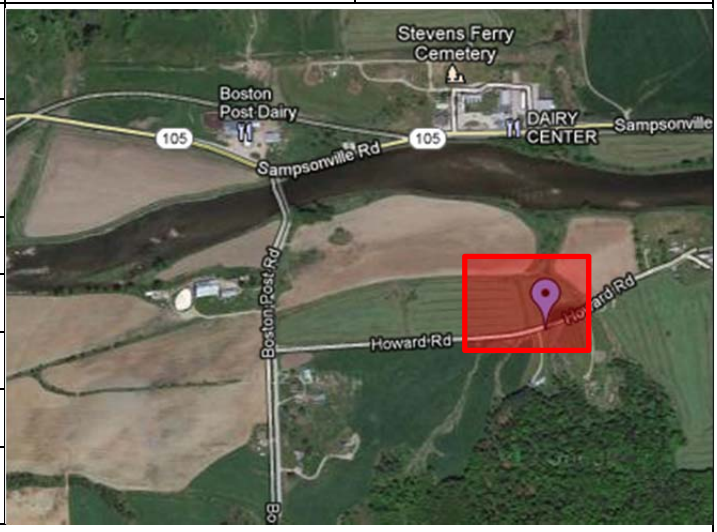
Photo 1. Ditch eroding landscaped area

Photo 2. Under-road culvert outfall at 3105 Perley Rd.

Description of Observed Conditions:

Erosion evident in several locations along Perley Rd; most serious issues are between 2982 and 3470 Perley Rd and between 2956 and 2982 Perley Rd. Some of the erosion is being cause by poorly constructed private driveways discharging into the public ROW; steep road slopes compound problems.

Problem Area Data Sheet

Problem Area ID:	**MQ-12**	Latitude: 44.917504	Longitude: -72.750542
Watershed:	Missisquoi River		
Location:	Howard Rd, east of intersection with Boston Post Rd		
Problem Type:	Local Drainage		
Identification Source:	Town/Village Feedback		
Ownership:	Local		
Classification Level:	2a		

Problem Description:

Ditch maintenance needed frequently (annually?) along Howard Rd due to sediment contributions from adjacent farmland.

Date of Field Data Collection: 9/21/12

Field Photos

Photo 1. Evidence of erosion in fields S of Howard Rd

Photo 2. Farm field ditch N of Howard Rd.

Description of Observed Conditions:

Ditches visible from roadside do not appear to currently be causing stormwater issues. Stream/ditch to wetland from the woods (Photo 1) may be artificially dug out; otherwise no problem areas evident. Problems may be more evident when fields are rotated into corn.

Problem Area Data Sheet

Problem Area ID:	**MQ-13**	Latitude: 44.9203	Longitude: -72.757366
Watershed:	Missisquoi River		
Location:	Boston Post Rd at intersection with Route 105		
Problem Type:	Localized Flooding		
Identification Source:	Town/Village Feedback		
Ownership:	Unknown		
Classification Level:	1		

Problem Description:

Annual flooding from the Missisquoi River overtops the road.

Date of Field Data Collection: 9/27/12

Field Photos

Photo 1. Boston Post Rd, S of Missisquoi crossing

Photo 2.

Description of Observed Conditions:

Interviewed Boston Post Dairy owners (located N of Boston Post Rd bridge). In their experience the corn field southeast of the bridge floods every spring as ice backs up underneath the bridge. Depending on the severity of the flooding, water can approach roadsides as well.

Problem Area Data Sheet

Problem Area ID:	**TB-13**	Latitude: 44.883978	Longitude: -72.787471
Watershed:	Tyler Branch		
Location:	Howrigan Rd, above intersection with Miss Vermont Dr		
Problem Type:	Local Drainage		
Identification Source:	Town/Village Feedback		
Ownership:	Private		
Classification Level:	2a		

Problem Description:

Erosion from farm land into ditch along Howrigan Rd.

Date of Field Data Collection: 9/21/12

Field Photos

Photo 1. Ditch near the Miss VT Dr, on Howrigan Rd

Photo 2. Ditch near the Miss VT Dr, on Howrigan Rd

Description of Observed Conditions:

No major erosion issues observed. Fields mostly slope down from the road; closest fields are (currently) planted in hay. Problems may be more evident when fields are rotated into corn.

Problem Area Data Sheet

Problem Area ID:	**MQ-14**	Latitude: 44.905163	Longitude: -72.813832
Watershed:	Missisquoi River		
Location:	St. Albans St, near intersection with Route 105		
Problem Type:	Future Development		
Identification Source:	Town/Village Feedback		
Ownership:	Unknown		
Classification Level:	2b		

Problem Description:

Village indicated desire to encourage future development (likely residential) along St Albans St.

Date of Field Data Collection: 9/21/12

Field Photos

Photo 1. Overview of potential area, existing drainage

Photo 2. Ditch to undersized culvert

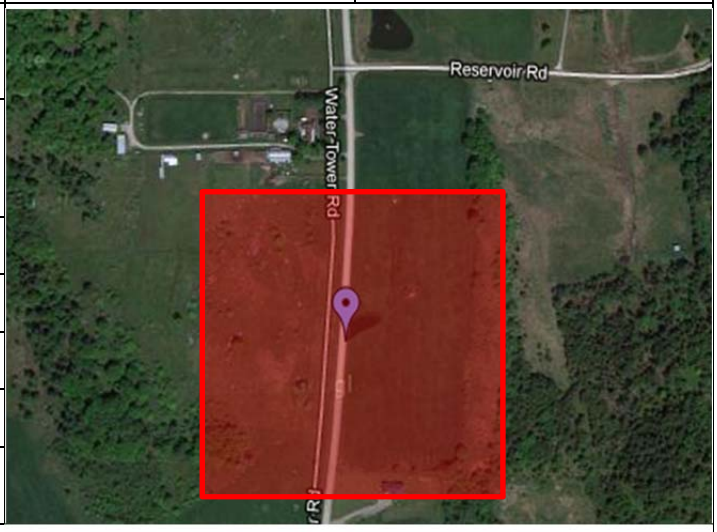
Description of Observed Conditions:

Infrastructure upgrades will be needed to support future development for example, culvert shown in Photo 2 is undersized. Northwest end of St. Albans St is undeveloped, but has some steep slopes (Photo 1). St. Albans St splits watershed boundaries—South of the street flows directly to the Missisquoi, North flows to Pearl St, then East to the center of town.

Problem Area Data Sheet

Problem Area ID:	**MQ-15**	Latitude: 44.931603	Longitude: -72.796032

Watershed:	Missisquoi River
Location:	Water Tower Rd, between Village and Reservoir Rd
Problem Type:	Future Development
Identification Source:	Town/Village Feedback
Ownership:	Unknown
Classification Level:	2b



Problem Description:

Village indicated desire to encourage future development (likely residential) along Water Tower Rd.

Date of Field Data Collection: 9/21/12

Field Photos

Photo 1. Ditch along Water Tower Rd

Photo 2. Ditch along Water Tower Rd

Description of Observed Conditions:

Some evidence of significant wet weather flows present in ditches along Water Tower Road currently. Strategies such as incorporating check dams into the existing ditches could help slow current and future flows.

Problem Area Data Sheet

Problem Area ID:	**TB-14**	Latitude: 44.85216	Longitude: -72.868817
Watershed:	Tyler Branch		
Location:	Duffy Hill Rd, south of the Village		
Problem Type:	Future Development		
Identification Source:	Town/Village Feedback		
Ownership:	Unknown		
Classification Level:	2b		

Problem Description:

Future residential growth on Duffy Hill Road, secondary as compared to likely primary development on Water Tower Rd and St. Albans St.

Date of Field Data Collection: 9/21/12

Field Photos

Photo 1. Ditch S of Tyler Branch Rd intersection

Photo 2. Duffy Hill Rd at Tyler Branch Rd

Description of Observed Conditions:

Plenty of area for future development. Roadside ditches will be primary stormwater conveyance; however steep road slope will present issues as stormwater volumes increase. Stormwater management strategies could be proactively incorporated into the existing conveyance system to reduce potential future impacts.

Problem Area Data Sheet

Problem Area ID:	**MQ-16**	Latitude: 44.903173	Longitude: - 72.805325
Watershed:	Missisquoi River		
Location:	Riparian areas along Missisquoi River, above the falls/dam		
Problem Type:	Bank Erosion		
Identification Source:	Town/Village Feedback		
Ownership:	Unknown		
Classification Level:	3		

Problem Description:

Bank erosion and dumping of yard debris observed behind Spears Funeral Home.

Date of Field Data Collection: 9/21/12

Field Photos

Photo 1. Evidence of yard debris disposal

Photo 2. Bank erosion due to lack of vegetation

Description of Observed Conditions:

Thin forest buffer strip along the Missisquoi transitions to shrubs and mowed grass behind Spears Funeral Home. Tree planting would increase the stability of the bank as the Missisquoi flows toward the falls.

Problem Area Data Sheet

Problem Area ID:	**MQ-17**	Latitude: 44.903617	Longitude: -72.800803
Watershed:	Missisquoi River		
Location:	Village Garage on Dickenson Ave		
Problem Type:	Local Drainage		
Identification Source:	Town/Village Feedback		
Ownership:	Unknown		
Classification Level:	4		

Problem Description:

Outfall from portion of the storm sewer system draining the elementary school and much of School St. causing erosion along the back edge of the Village Garage property before draining to Missisquoi.

Date of Field Data Collection: 9/21/12

Field Photos

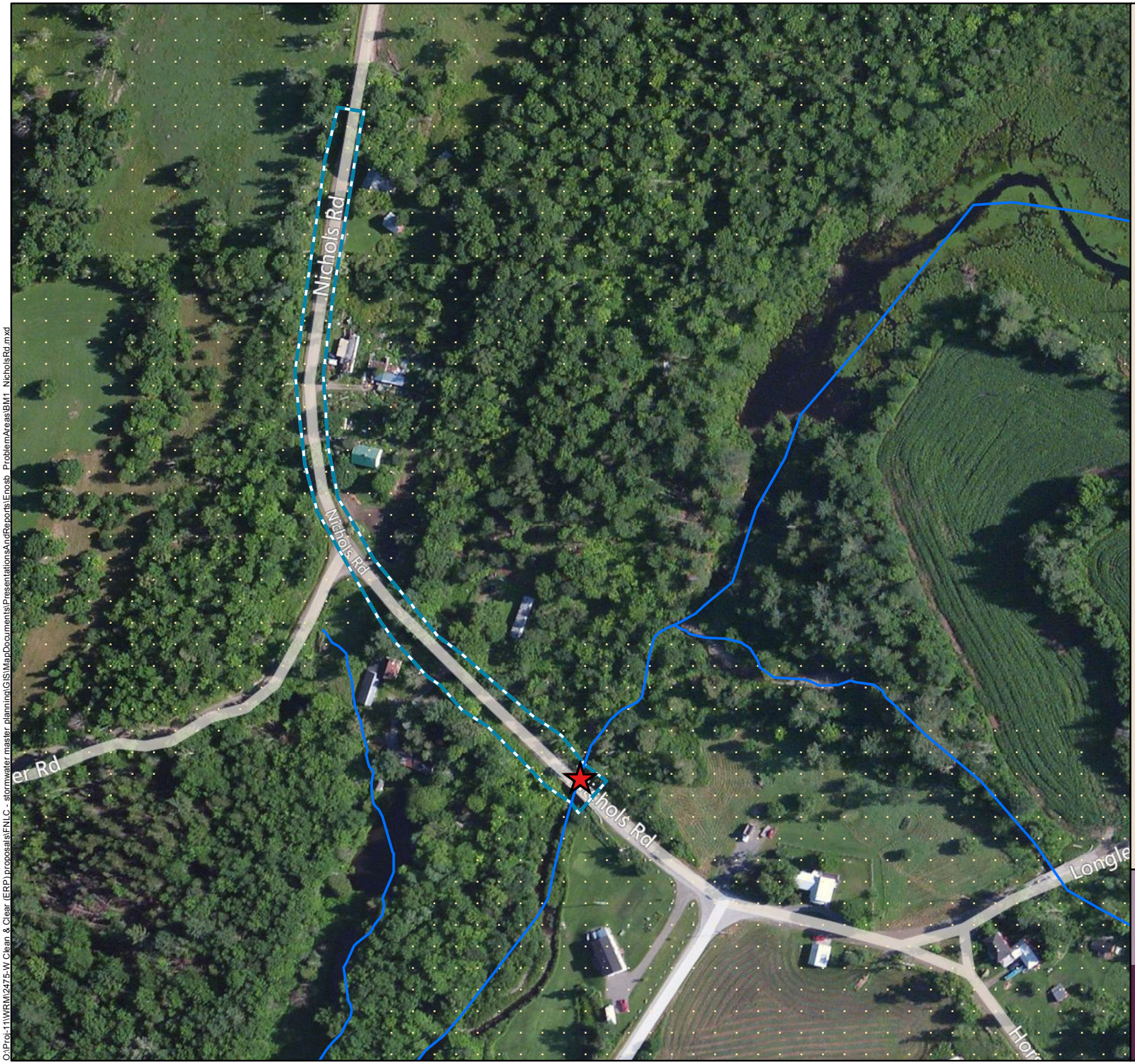
Photo 1. Stream leaves stone-lined ditch

Photo 2. Ultimately causes 3 foot head cut (above)

Description of Observed Conditions:

Stone-lined ditch along the back edge of the Village Garage property, intended to direct stormwater runoff to the river, is partially blocked; some runoff has created an alternate channel through a nearby meadow. This channel is creating erosion before reaching the Missisquoi. Addressing this problem is particularly important given the planned construction of an additional building within the Village Garage lot, west of the problem area.

APPENDIX D: DRAINAGE AREA MAPS FOR PRIORITY STORMWATER PROBLEM AREAS



N

BERKSHIRE
ENOSBURG
BAKERSFIELD

0 50 100 200
Feet

SW Treatment Opportunity
River or Stream
Drainage Area (1.4 Acres)
Erodible Soils (k > 0.17)

Treatment Opportunity:
Bridge on Nichols Rd causing scour pools and channel constrictions.

Sources: Stormwater Infrastructure, Stormsewer Subwatersheds: VT DEC; Problem Areas: Stone; Future Growth Areas: Enosburgh Town Plan (2008); Potential Erosion Areas: SSURGO; Hydrography, Roads: VCGI; Imagery: Bing Maps.

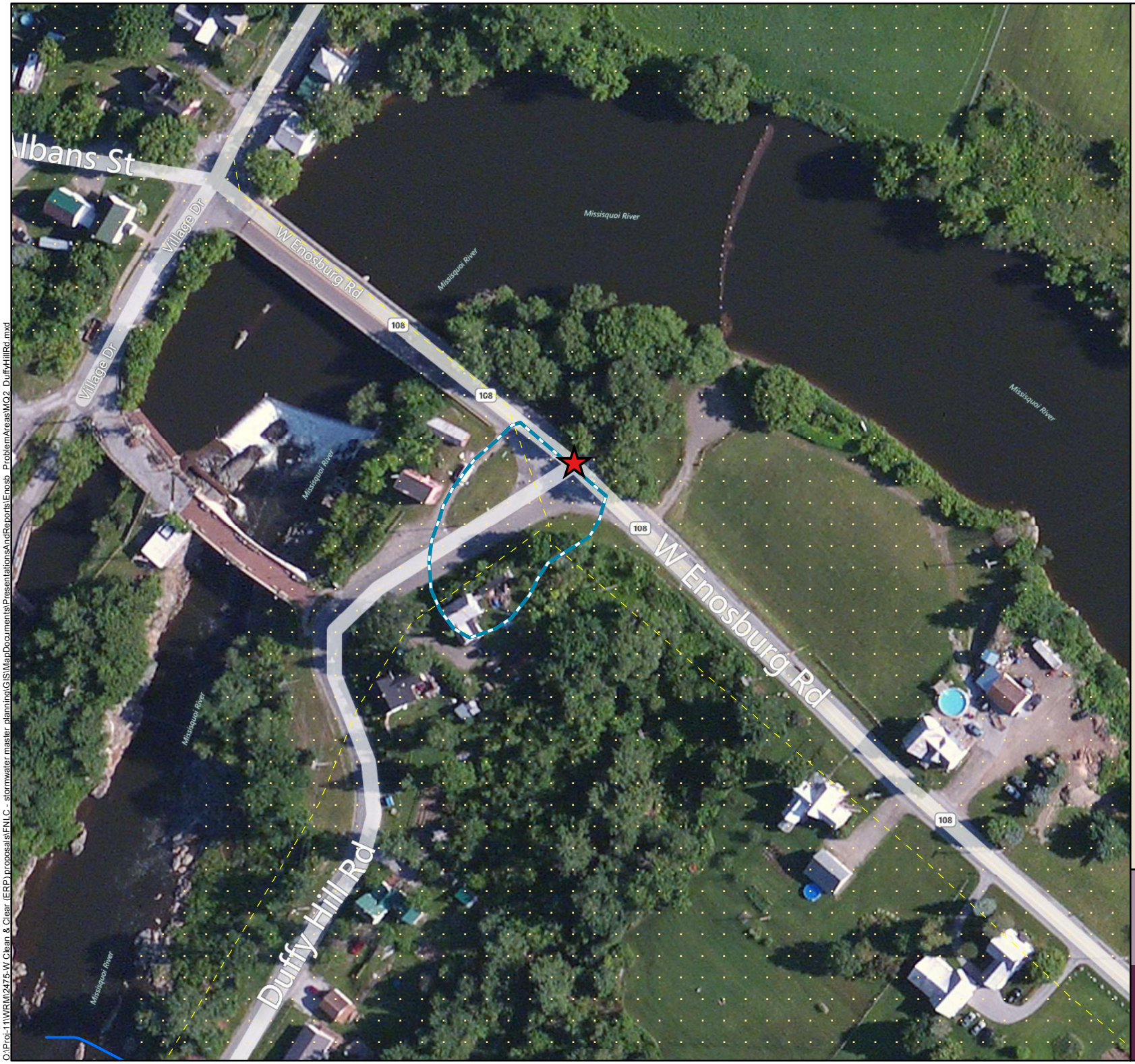
STONE ENVIRONMENTAL INC

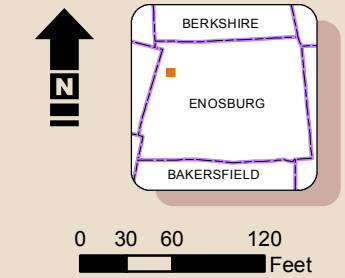
Nichols Rd Bridge

BM-1

Enosburgh Stormwater Management Planning

O:\Proj-11\WRM\2475-W Clean & Clear (ERP) proposals\ENLC - stormwater master planning\GIS\MapDocuments\PresentationsAndReports\Enosb_ProblemAreas\BM1_NicholsRd.mxd





SW Treatment Opportunity

River or Stream

Drainage Area (0.5 Acres)

Erodible Soils (k > 0.17)

Sanitary line

Treatment Opportunity:
Road run-off, intersection of Village Dr, Duffy Hill Rd, and VT Route 108.

Sources: Stormwater Infrastructure, Stormsewer Subwatersheds: VT DEC; Problem Areas: Stone; Future Growth Areas: Enosburgh Town Plan (2008); Potential Erosion Areas: SSURGO; Hydrography, Roads: VCGI; Imagery: Bing Maps.

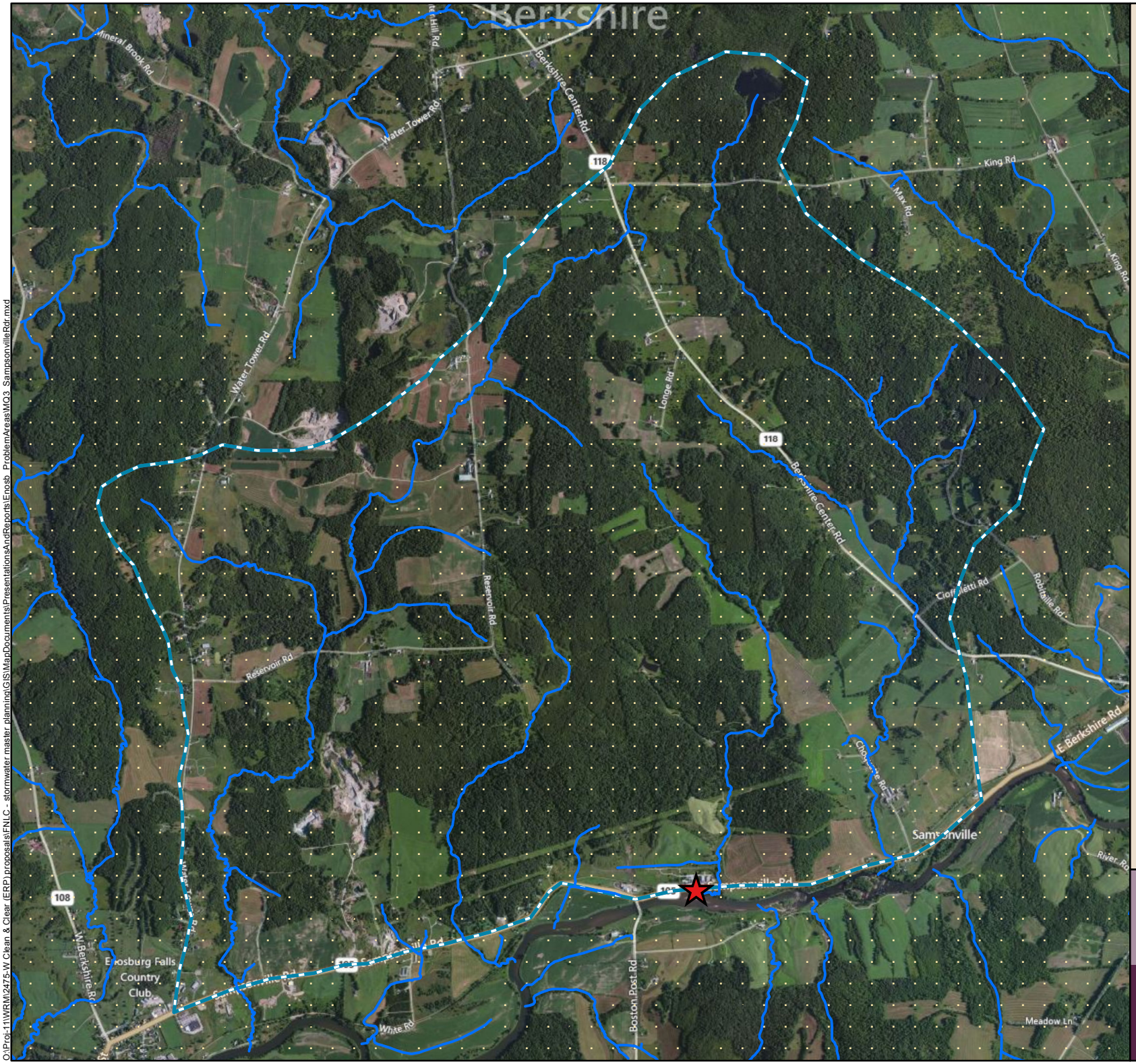
STONE ENVIRONMENTAL INC

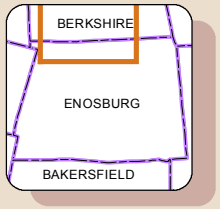
VT 108, Duffy Hill Rd Intersection

MQ-2

Enosburgh Stormwater Management Planning

O:\Proj-11WRM\2475-W Clean & Clear (ERP) proposals\FNLC - stormwater master planning\GIS\MapDocuments\PresentationsAndReports\Enosb_ProblemAreas\MQ2_DuffyHillRd.mxd





0 0.25 0.5 Miles

SW Treatment Opportunity

River or Stream

Drainage Area (6,185 Acres)

Erodible Soils (k > 0.17)

Treatment Opportunity:
Road runoff from Sampsonville Rd predicted byLCBP Missisquoi Bay model to be potential "critical source area."

Sources: Stormwater Infrastructure, Stormsewer Subwatersheds: VT DEC; Problem Areas: Stone; Future Growth Areas: Enosburgh Town Plan (2008); Potential Erosion Areas: SSURGO; Hydrography, Roads: VCGI; Imagery: Bing Maps.

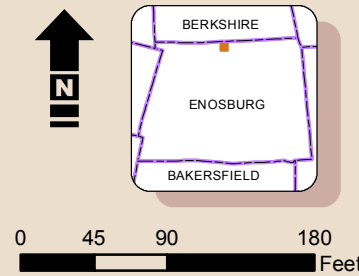
STONE ENVIRONMENTAL INC

Sampsonville Rd

MO-3

Enosburgh Stormwater Management Planning

O:\Proj-11\WRM\2475-W Clean & Clear (ERP) proposals\ENLC - stormwater master planning\GIS\MapDocuments\PresentationsAndReports\Enosb_ProblemAreas\MO3_SampsonvilleRdr.mxd



SW Treatment Opportunity

River or Stream

Drainage Area (10 Acres)

Erodible Soils (k > 0.17)

Treatment Opportunity:
Significant amount of untreated impervious surface present; no obvious stormwater infrastructure at the Dairy Center.

Sources: Stormwater Infrastructure, Stormsewer Subwatersheds: VT DEC; Problem Areas: Stone; Future Growth Areas: Enosburgh Town Plan (2008); Potential Erosion Areas: SSURGO; Hydrography, Roads: VCGI; Imagery: Bing Maps.

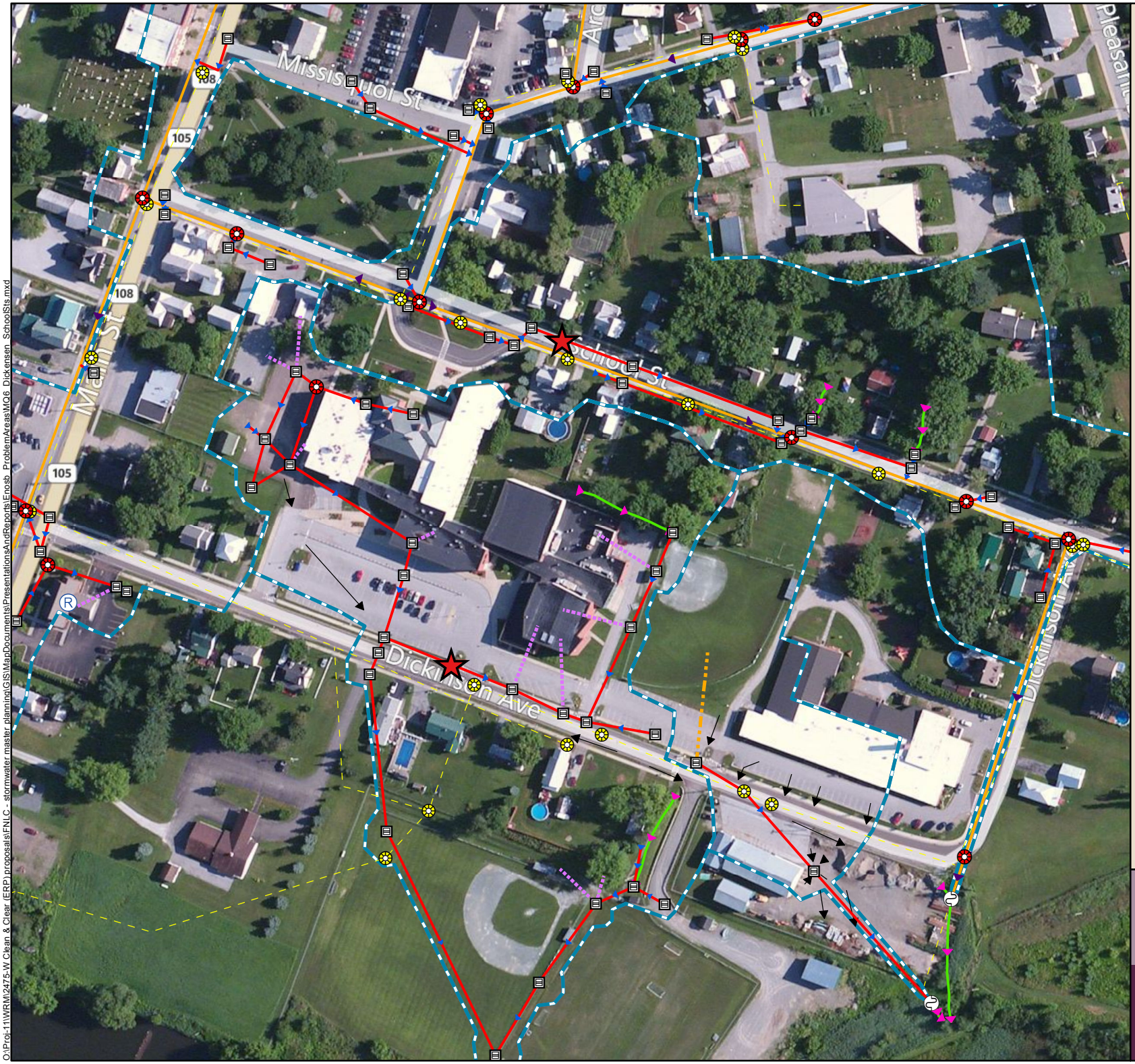
STONE ENVIRONMENTAL INC

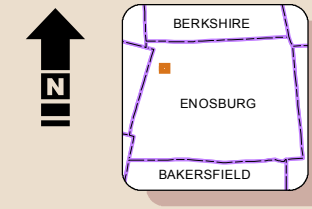
The Dairy Center

MQ-4

Enosburgh Stormwater Management Planning

O:\Proj-11\WRM\2475-W Clean & Clear (ERP) proposals\ENLC - stormwater master planning\GIS\MapDocuments\PresentationsAndReports\Enosb_ProblemAreas\MQ4_DairyCenter.mxd





0 55 110 220 Feet

SW Treatment Opportunity

- River or Stream
- Drainage Area (57 Acres)
- Erodible Soils (k > 0.17)
- Catchbasin
- Stormwater manhole
- Sanitary manhole
- Outfall
- Retrofit
- Storm line
- Storm line (old Sanitary line)
- Sanitary line
- Swale
- Footing drain
- Under drain
- Overland flow

Treatment Opportunity:
Unmanaged stormwater runoff along Dickenson Ave and School St is causing erosion along road shoulders,

Sources: Stormwater Infrastructure, Stormsewer Subwatersheds: VT DEC; Problem Areas: Stone; Future Growth Areas: Enosburgh Town Plan (2008); Potential Erosion Areas: SSURGO; Hydrography, Roads: VCGI; Imagery: Bing Maps.

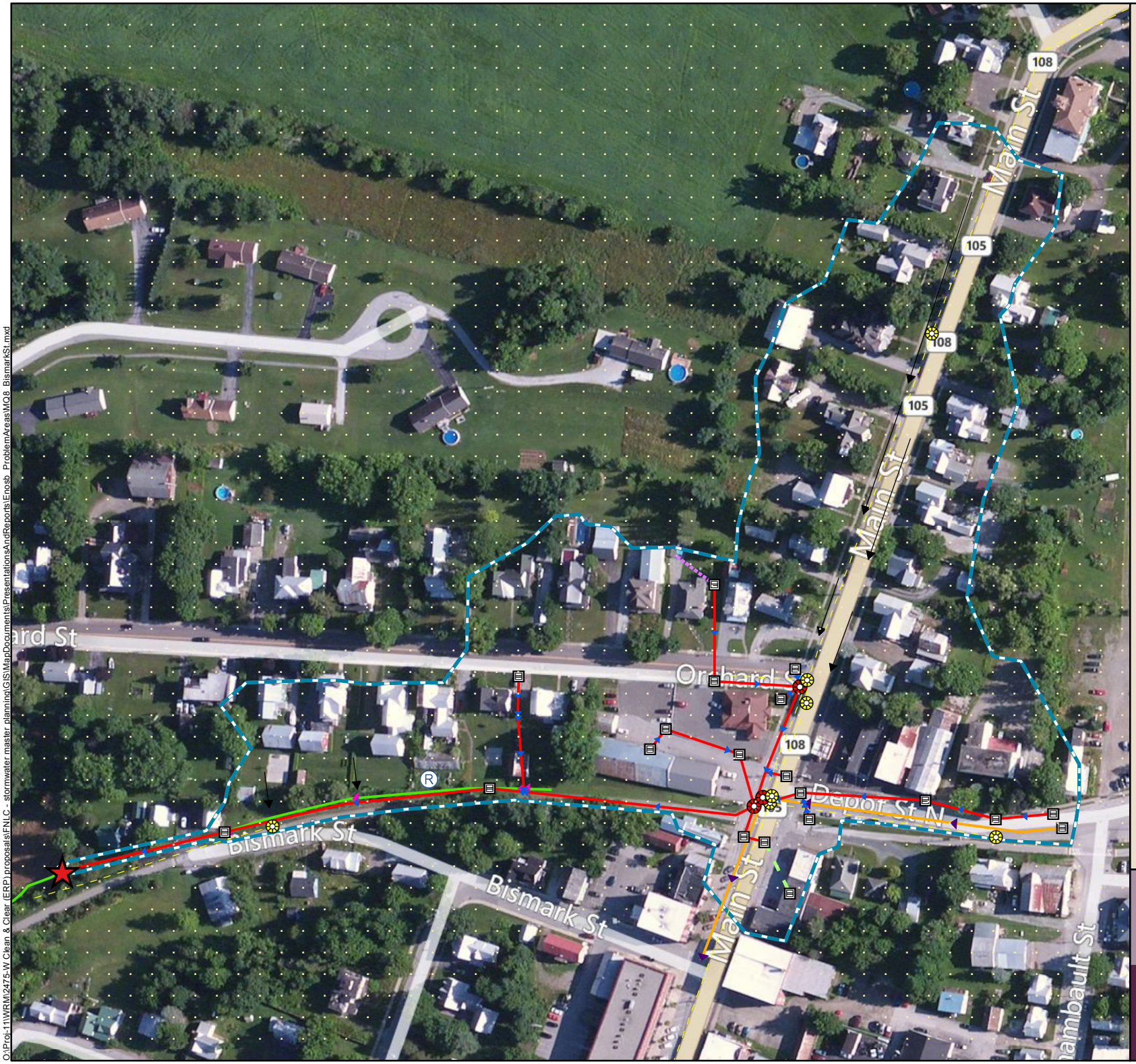
STONE ENVIRONMENTAL INC

Dickensen Ave and School St

MO-9

Enosburgh Stormwater Management Planning

O:\Proj-11\WRM\2475-W Clean & Clear (ERP) proposals\ENLC - stormwater master planning\GIS\MapDocuments\PresentationsAndReports\Enosb_ProblemAreas\MO6_Dickensen_SchoolSts.mxd



N

BERKSHIRE
ENOSBURG
BAKERSFIELD

0 55 110 220
Feet

SW Treatment Opportunity

- River or Stream
- Drainage Area (13 Acres)
- Erodible Soils (k > 0.17)
- Catchbasin
- Stormwater manhole
- Sanitary manhole
- Outfall
- Retrofit
- Storm line
- Storm line (old Sanitary line)
- Sanitary line
- Swale
- Footing drain
- Roof drain
- Overland flow

Treatment Opportunity:
Active erosion caused by flows from two storm sewer outfalls.

Sources: Stormwater Infrastructure, Stormsewer Subwatersheds: VT DEC; Problem Areas: Stone; Future Growth Areas: Enosburgh Town Plan (2008); Potential Erosion Areas: SSURGO; Hydrography, Roads: VCGI; Imagery: Bing Maps.

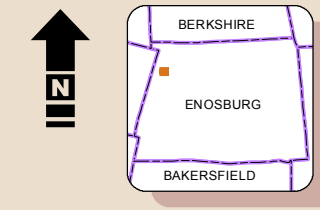
STONE ENVIRONMENTAL INC

Bismark St Outfall

MQ-8

Enosburgh Stormwater Management Planning

O:\Proj-11\WRM\2475-W Clean & Clear (ERP) proposals\ENLC - stormwater master planning\GIS\MapDocuments\PresentationsAndReports\Enosb_ProblemAreas\MQ8_BismarkSt.mxd



0 50 100 200 Feet

SW Treatment Opportunity

- River or Stream
- Drainage Area (8.3 Acres)
- Erodible Soils (k > 0.17)
- Catchbasin
- Stormwater manhole
- Sanitary manhole
- Outfall
- Retrofit
- Storm line
- Storm line (old Sanitary line)
- Sanitary line
- Swale
- Footing drain
- Overland flow

Treatment Opportunity:
Stormwater runoff from impervious surfaces surrounding the Village wastewater treatment facility discharges directly to Missisquoi.

Sources: Stormwater Infrastructure, Stormsewer Subwatersheds: VT DEC; Problem Areas: Stone; Future Growth Areas: Enosburgh Town Plan (2008); Potential Erosion Areas: SSURGO; Hydrography, Roads: VCGI; Imagery: Bing Maps.

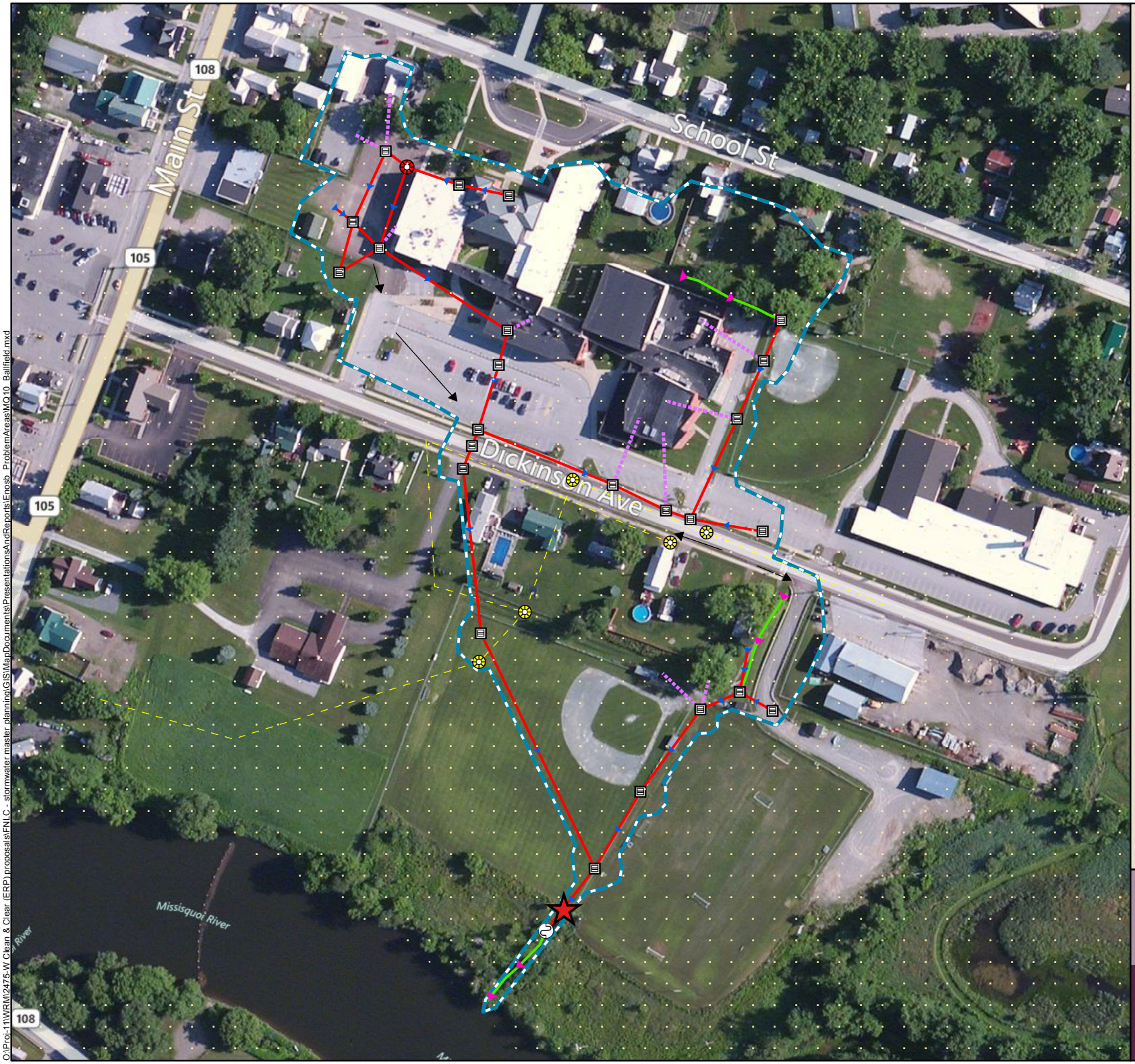
STONE ENVIRONMENTAL INC

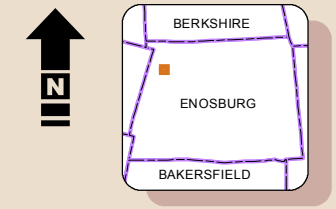
Village Wastewater Facility

MO-6

Enosburgh Stormwater Management Planning

O:\Proj-11\WRM\2475-W Clean & Clear (ERP) proposals\ENLC - stormwater master planning\GIS\MapDocuments\PresentationsAndReports\Enosb_ProblemAreas\MO9_StAlbansSt.mxd





0 55 110 220 Feet

SW Treatment Opportunity

- River or Stream
- Drainage Area (11 Acres)
- Erodible Soils (k > 0.17)
- Catchbasin
- Stormwater manhole
- Sanitary manhole
- Outfall
- Storm line
- Sanitary line
- Swale
- Footing drain
- Overland flow

Treatment Opportunity:
Erosion occuring at outfall from storm sewer that carries flows from Enosburg Schools and Dickenson Ave to Missisquoi River.

Sources: Stormwater Infrastructure, Stormsewer Subwatersheds: VT DEC; Problem Areas: Stone; Future Growth Areas: Enosburgh Town Plan (2008); Potential Erosion Areas: SSURGO; Hydrography, Roads: VCGI; Imagery: Bing Maps.

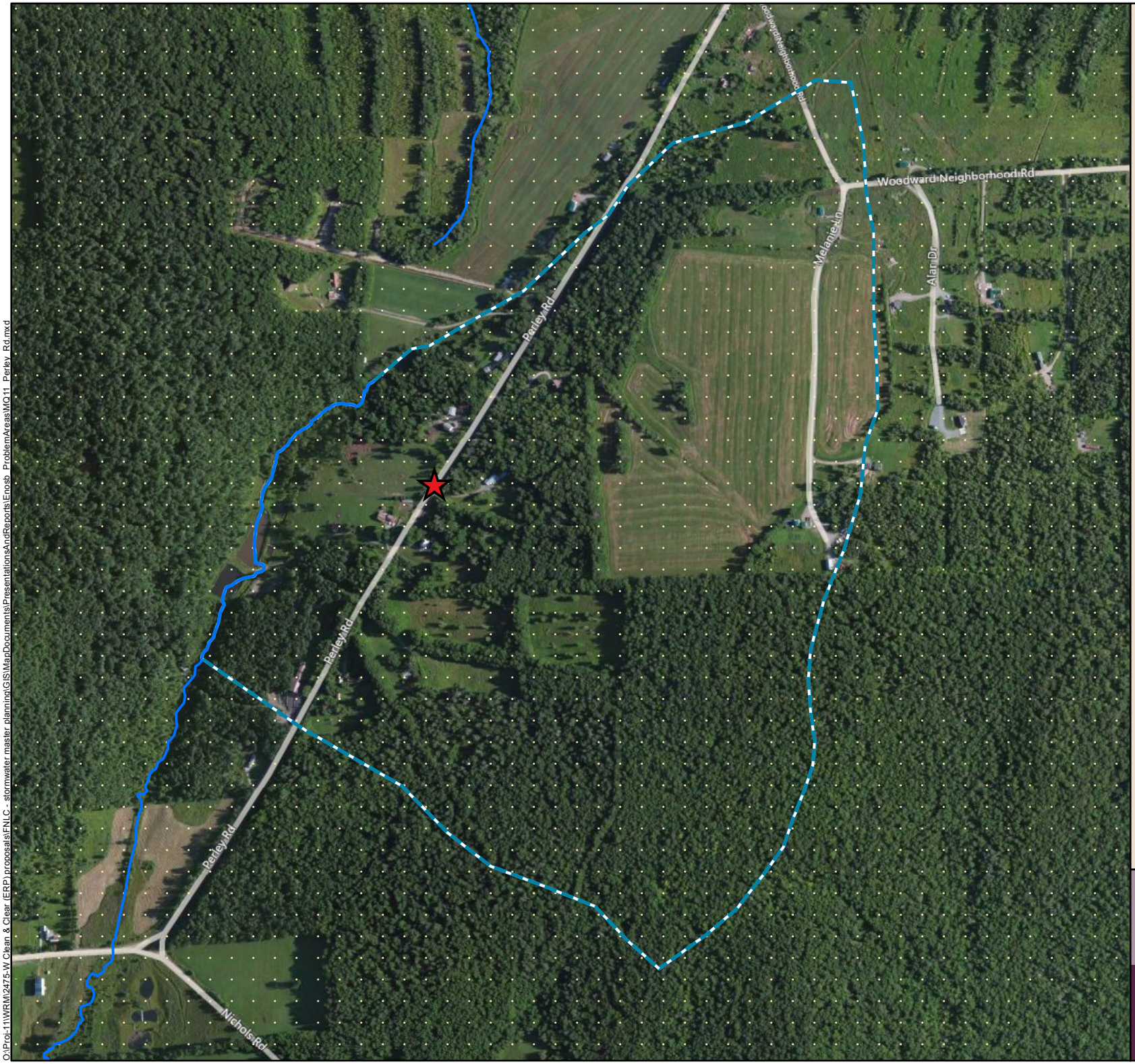
STONE ENVIRONMENTAL INC

Dickenson Ave, Ballfield Drainage

MQ-10

Enosburgh Stormwater Management Planning

O:\Proj-11\WRM\2475-W Clean & Clear (ERP) proposals\ENLC - stormwater master planning\GIS\MapDocuments\PresentationsAndReports\Enosb_ProblemAreas\MQ10_Ballfield.mxd



N

BERKSHIRE
ENOSBURG
BAKERSFIELD

0 205 410 820
Feet

SW Treatment Opportunity

River or Stream

Drainage Area (215 Acres)

Erodible Soils (k > 0.17)

Treatment Opportunity:
Ditch erosion and drainage concerns along Perley Rd.

Sources: Stormwater Infrastructure, Stormsewer Subwatersheds: VT DEC; Problem Areas: Stone; Future Growth Areas: Enosburgh Town Plan (2008); Potential Erosion Areas: SSURGO; Hydrography, Roads: VCGI; Imagery: Bing Maps.

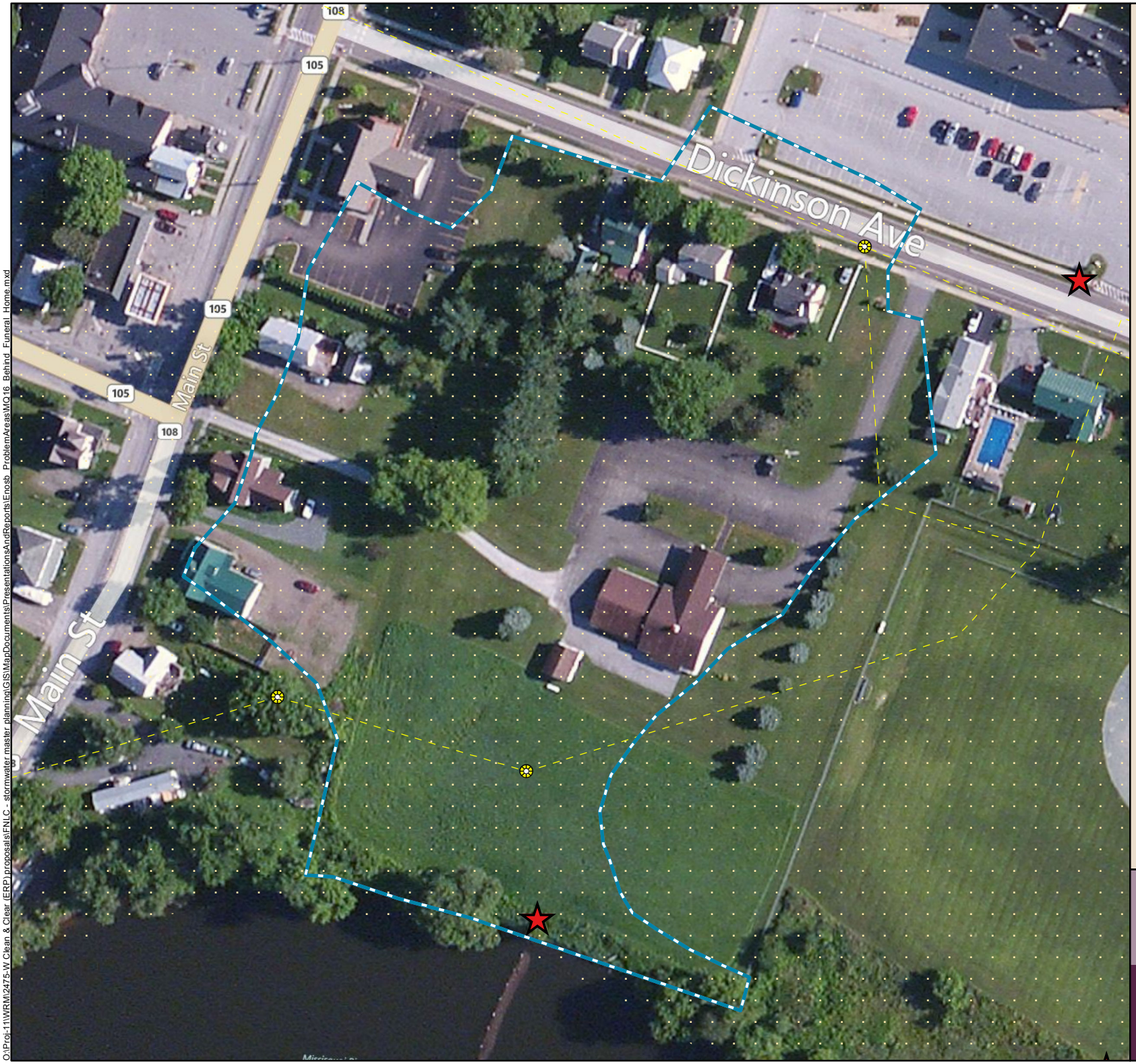
STONE ENVIRONMENTAL INC

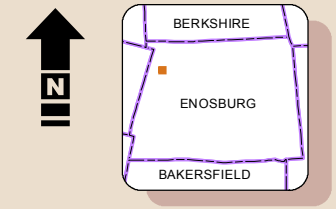
2982 - 3401
Perley Rd

MQ-11

Enosburgh Stormwater Management Planning

O:\Proj-11\WRM\2475-W Clean & Clear (ERP) proposals\ENLC - stormwater master planning\GIS\MapDocuments\PresentationsAndReports\Enosb_ProblemAreas\MQ11_Perley_Rd.mxd





0 30 60 120
Feet

SW Treatment Opportunity

River or Stream

Drainage Area (6 Acres)

Erodible Soils (k > 0.17)

Sanitary manhole

Sanitary line

Treatment Opportunity:
Tree planting could alleviate bank erosion, yard debris should also be removed from area behind Spears Funeral Home.

Sources: Stormwater Infrastructure, Stormsewer Subwatersheds: VT DEC; Problem Areas: Stone; Future Growth Areas: Enosburgh Town Plan (2008); Potential Erosion Areas: SSURGO; Hydrography, Roads: VCGI; Imagery: Bing Maps.

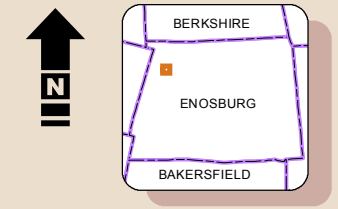
STONE ENVIRONMENTAL INC

Spears Funeral Home

MQ-16

Enosburgh Stormwater Management Planning

O:\Proj-11\WRM\2475-W Clean & Clear (ERP)\proposals\ENLC - stormwater master planning\GIS\MapDocuments\PresentationsAndReports\Enosb_ProblemAreas\MQ16_Behind_Funeral_Home.mxd



0 75 150 300 Feet

- SW Treatment Opportunity
- River or Stream
- Drainage Area (16 Acres)
- Erodible Soils (k > 0.17)
- Catchbasin
- Stormwater manhole
- Sanitary manhole
- Outfall
- Storm line
- Storm line (old Sanitary line)
- Sanitary line
- Swale
- Footing drain
- Under drain
- Overland flow

Treatment Opportunity:
Outfall from storm sewer system causing erosion along the back edge of the Village Garage property before draining to river.

Sources: Stormwater Infrastructure, Stormsewer Subwatersheds: VT DEC; Problem Areas: Stone; Future Growth Areas: Enosburgh Town Plan (2008); Potential Erosion Areas: SSURGO; Hydrography, Roads: VCGI; Imagery: Bing Maps.

STONE ENVIRONMENTAL INC

Enosburg Falls
Village Garage

MQ-17

Enosburgh Stormwater
Management Planning

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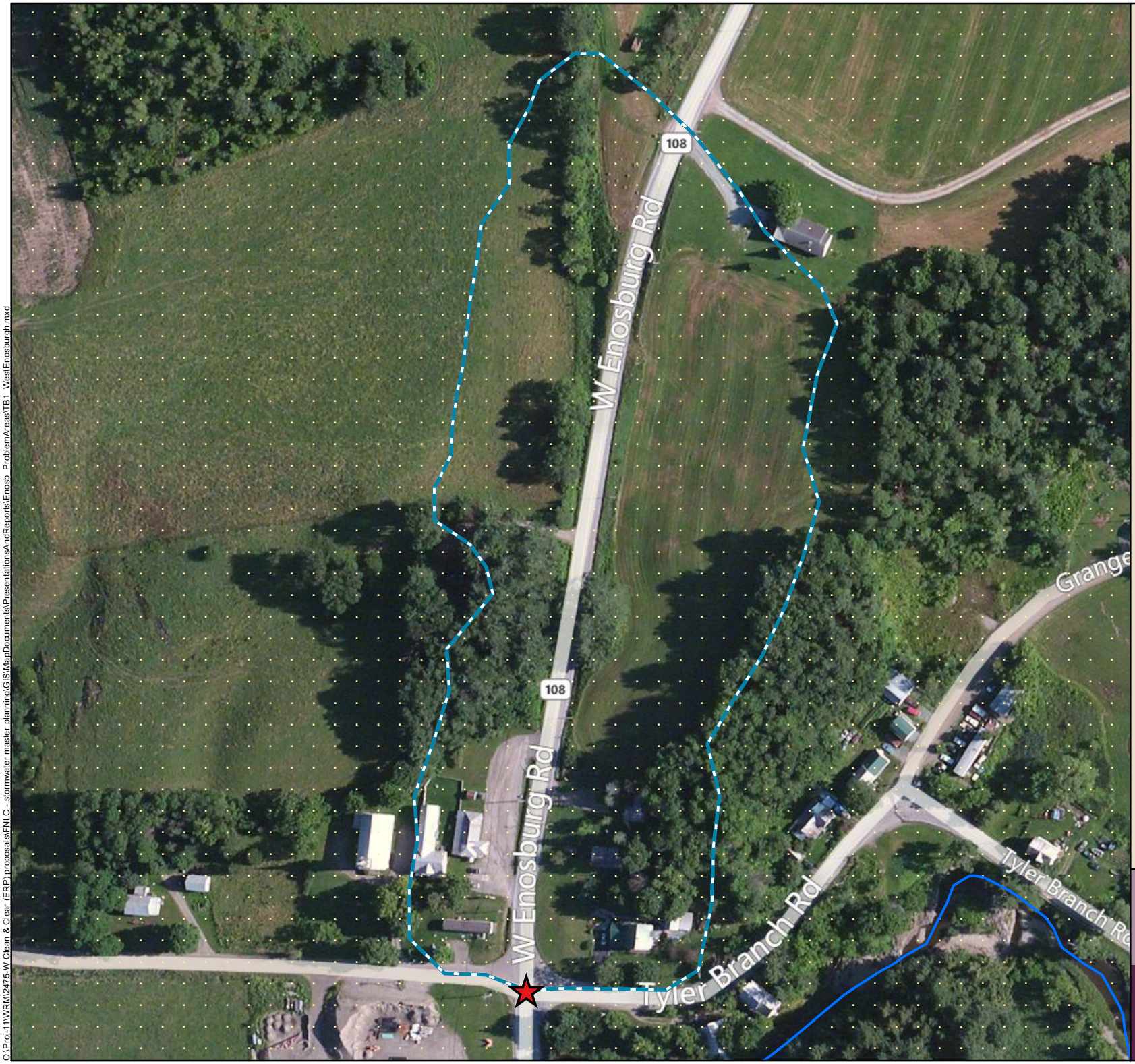
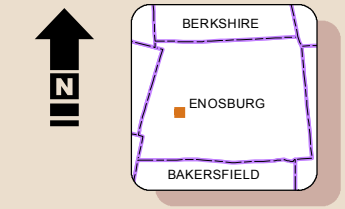




0 50 100 200 Feet

SW Treatment Opportunity

River or Stream

Drainage Area (11 Acres)

Erodible Soils (k > 0.17)

Treatment Opportunity:
Road run-off from intersection identified as a "critical source area" in LCBP Missisquoi Bay Basin model.

Sources: Stormwater Infrastructure, Stormsewer Subwatersheds: VT DEC; Problem Areas: Stone; Future Growth Areas: Enosburgh Town Plan (2008); Potential Erosion Areas: SSURGO; Hydrography, Roads: VCGI; Imagery: Bing Maps.

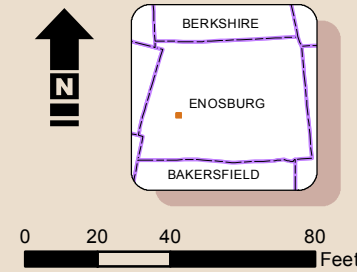
STONE ENVIRONMENTAL INC

Rt 108, Tyler Branch Rd

TB-1

Enosburgh Stormwater Management Planning

O:\Proj-11\WRM\2475-W Clean & Clear (ERP) proposals\ENLC - stormwater master planning\GIS\MapDocuments\Presentations\AndReports\Enosb_ProblemAreas\TB1_WestEnosburgh.mxd



SW Treatment Opportunity

River or Stream

Drainage Area (2 Acres)

Erodible Soils (k > 0.17)

Treatment Opportunity:
Improvement of town garage needed, including salt and sand storage.

Sources: Stormwater Infrastructure, Stormsewer Subwatersheds: VT DEC; Problem Areas: Stone; Future Growth Areas: Enosburgh Town Plan (2008); Potential Erosion Areas: SSURGO; Hydrography, Roads: VCGI; Imagery: Bing Maps.

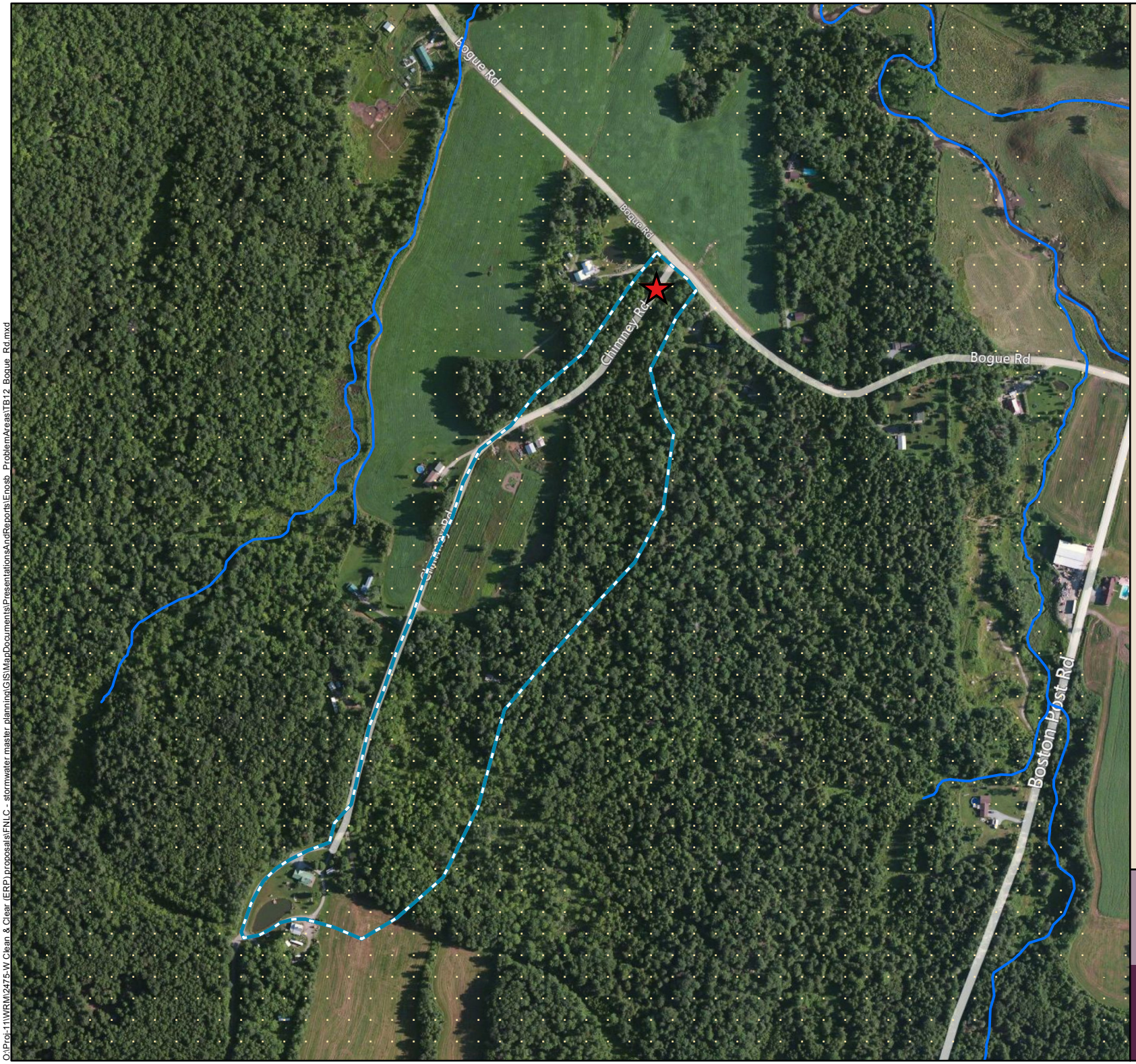
STONE ENVIRONMENTAL INC

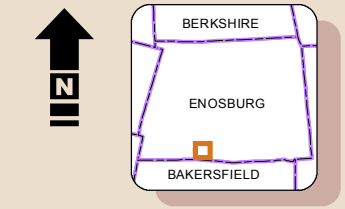
Enosburgh Town Highway Garage

TB-7

Enosburgh Stormwater Management Planning

O:\Proj-11\WRM\2475-W Clean & Clear (ERP) proposals\ENLC - stormwater master planning\GIS\MapDocuments\PresentationsAndReports\Enosb_ProblemAreas\TB7_TownSandShed.mxd





0 130 260 520 Feet

SW Treatment Opportunity

River or Stream

Drainage Area (28 Acres)

Erodible Soils (k > 0.17)

Treatment Opportunity:
Ditch erosion and drainage concerns at the intersection of Bogue Rd and Chimney Rd.

Sources: Stormwater Infrastructure, Stormsewer Subwatersheds: VT DEC; Problem Areas: Stone; Future Growth Areas: Enosburgh Town Plan (2008); Potential Erosion Areas: SSURGO; Hydrography, Roads: VCGI; Imagery: Bing Maps.

STONE ENVIRONMENTAL INC

Chimney Rd

TB-12

Enosburgh Stormwater Management Planning

O:\Proj-11\WRM\2475-W Clean & Clear (ERP) proposals\ENLC - stormwater master planning\GIS\MapDocuments\PresentationsAndReports\Enosb_ProblemAreas\TB12_Bogue_Rd.mxd

APPENDIX E: CONCEPTUAL SOLUTIONS FOR HIGHEST PRIORITY STORMWATER PROBLEM AREAS

February 20. 2013

MEMO

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

From: Jeremy Krohn
Direct Phone: 802-552-1005
E-Mail: jkrohn@stone-env.com

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

SEI No. 11-2475
Re: Enosburg SWMP: Priority Projects

During summer and fall of 2012, Stone staff identified and evaluated stormwater problem areas in the Town of Enosburg and Village of Enosburg Falls. The compiled list of problem areas gave priority to those with the greatest potential to improve water quality and/or where effective treatment was most feasible. Stone then revisited the highest priority sites to further investigate site-specific treatment potential and gather additional information needed to develop conceptual solutions.

The intent of this memo is to present a list of high priority stormwater improvement projects within the Town of Enosburg and Village of Enosburg Falls; projects have been screened based on their feasibility and potential to improve water quality. All references to soil types are based on reports produced by the USDA-NRCS Web Soil Survey[1]. Measurements, watershed delineations, and direction of flow reported in this memo are based on GIS analysis or field investigation. While this information is sufficient to support the pre-engineering design concepts presented in this document, final design will require a more comprehensive and detailed survey of each site.

1 http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

1.1 Road Maintenance Garage (Town)

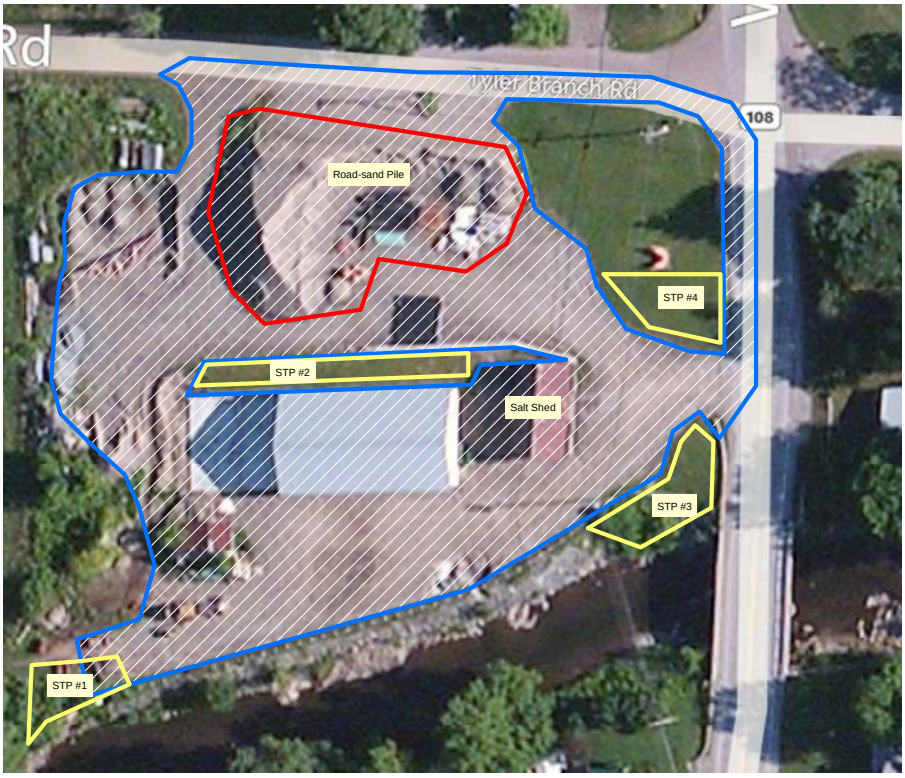


Figure 1. The Enosburg town road maintenance facility includes 1.5 acres of treatable impervious surface (outlined in blue). Potential STP locations are outlined in yellow.

The Enosburg Town road maintenance facility includes 1.5 acres of treatable impervious surface. The site comprises 0.2 acres of roof top and 1.3 acres of compacted gravel utilized for parking, equipment storage, and winter road-sand stockpiling. The road-sand stockpile is a persistent source of sediment. A significant amount of material is mobilized and washed off site during every rain event (see Figure 2).

Figure 2. Material erodes from the stockpile and is carried offsite via the swale shown in center of photo.

Currently, stormwater flows south across the property toward the Tyler Branch. A berm at the top of the river bank directs flow to the southwest corner of the property where stormwater drains directly to the Missisquoi River.

Covering the road-sand stockpile is the best way to prevent the erosion of material. Recently, the town was awarded grant for approximately $50,000 for this specific purpose. An engineer's cost estimate, however, approximated the total cost for a suitable structure to be $250,000.

Locating a stormwater treatment practice (STP) at the southwest corner of the property (labeled STP #1 in Figure 1 and Figure 3) could reduce stormwater and sediment loads to Tyler Branch. An asphalt swale or similar practice may be needed to convey a wider range of flows to STP #1. Including the other STPs shown (STP#2-4) would reduce the burden on STP #1. This could help to reduce the size required for STP #1 and improve effluent water quality.

Figure 3. Stormwater that currently flows, southwest across the property could be captured and treated in an STP in the southwest corner of the property.

Soils at STP #1 are reported as Ondawa variant silt loam (HSG B). This soil would support infiltration practices. However, an underdrain should be included in the design. The remainder of the site is reported to be Buxton silt loam (HSG C). This soil type would not allow adequate percolation for effective infiltration practices. STPs in these locations must include some sort of underdrain structure to prevent pooling beyond the intended retention time. The most important feature of STPs at this site will be the removal of sediment. Pre-treatment forebays and regular maintenance will be crucial for ensuring successful stormwater treatment.

1.2 Dairy Center (Town)

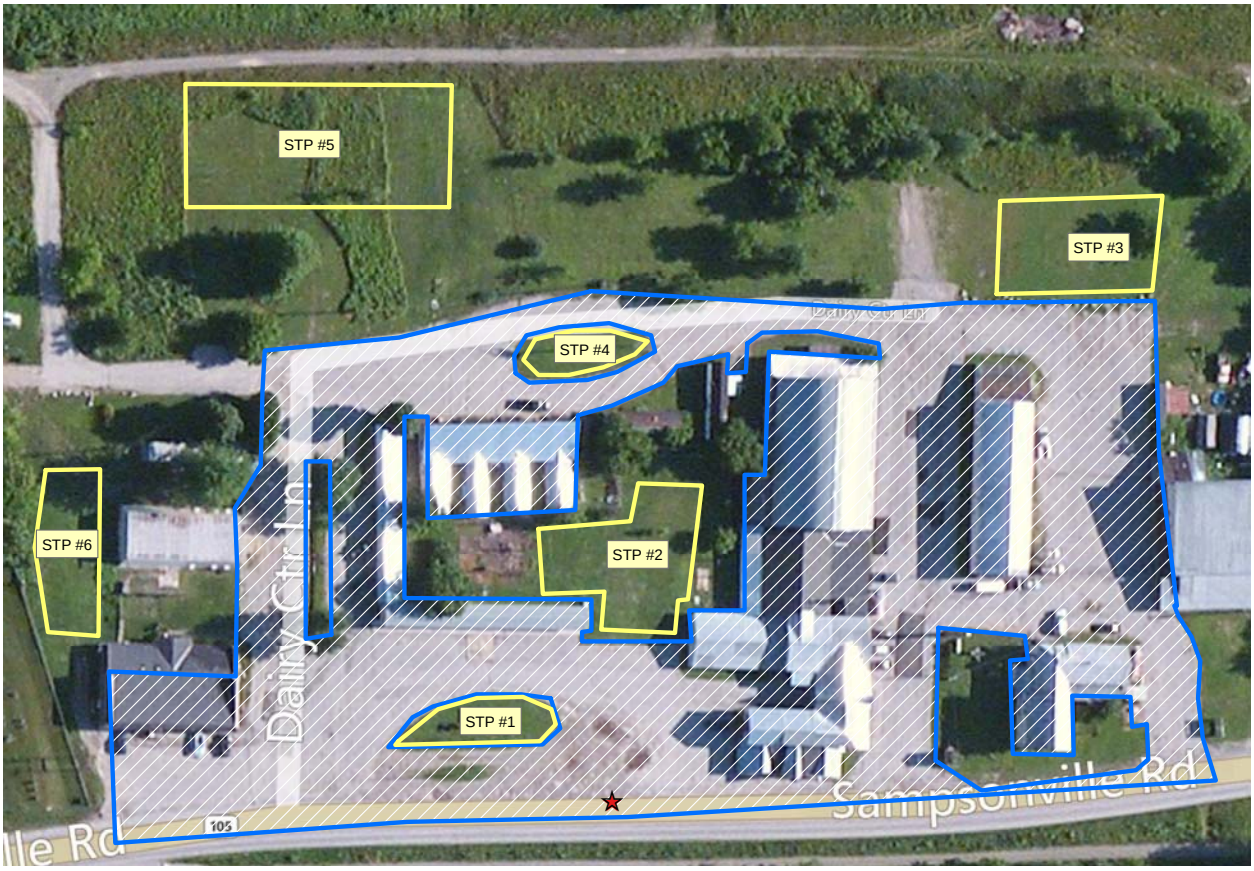


Figure 4. 3.6 acres of treatable impervious area has been identified (highlighted in blue) at The Dairy Center. A number of STP location options exist (highlighted in yellow).

The Dairy Center is a five acre development that includes a bowling alley, restaurant, and lodging. This complex on Rt. 105 includes a large expanse of buildings and asphalt pavement. Approximately 3.6 acres of treatable impervious area has been identified on the property including a number of rooftops and a significant amount of asphalt pavement. The property is immediately across the road from the Missisquoi River.

A number of possible STP locations have been identified and are shown in Figure 4. Examples of two potential STP layouts are provided in Figure 5 and Figure 6.

Figure 5 shows a depression in the pavement at the complex entrance along Rt. 105. GIS analysis shows that stormwater currently flows toward the existing landscaped area where the flags and sign are located. A portion of the deteriorating pavement could be replaced with an STP. This STP would reduce stormwater and pollutant loads to the Missisquoi River while beautifying this highly visible property.

Figure 5. A stormwater treatment practice in the parking median at the Dairy Center could be an effective option with minimal impact on the parking lot traffic patterns.

Figure 6 shows a section of the complex courtyard. Roof runoff could be captured in a simple STP which would promote infiltration. Again, this STP would improve stormwater runoff conditions while blending with the existing landscaping aesthetic.

Figure 6. Roof runoff could be captured and infiltrated through an STP place in the complex courtyard.

The NRCS reports soils at the Dairy Center to be Missisquoi loamy sand (HSG A). Infiltration would likely be effective at all potential STP sites. The asphalt pavement at the Dairy Center is expansive. Stormwater impacts could be greatly reduced by "de-paving" the existing pavement and replacing with vegetation or stormwater treatment practices. Pervious pavement may also be an option to reduce stormwater runoff given the flat topography and well-drained soils underlying the parking lot.

1.3 Enosburg School Campus (Village)

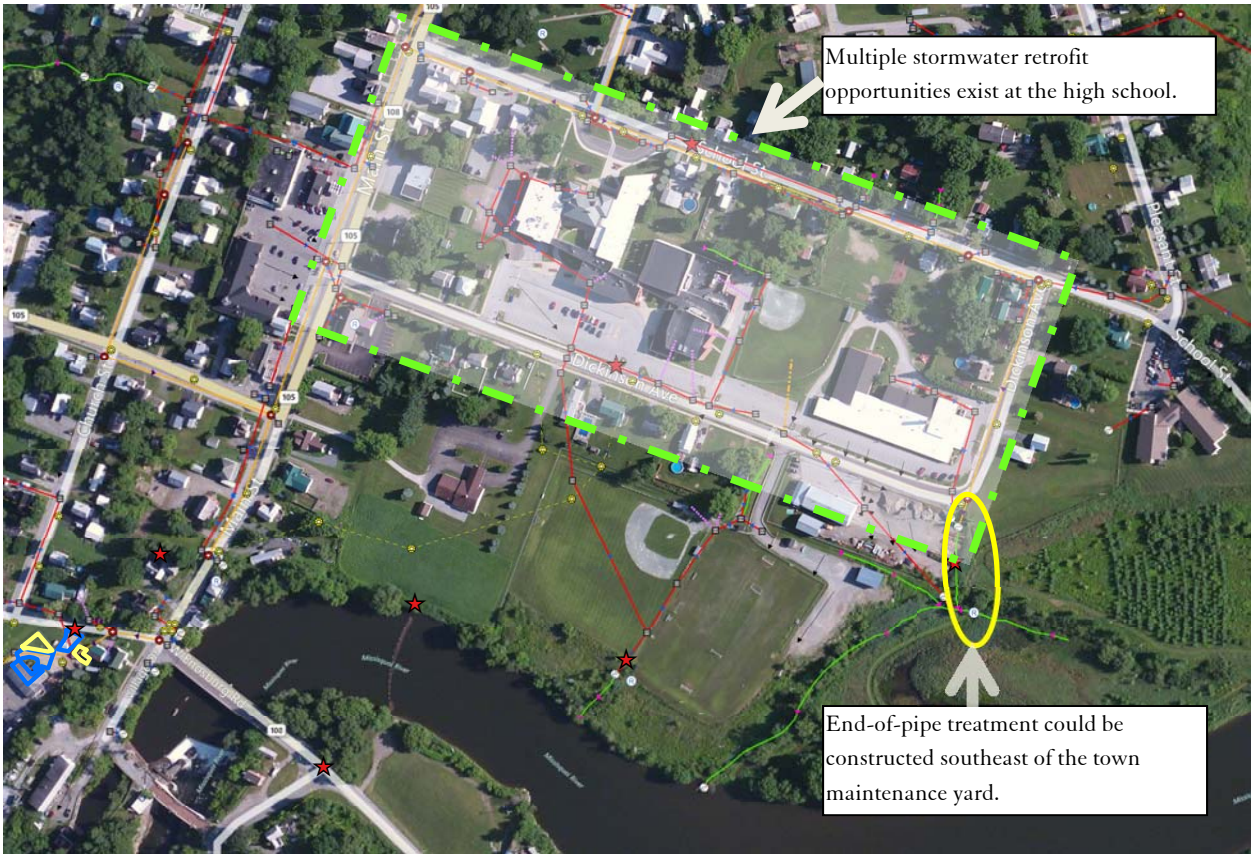


Figure 7. The Enosburg school campus and surrounding Dickinson Avenue neighborhood includes multiple stormwater improvement opportunities.

Stormwater from the Enosburg school campus and much of the surrounding Dickinson Avenue neighborhood is collected in a storm sewer and discharged, untreated, at two locations in the floodplain of the Missisquoi River. Stormwater then drains directly to the Missisquoi River via vegetated swales. This neighborhood includes a large amount of impervious area in the form of rooftops and asphalt pavement.

A two-pronged approach is recommended to treat stormwater from the Enosburg school campus and Dickinson Avenue neighborhood.

- A number of retrofit opportunities exist at stormwater catch basin locations around the school property.
- Second, a larger end-of-pipe treatment practice, such as micro-pool detention, constructed between the outlet to the storm sewer (at the southeast corner of Dickenson Ave.) and the Missisquoi River.

1.3.1 School Campus Retrofits

Retrofits at the storm sewer inlets could treat stormwater runoff close to the source. The retrofit opportunities that were identified during field investigation are highlighted in Figure 8. It is expected that more opportunities could be identified during a design-level inspection of the campus.

Figure 8. Numerous stormwater retrofit opportunities exist at the Enosburg Falls school property.

The NRCS reports soils at the school to be Enosburg loamy fine sand, and Eldridge loamy fine sand. As HSG C soil types, both are less than adequate to support infiltration practices. All STPs should include underdrains to assure stormwater is discharged at a satisfactory rate. These retrofits should be relatively straightforward given the proximity of existing stormwater infrastructure at all identified sites.

Some examples of typical STP retrofit opportunities at the Enosburg school campus are provided in Figure 9 through Figure 15.

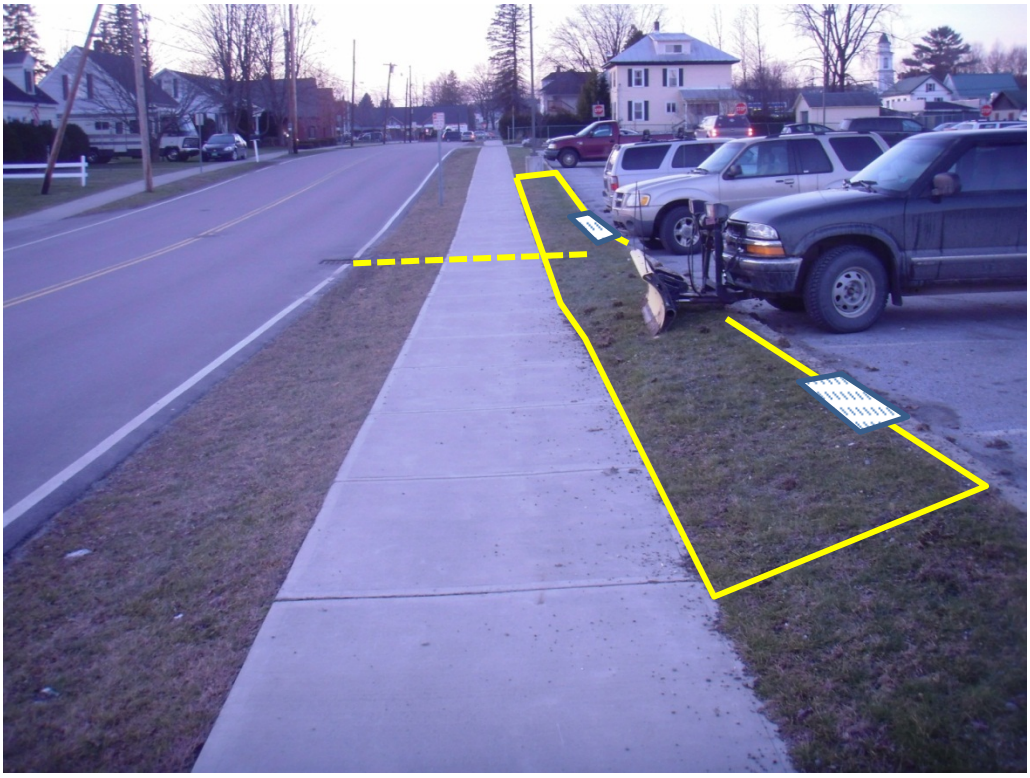


Figure 9. Curb cuts could intercept stormwater runoff from the parking lot as shown. Water could be treated in an infiltration or filter trench within the existing green strip.

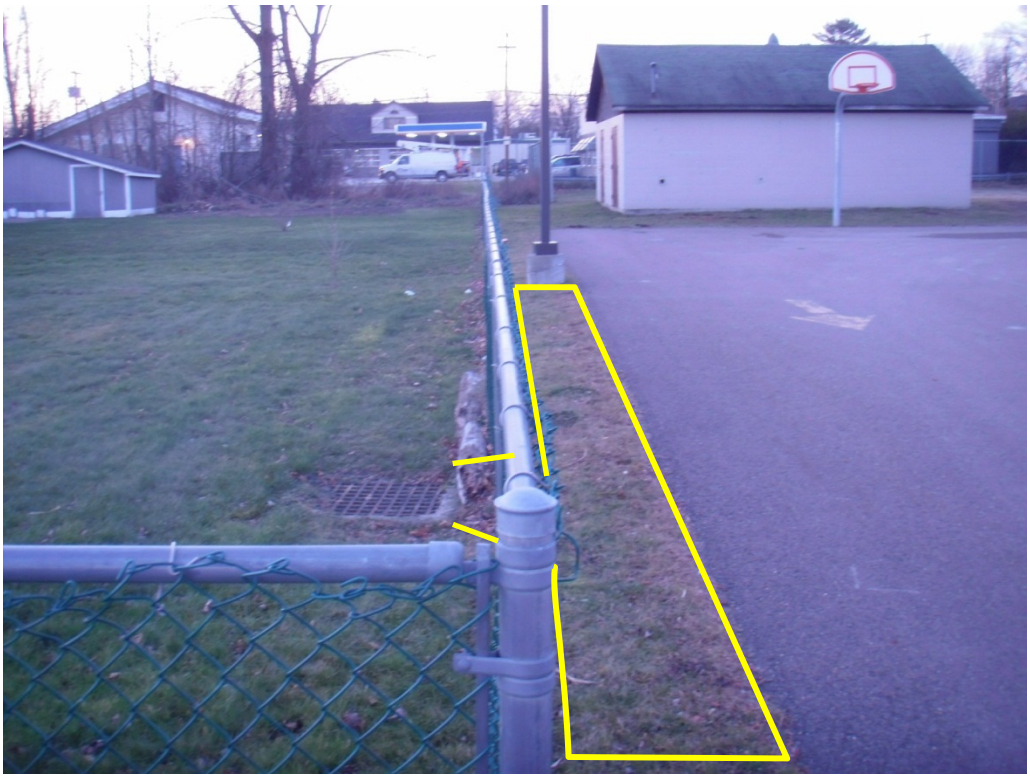


Figure 10. Parking lot runoff could be captured and detained in a small filtration trench or vegetated swale before being discharged to the existing catch basin.

Figure 11. Stormwater currently flows from the left of the photo and then along the curb to the catch basin (highlighted in green). A curb-cut retrofit STP within the existing parking island could intercept and a treat runoff.

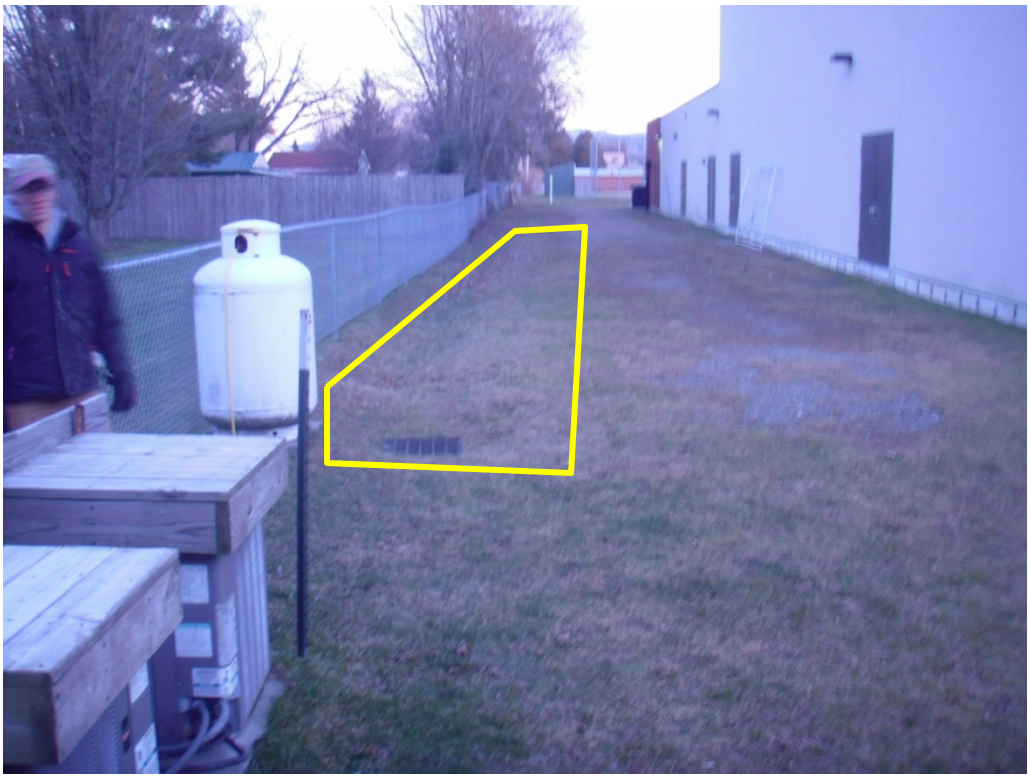


Figure 12. A catch basin to the rear of the high school could easily be retrofitted with a stormwater STP such as a bioretention swale to capture and detain roof runoff.

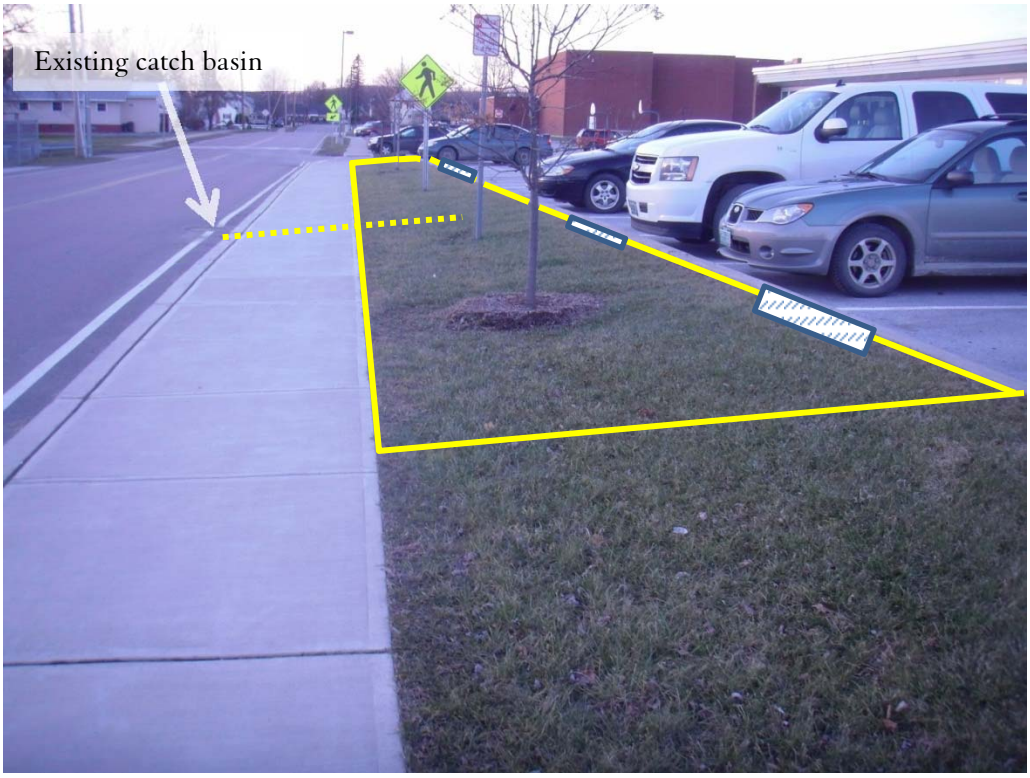


Figure 13. This green strip in front of the elementary school could be modified to treat stormwater. Curb cuts would intercept stormwater from the parking lot. Water could then be treated in the greenstrip before being discharged to the existing storm sewer via an underdrain system.

Figure 14. This parking island could be utilized to treat stormwater with a simple retrofit design creating a small bioretention basin.

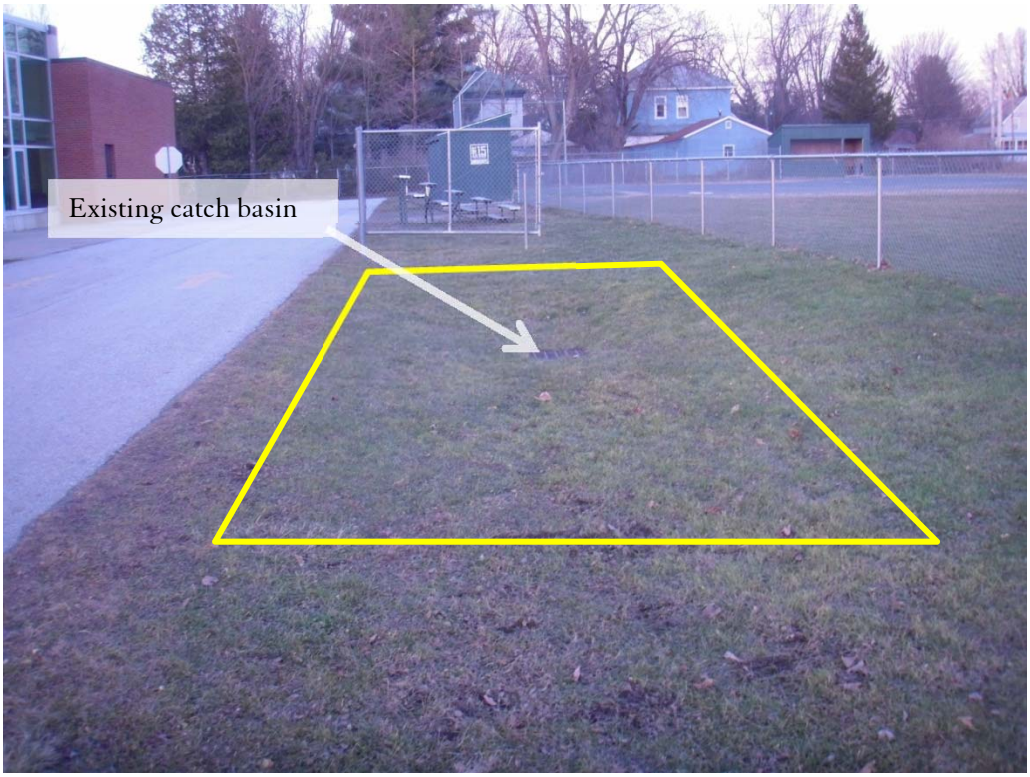


Figure 15. Another example of an existing catch basin that could be modified to provide stormwater treatment in a bioretention basin or similar practice.

1.3.2 End of Pipe Treatment

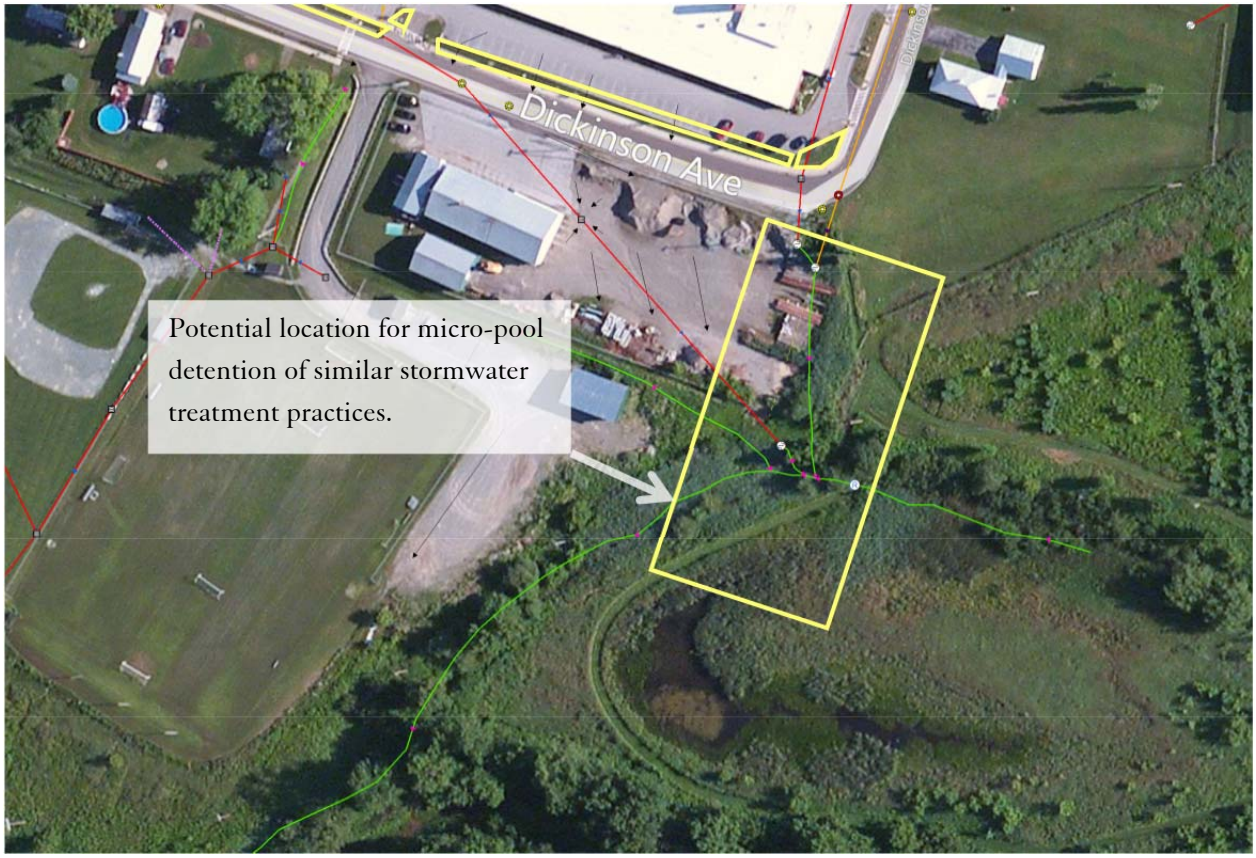


Figure 16. Possible location of proposed STP southeast of the Enosburg Falls road maintenance yard.

The storm sewer line that drains the elementary school portion of the campus and the School Street neighborhood (north of the school) discharges southeast of the maintenance garage. A large amount of space exists near the outfall that could be utilized for a stormwater treatment practice such as a micropool extended detention pond. An example of this type of treatment practice is provided in Figure 17. The village Public Works Director has indicated plans for a significant construction project at the garage in 2013. There could be considerable synergy between this retrofit project and the planned work at the garage. However, if the only feasible locations for an end-of-pipe structure are in the 100-year floodplain, they would not be permittable or eligible for grant-based implementation funding.

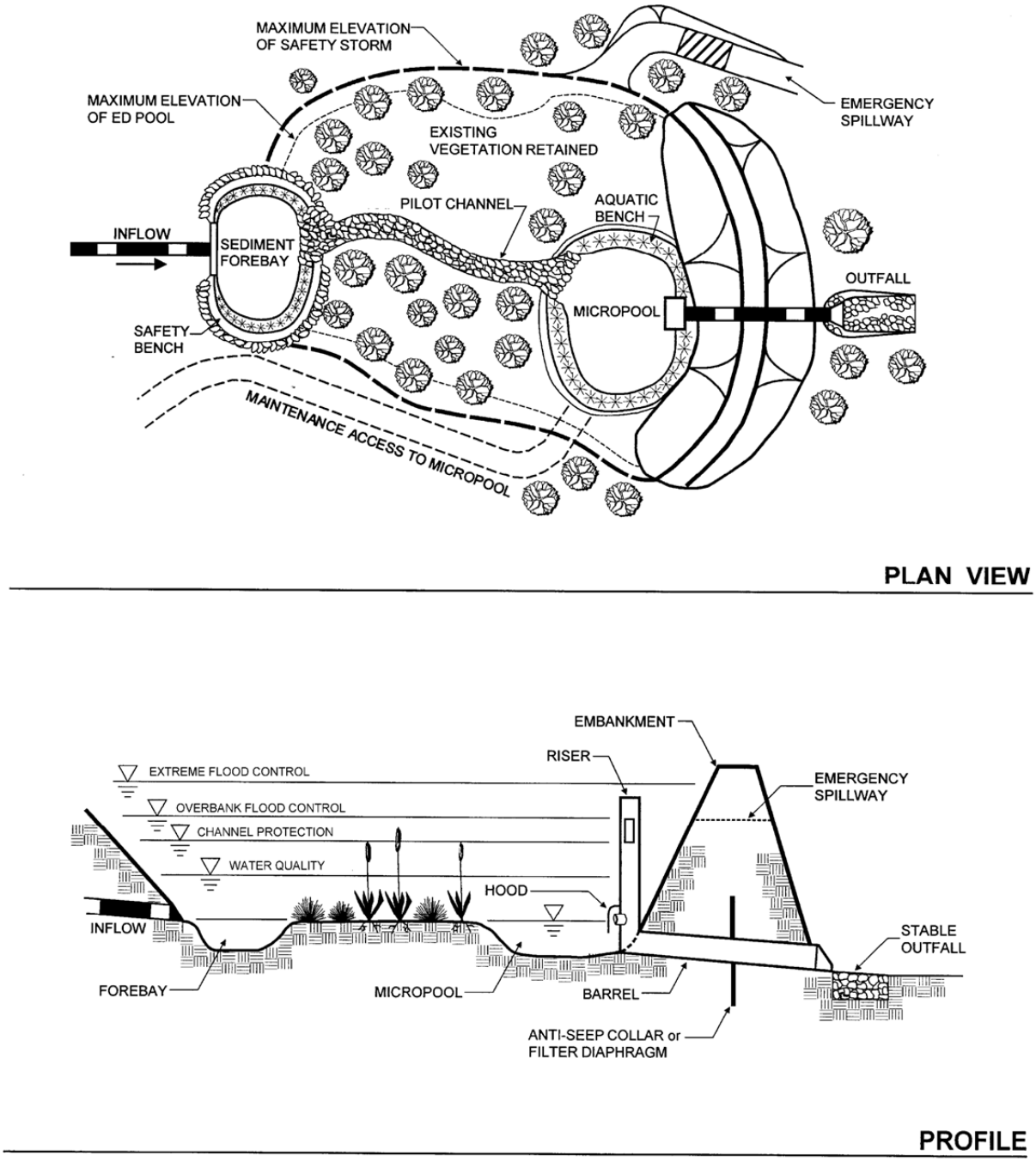


Figure 17. Micropool Extended Detention Pond. Source: The Vermont Stormwater Management Manual.

1.4 Waste Water Treatment Plant (Village)

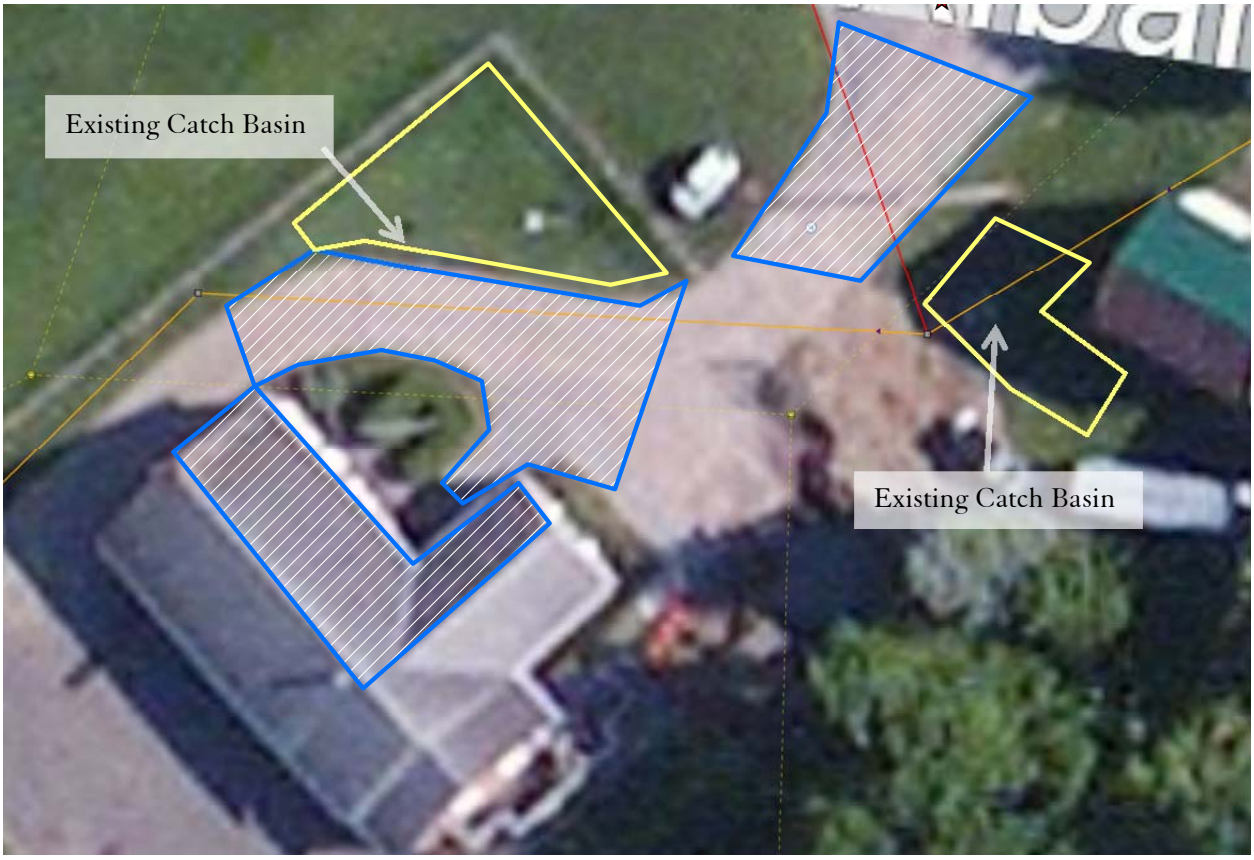


Figure 18. Two STPs could be built around two well-located catch basins at the wastewater treatment plant.

The Enosburg Falls Waste Water Treatment Plant property on St. Albans Street has two catch basins that could be easily retrofitted to treat stormwater. Runoff from portions of two building roofs and two sections of the asphalt drive could be captured and slowly released to the existing stormwater infrastructure through retrofit-bioretention basins. 1/10 of an acre of treatable impervious surface was identified. Figure 19 and Figure 20 show conceptual locations for the proposed STPs. The USGS reports soils at these locations to be Eldridge loamy fine sand. This soil type (HSG C) drains slowly when thoroughly wet. For this reason, infiltration practices are not expected to be effective.

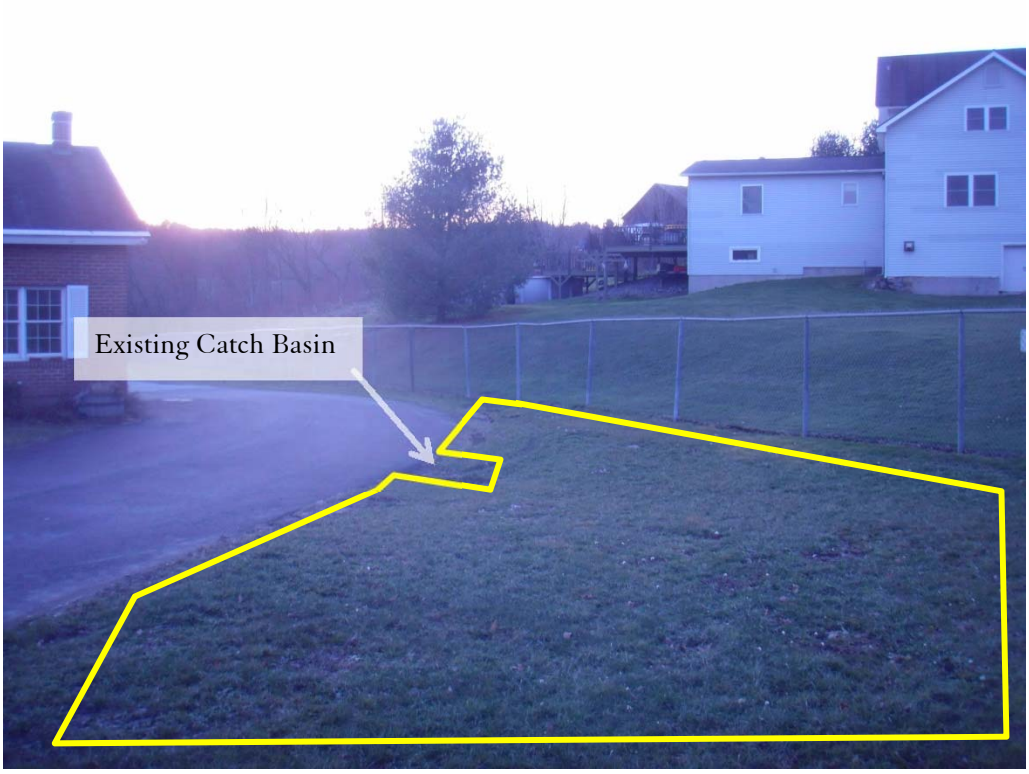


Figure 19. The location of this catch basin makes retrofitting a appealing option.

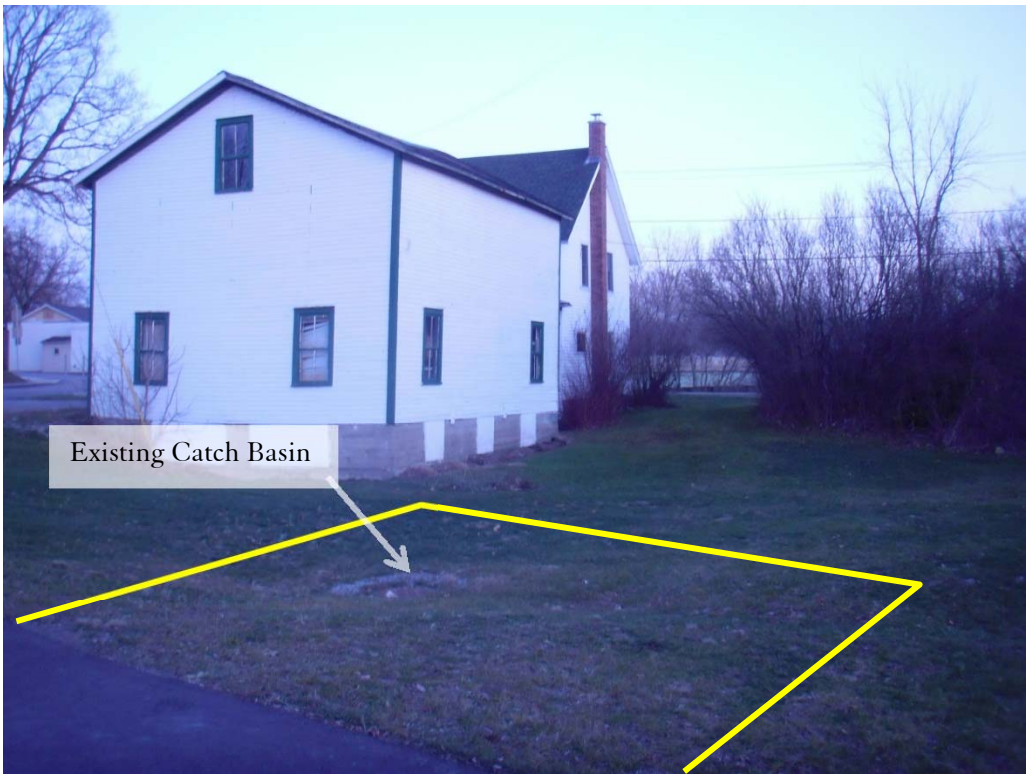


Figure 20. This catch basin located behind the Enosburg Falls village office provides a good retrofit opportunity.

1.5 Perley Road (Town)

Perley Road is a gravel-surfaced road that runs from Nichols Rd. in Enosburg to Montgomery Rd. in Franklin. A significant amount of work was recently completed, most notably, stone-lining of ditches. However, two substantial stormwater improvement opportunities were found along the Enosburg portion of this route:

- A section of roadside ditch is clogged and has cause erosion of the road surface and an adjacent property.
- Replacement of aging corrugated metal pipe culvert that is too short.

1.5.1 Roadside Ditch Maintenance

A portion of the road side ditch appears to be in need of cleaning (see Figure 21). In the ditch's existing condition, water has been diverted down and across the road, causing damage to the road surface and a neighboring property. At the time of inspection, recent repairs have been made to the eroded section of road and adjacent property but ditch had not been cleaned.

Figure 21. Ditch along Perley road has become filled in. Diverted water is eroding the road surface.

1.5.2 Undersized Culvert Replacement

The ditch-relief (cross drain) culvert located near 2982 Perley Road is too short for the current width of the road. The short culvert forces the road embankment to be too steep. The resulting approximate 1:1 slope has created unstable conditions at both the inlet and the outlet to this 36" culvert (see Figure 22). Generally, vegetated slopes should be limited to 2:1 (horizontal to vertical) to maintain stable conditions. The resulting erosion leads to deteriorating road conditions and impacts to water quality.

Figure 22. This culvert near 2982 Perley Rd. is too short, resulting in steep, erodible banks. Culvert inlet shown on left; Outlet is on the right.

The existing culvert pipe is significantly corroded (See Figure 23). It is likely that this culvert was of adequate length for the width of road when it was installed. Over time, through grading and re-surfacing practices, the road width may have increased, leading to over-steepened banks. Given the deteriorating condition of the culvert, it is a good candidate for replacement. The replacement culvert should be long enough to accommodate 2:1 slopes at the inlet and outlet of the culvert.

For now, the banks surrounding the inlet and outlet of the culvert could be stabilized with geotextile fabric and a riprap blanket treatment. The slopes of the existing embankment may be too steep to truly stabilize with this practice. Nonetheless, this standard approach of armoring of the slopes would reduce erosion and subsequent impacts.

Figure 23. Corroded 36" culvert on Perley Road.