TOWN OF GEORGIA

STORMWATER MANAGEMENT PLAN

FINAL REPORT

Stone Project ID 112475-W

February 20, 2013

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ACKNOWLEDGEMENTS

This project was performed by Stone Environmental, Inc. for the Friends of Northern Lake Champlain and the Town of Georgia with funding provided by Vermont Department of Environmental Conservation - Ecosystem Restoration Program.

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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., Deer Brook, Mill River), as well as in downstream water bodies (e.g., Lamoille River, 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 Georgia Comprehensive Municipal Plan states: *Stormwater runoff has also been identified as a threat to our local waterways as it carries sediment and pollutants, increases the volume of water in our rivers, accelerates flows, and exacerbates erosion in the stream channel. Ensuring stormwater from roads, parking lots, roofs and other impervious surfaces is adequately captured and treated is an important step to protecting our water quality and improving the stability of our streams and shorelines* (Town of Georgia, 2011).

The ultimate goal of this project is to provide the Town of Georgia 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 Georgia, and incorporates any information available from 1992 through 2012.

This Stormwater Management Plan also:

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

2. GENERAL DESCRIPTION OF THE STUDY AREAS

The Town of Georgia is located in Franklin County, in northwest Vermont. The population was 4,511 at the 2010 census, an increase of about 150 people since the 2000 census (U.S. Census Bureau, 2011). The Town covers a total area of more than 45 square miles, although most of the residential and commercial development is concentrated along Vermont Route 7 and the seven miles of Lake Champlain shoreline within the town.

The Town of Georgia lies wholly within the Lake Champlain basin, and has a number of rivers, streams and lakes within its boundaries. The Town of Georgia includes portions of the Lamoille River, Rugg Brook, Mill River, and most of Stone Bridge Brook, in addition to many smaller streams and brooks. The Town has substantial areas of sandy and well-drained soils, which are well suited for effective stormwater management via infiltration. However, these soils are also very sensitive to erosion if water is directed over them in a concentrated flow. Erosion is thus a major issue in Georgia's rivers, due both to these erosion-prone soils and to significant conflicts between rivers and road infrastructure. Each watershed in the Town is described in more detail below, and watershed boundaries are shown on Map 1 in Appendix A.

2.1. Lamoille River and Arrowhead Mountain Lake

Over 611 miles of rivers and streams drain the land area known as the Lamoille River watershed, which ultimately empties into outer Malletts Bay in Lake Champlain. The Lamoille River originates at Horse Pond in Hardwick. Just west of the village of Fairfax, the Browns River enters from the south and increases the size of the Lamoille River substantially. From the confluence of the Browns River, the Lamoille flows westerly for almost four miles before becoming Arrowhead Mountain Lake in the southeastern corner of Georgia. The dam that impounds the Lamoille is located downstream in Milton. Arrowhead Mountain Lake is used as a water source for the Georgia Dairy Industrial Park as well as for recreational boating and fishing. The southeastern portion of the Town drains directly to the Lamoille River and Arrowhead Mountain Lake.

2.2. Deer Brook

The Deer Brook watershed includes approximately 8.4 square miles in the towns of Georgia and Fairfax. Deer Brook flows into Arrowhead Mountain Lake, which is part of the Lamoille River, and ultimately flows into Lake Champlain. Deer Brook is considered to be "impaired" by sediment, from its mouth to 2.5 miles upstream. Stormwater discharges from an industrial park, a sand pit, and corroding road culverts have all been identified as important sources of pollution in Deer Brook. VTrans completed temporary repairs to one of the culverts; stormwater management practices and erosion control measures were implemented at the industrial park to divert stormwater runoff from an intermittent stream to a detention pond and stabilize an eroding gully (VTANR 2009a). Within four to eight years (roughly 2016-2020), the State of Vermont will develop a TMDL (Total Maximum Daily Load) or pollution budget for Deer Brook (VTDEC 2012).

2.3. Mill River

The Mill River watershed includes approximately 16.7 square miles and includes small portions of St. Albans Town, Fairfax, and Fairfield, in addition to northern half of the Town of Georgia. The river originates near the St. Albans Reservoir and flows out into St. Albans Bay. Land use in the watershed is dominated by agricultural and light to heavy residential development. Mill River is considered to be an "impaired" waterbody, meaning it does not currently meet water quality standards. The state has identified the pollutants of concern as sediment, nutrient, and *E. coli* bacteria, and has attributed these pollutants primarily to agricultural runoff and streambank erosion. Within four to eight years (roughly 2016-2020), the State of Vermont will develop a TMDL for Mill River (VTDEC 2012).

2.4. Stone Bridge Brook

Stone Bridge Brook is six miles long, and the watershed includes approximately 12.3 square miles. Stone Bridge Brook flows through the Town of Georgia before draining into Milton and ultimately Lake Champlain south of St. Albans Bay. The Stone Bridge Brook mainstem is relatively well protected by generally continuous wetlands and forest (NRPC 2008). Impacts attributed to nutrient and sediment runoff from agricultural sources resulted in a 2-mile segment of the stream being added to Vermont's 303(d) list of impaired waters. Water quality improved after farmers implemented a variety of agricultural best management practices. Data collected in 2011 showed that Stone Bridge Brook complied with state water quality standards, and the stream was removed from the list of impaired waters in 2012.

2.5. Other Watersheds in Georgia

Watersheds located partially within the Town of Georgia, but which were not the focus of this project, include Silver Lake and Rugg Brook. Both of these watersheds are described briefly below.

2.5.1. Silver Lake

Silver Lake and its tributaries are located in the Town of Georgia; a piping system carries water from the lake to the active drinking water supply reservoir for St. Albans. Silver Lake is surrounded by woodland, but its shoreline is not currently conserved.

2.5.2. Rugg Brook

Rugg Brook flows into the northwest corner of Georgia from St Albans Town and confluences with Mill River before draining into St Albans Bay. Rugg Brook originates on Bellvue Hill southeast of St. Albans City. There is a diversion structure on Rugg Brook in the City of St Albans, which shunts water from Stevens Brook to Rugg Brook during high flows in order to protect the City from flooding. This structure increases the volume of storm flows for all downstream reaches of Rugg Brook.

3. EXISTING PLANS AND DATA

Numerous and varied groups and individuals have invested considerable effort in evaluating different components of Georgia's 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 the Town of Georgia and to future efforts to develop a list of strategic, prioritized projects that could be undertaken to improve water quality in and around Georgia. 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 Vermont Agency of Natural Resources (VTANR). 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 *Lamoille River Basin Water Quality Management Plan* (VTANR 2009a) covers approximately half to the Town of Georgia's land area; the other half is covered by the *Water Quality Management Plan for the Northern Lake Champlain Direct Drainages* (VTANR 2009b).
- 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 several stream/river segments within the Town of Georgia: Deer Brook, Mill River including Rugg Brook, and Stone Bridge Brook.
- Water quality monitoring, including biological assessments. At least one year of assessment data has been collected at more than 20 different locations within the Town of Georgia. In addition, as part of the Lake Champlain Long-Term Water Quality Monitoring Program, a USGS gaging station was installed on Mill River in 2010.
- 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. A TMDL addresses a single pollutant or stressor for each waterbody. The previously approved Lake Champlain phosphorus TMDL is currently under review by EPA Region 1.
- Stormwater infrastructure mapping completed by VTANR in February 2012, and the Illicit Discharge Detection and Elimination survey which is ongoing (completion expected in 2013).

3.2. Town-Wide Assessments and Programs

In addition to the watershed-based assessments, a number of pieces of data that 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, work by the Vermont Agency of Transportation (VTrans), and past and current planning initiatives, specifically:

- VTrans-sponsored programs, including routine inspections of bridges and culverts and grant opportunities provided by the Better Backroads Program, have identified a number of potential projects of needed to protect existing infrastructure and whose implementation would improve stormwater management.
- Georgia's Town Plan both generally recognizes the important role that the physical setting of the town plays in determining areas most suitable for development (e.g., "to protect private and

public investment and maintain the natural environment by considering topography and geology when determining land use") and identifies a handful of potential projects of importance to the Town that might also be able to incorporate improved stormwater management for a relatively small incremental cost.

- Georgia's zoning regulations for the South Village Core include specific guidelines related to erosion control and stormwater management. Specifically, the guidelines encourage developers to incorporate low impact development techniques into plans for stormwater management and highlight the use of bioretention areas and permeable pavement (Town of Georgia 2010).

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, and noting the location of any concerns related to stormwater
- Engagement with local officials, including:
  - March 7th, kick-off meeting with Town Administrator
  - March 26th, Georgia Select Board reviewed preliminary problem area information and maps
  - June 12th, presentation to Georgia Select Board and Planning Commission
  - June 22nd, presentation at joint FNLC and Georgia Conservation Commission pig roast
- Targeted site visits to verify problems areas (May and June 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. In total, more than 20 potential problem areas were identified and geo-located. The data sheets for all of the problem areas identified in Georgia are provided in Appendix C of this report.

4.2. Evaluation of Problem Areas

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

Each problem area was given a score, with the intent of generally assessing the severity of existing problems, removing low priority problem areas from the dataset, and providing general guidance on the relative order in which the problems should be addressed when considered town-wide. 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 14 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, six conceptual solutions were developed – addressing eight of the 14 high-priority problem areas. Each of the conceptual solutions is described in the following sections, while the complete analyses are presented in Appendix E.

4.3.1. Intersection of Routes 7 and 104A/Deer Brook Gully

A collection of treatment opportunities is concentrated along U.S. Route 7, near the intersection with Route 104A to the south of the I-89 interchange. This area is drained by a system of roadside ditches and storm sewers. The outfall from this system is at the head of the “Deer Brook Gully”, a known, significant problem area that the Northwest Regional Planning Commission assessed and documented in 2007 (EPSC et al. 2007). The report describes the condition of the gully, linking its deterioration to excessive stormwater flows from upland impervious areas. The report provides a design for mitigation of the erosion problem. The report also provides general recommendations for stormwater treatment practices (STPs) that could be implemented to reduce stormwater impacts. Additional development and redevelopment has occurred in the watershed since this report was completed.

This conceptual project builds on the recommendations of the Deer Brook Gully report. Specific areas are identified for treatment practices based on existing conditions, expected development, ease of design and construction, and expected performance potential. Proposed efforts could be divided into two larger projects:

- Retrofitting the existing roadside drainage systems to provide treatment of stormwater from the road surface, and
- Addressing stormwater from private property – specifically the existing medical building and, potentially, untreated areas of the Georgia Market parking lot.

4.3.1.1. U.S. Route 7 Roadside Drainage

Multiple treatment opportunities exist along U.S. Route 7. The roadside ditches along this stretch of road are rather deep. Existing catch basins and driveway culverts could be retrofitted with flow-control devices; the roadside ditches, given their depth, could provide significant storage of stormwater. Further gains could be achieved by enhancing infiltration capabilities in these areas. Potentially suitable locations for retention and infiltration practices along Route 7 are shown below in Figures 1, 2 and 3.

Figure 1. Treatment opportunities along U.S. Route 7 near the Georgia Market Property.

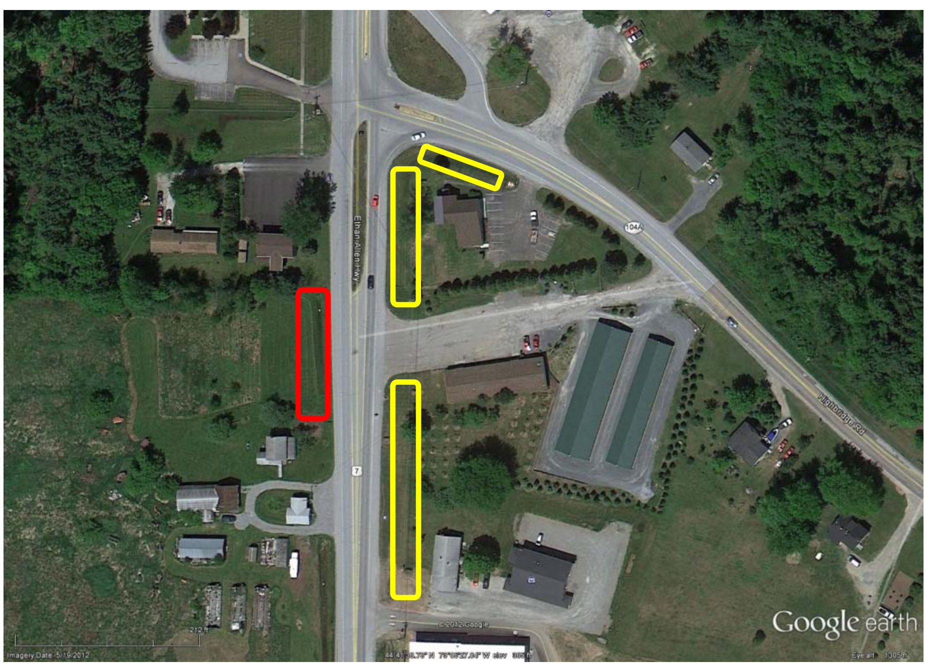

Figure 2. Potential stormwater treatment areas along U.S. Route 7 and VT Route 104A north of the Georgia Market property.

Figure 3. Potential location for stormwater treatment along the west side of Route 7, north of VT Route 104A, between the People's Trust Bank and the Mobil gas station.

4.3.1.2. Georgia Eye Center / Northwestern Occupational Health Building

The building housing the Georgia Eye Center and Northwestern Occupational Health includes approximately one acre of impervious area, which is nearly 50% of the parcel. Impervious surfaces include the building roof, sidewalk, and asphalt parking area. The roof is drained by gutters with downspouts connected to the stormwater drain. The parking lot is drained by two catch basins (one within the asphalt footprint and one in the lawn). These two catch basins drain approximately one third of the impervious surface. The remainder of the roof top and parking lot drain to a grass swale that flows along the perimeter of the property.

USDA-NRCS Soil Surveys report Deerfield loamy, fine sand. Treatment potential for this property is quite high, given the well-drained soils, space for treatment practices, and existing infrastructure suitable for retrofitting. As highlighted in Figure 4, below:

- Roof runoff could be treated by redirecting the existing downspouts to route stormwater through rain gardens or similar soak-away practices (shown in green on Figure 4).
- Runoff from the parking lot could be treated with bioretention basins designed to encourage infiltration (shown in yellow on Figure 4).
- The grass swale which flows clockwise from the southern end of the parking lot to the roadside ditch at the northeast corner of the property could be retrofitted with concrete weirs or check dams, and flow control apparatus to enhance infiltration (shown in orange on Figure 4).
- An additional or alternative stormwater treatment option would be to create a bioretention/infiltration basin or similar structure at the north end of the property between the

existing stormwater outfall and the existing roadside ditch along the west side of Route 7 (shown in red on Figure 4).

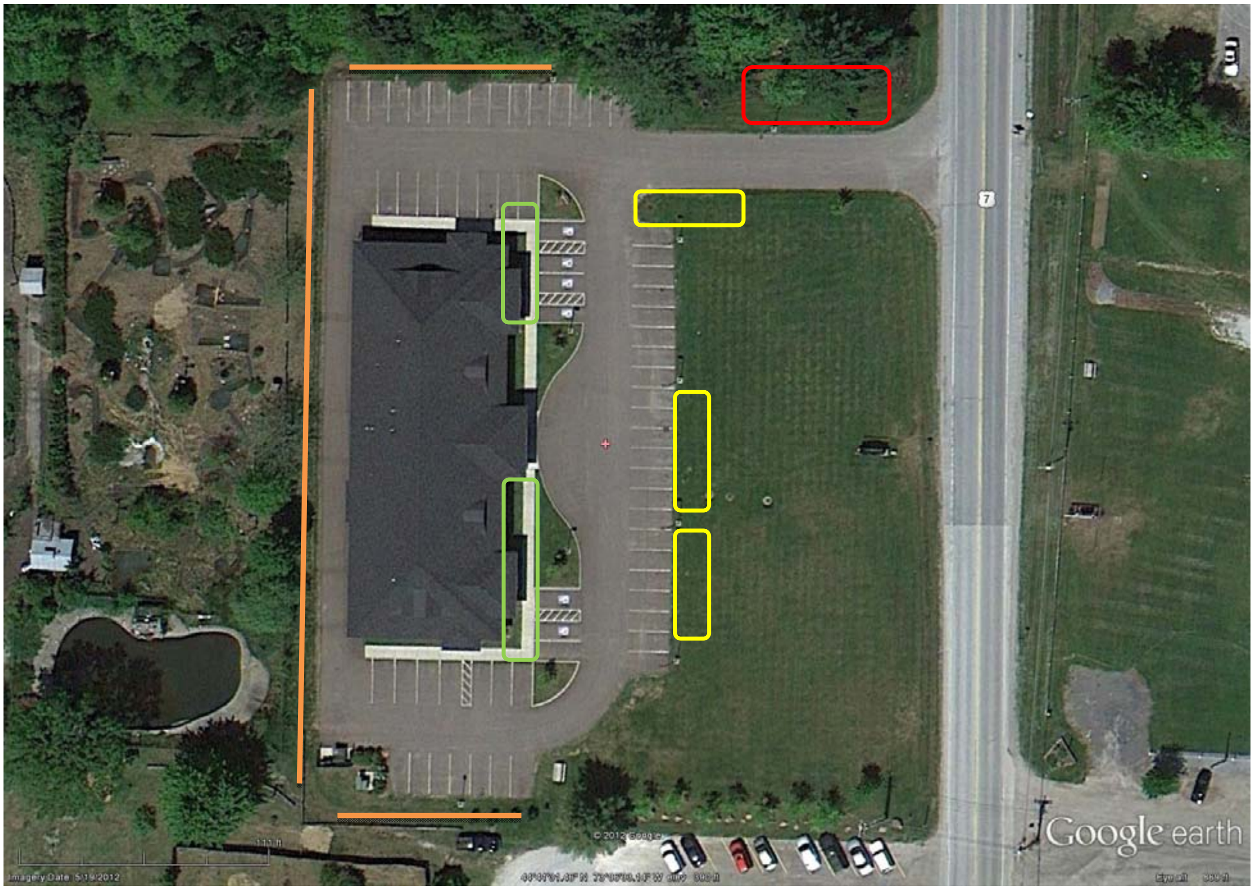

Figure 4. Potential treatment opportunities at the Georgia Eye Center / Northwest Occupational Health Building.

4.3.2. Lakeview Terrace

Stormwater draining along Lakeview Terrace from south to north discharges from the roadside ditch between the Red Barn Storage property and the neighboring property to the west (Figure 5). Where the channel turns west, away from the road, a significant scour hole approximately 7-8 feet wide and 3-4 feet deep has developed. Eroded soil is conveyed with stormwater along the Red Barn Storage property before crossing under Rte. 7 and flowing to Arrowhead Mountain Lake via a small tributary. Two potential solutions are shown on Figure 5:

- Repair and reinforcement of the scoured channel would reduce sediment loads downstream. Installation of a STP such as a bioretention basin, in the existing roadside ditch along the hedge row (upstream of the scour hole) would improve water quality and also prevent future erosion or scouring of the channel.
- An alternative or addition to a solution along Lakeview Terrace is to locate a treatment practice encouraging infiltration along the southern border of the Red Barn Storage property. Locating the treatment practice here would increase the land area potentially available for infiltration.

Figure 5. Red Barn property and surrounding neighborhood. Location of existing scour hole shown in red. Potential STP locations shown in yellow and orange.

4.3.3. Oakland Station Road- Mill River Box Culvert

Significant streambank erosion is occurring at the Oakland Station Road- Mill River crossing. Mill River crosses under Oakland Station Road via a concrete box culvert just south of Conger and Loomis Roads. Unmanaged road runoff is causing erosion behind the southeast wingwall (Figure 6), and past stabilization attempts appear to be failing. Erosion from this source could be minimized with improved management of road runoff coupled with bank stabilization that includes properly sized riprap keyed-in below the scour depth of the stream bed.

The outlet of the box culvert drops steeply to a scour pool. This appears to be a barrier to aquatic organism passage. If this blockage is truly blocking the passage of fish and other aquatic organisms, retrofit options should be considered to improve the connectivity of the stream by lessening or removing the drop between the box culvert and the scour pool below. A tail-water control structure, such as a rock weir at the end of the scour pool, can raise the pool surface to create better passage conditions.

This structure appears to be in serviceable condition. However, when this box culvert reaches the end of its service life, it should be replaced with a structure that meets current State of Vermont design standards. This will help ensure sediment transport equilibrium, reduce erosion hazards, and maximize the ecological integrity of this road-stream crossing.

Figure 6. Failing slope near inlet to box culvert over Mill River on Oakland Station Rd.

4.3.4. Rugg Brook Bridge on Mill River Road

The Rugg Brook-Mill River Road bridge, just east of Bronson Road, consists of a concrete slab resting on two stone-masonry abutments (Figure 7). The span between abutments is narrower than the bankfull width of the stream. At elevated flow rates, this causes increased velocities, leading to erosion of the stream bed and banks, as evidenced by a large scour pool that has formed downstream of the structure. The existing structure appears to be approaching the end of the service life, with undercutting apparent beneath the abutments and deterioration of the stone masonry. When the structure is replaced, the new structure should be constructed with sufficient length to allow unimpeded flow of the stream at bankfull conditions. Designing the bridge with adequate length ensures sediment–transport continuity and maximizes ecological integrity of the road-stream crossing, while creating a flood resistant structure that requires reduced maintenance over its service life.

Figure 7. Deteriorating stone abutments of Mill River Rd. bridge over Rugg Brook.

4.3.5. Industrial Park

The Georgia Industrial Park contains a large amount of impervious area. This property is served by permitted stormwater treatment facilities that include dry wells and dry ponds. Soils at the Industrial Park are dominated by sands (hydrologic soil group A), so any stored runoff is likely to quickly infiltrate. Although it would be relatively straightforward to retrofit these facilities, it is unclear whether they routinely discharge or if any stored water simply infiltrates. Before proceeding with retrofits, the facility should be monitored to evaluate the frequency of discharge following storm events, with particular attention given to the detention pond highlighted in Figure 8. There are several low cost/low-tech means for evaluating whether an overflow event occurs, including placing small wood blocks in the outfall that would be washed away during an overflow event. If evidence of significant discharge is found, opportunities can then be assessed to improve treatment by modifying the existing facility, or by slowing or infiltrating stormwater closer to the source.

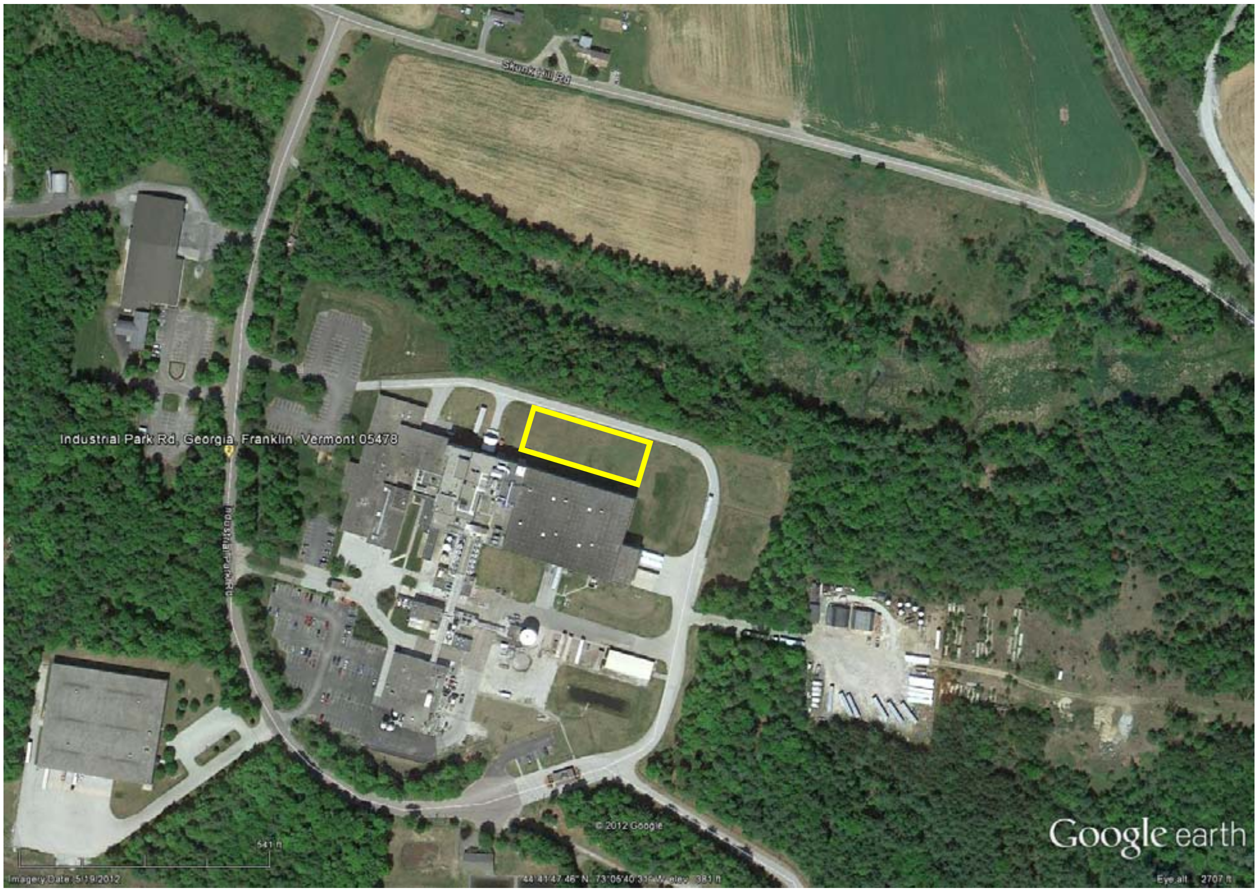

Figure 8. Georgia Industrial Park off Skunk Hill Rd. Detention area is highlighted in yellow.

4.3.6. Cedarwood Terrace

Stormwater-related issues reported during the March 7 kick-off meeting were investigated in the area of Cedarwood Terrace (Figure 9). While on site, one local land owner cited significant erosion of the road shoulder, claiming there was once enough room to park a vehicle where there is now only a few feet of space between the road and channel side-slope. Two compromised culverts were found under driveways providing access to two abutting private residences; there is some evidence of on-going erosion around the culverts.

The root cause of stormwater issues in this neighborhood is increased volume and flow attributable to increased impervious surfaces associated with development. Opportunities for stormwater treatment practices on public land or rights-of-way in the Cedarwood Terrace and Manor Drive neighborhoods are limited. Participation from private homeowners through implementing practices such as rain gardens or pervious pavement would help reduce stormwater impacts and improve water quality.

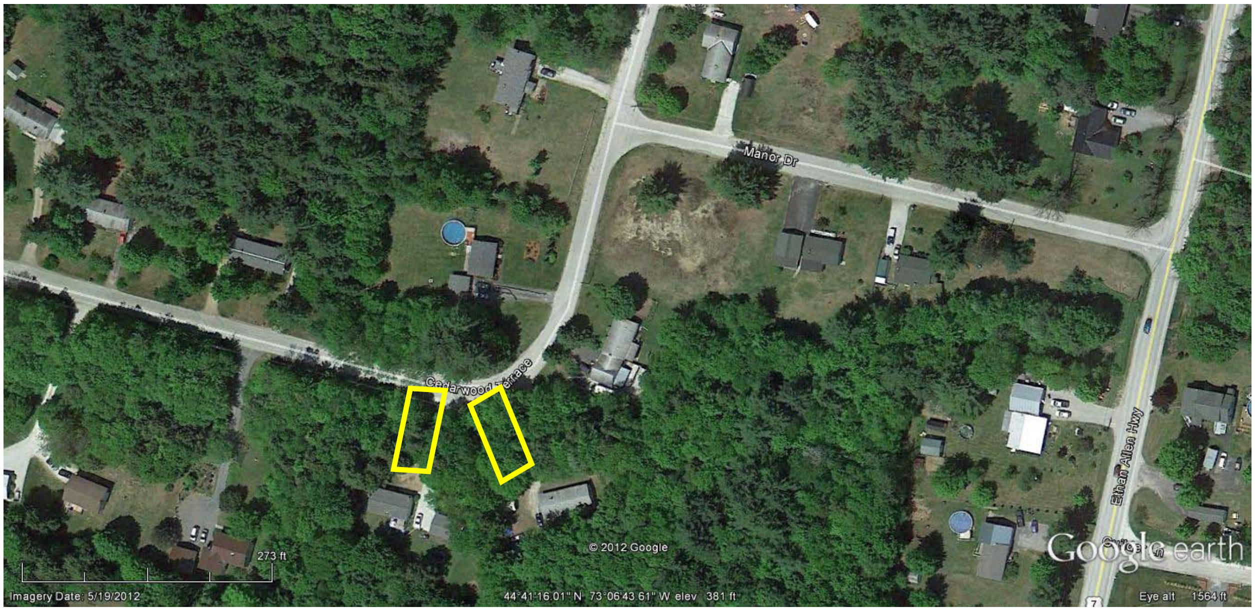

Figure 9. Compromised culverts conveying stormwater under private drives on Cedarwood Terrace, highlighted in yellow

5. NEXT STEPS

This document represents an extensive effort to identify and evaluate potential stormwater problem areas throughout the Town of Georgia. Several high priority potential stormwater improvement projects were identified that the Town could either pursue directly, or could work with local landowners to address.

Recognizing that resources are key to seeing these projects implemented, the Friends of Northern Lake Champlain (FNLC) applied for and received a grant from VTDEC to support the design and implementation of at least one of the high priority problem areas described in Section 4 above. FNLC plans to focus their implementation efforts on the suite of treatment opportunities concentrated along U.S. Route 7, near the intersection with Route 104A, south of the I-89 interchange. VTrans is responsible for a significant amount of the impervious surface in this area (and thus is also responsible for a substantial proportion of stormwater runoff generated in this vicinity, see Section 4.2.1), but also owns land available for potential treatment. FNLC has made initial outreach efforts to VTrans and will continue to pursue this opportunity with the intention of implementing improved stormwater management practices along Route 7 in late 2013.

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

- Require that a certain volume (i.e., the first ½ inch) of stormwater runoff be treated as part of all development and redevelopment projects;

- Use stormwater management as a tool to shape, generally, where and how development occurs – effectively creating incentives for redevelopment projects;
- Articulate a clear preference for practices that seek to infiltrate and soak away stormwater or use water as an aesthetic amenity in landscaping, as opposed to those that store and release stormwater runoff; and
- Create or enhance incentives to conserve and protect sensitive areas, minimize the creation of new impervious surface, and use landscaping practices and soil amendments to soak away stormwater.

Some specific examples of how this might be accomplished include:

- Modifying roadway design standards to minimize impervious surface and maximize the treatment of road runoff in the right-of-way (ROW). Widening the ROW to accommodate this sort of streetscape might necessitate reconsideration of setback requirements relative to the ROW—allowing houses to be constructed closer to the ROW, even if they are no closer to the street, because of the requirement for a wider planting strip.
- Revising parking standards to encourage minimal use of impervious surface and stormwater management in appropriately designed landscaping areas. For example:
    - Re-evaluating specified parking minimums to prevent the creation of surplus amounts of parking. This could involve establishing maximum parking requirements that closely mirror or are slightly less than current minimum parking requirements, and providing a minimum parking requirement that is anywhere from 20-80% of the maximum, depending on the associated use. Using a minimum and maximum effectively creates a range of acceptable parking requirements, providing the development community a chance to be more flexible and efficient in their design.
    - Establishing a default style for “planting islands” within parking lots as a stormwater treatment practice (collection and treatment area), and that requires parking lots be graded to drain towards the islands.

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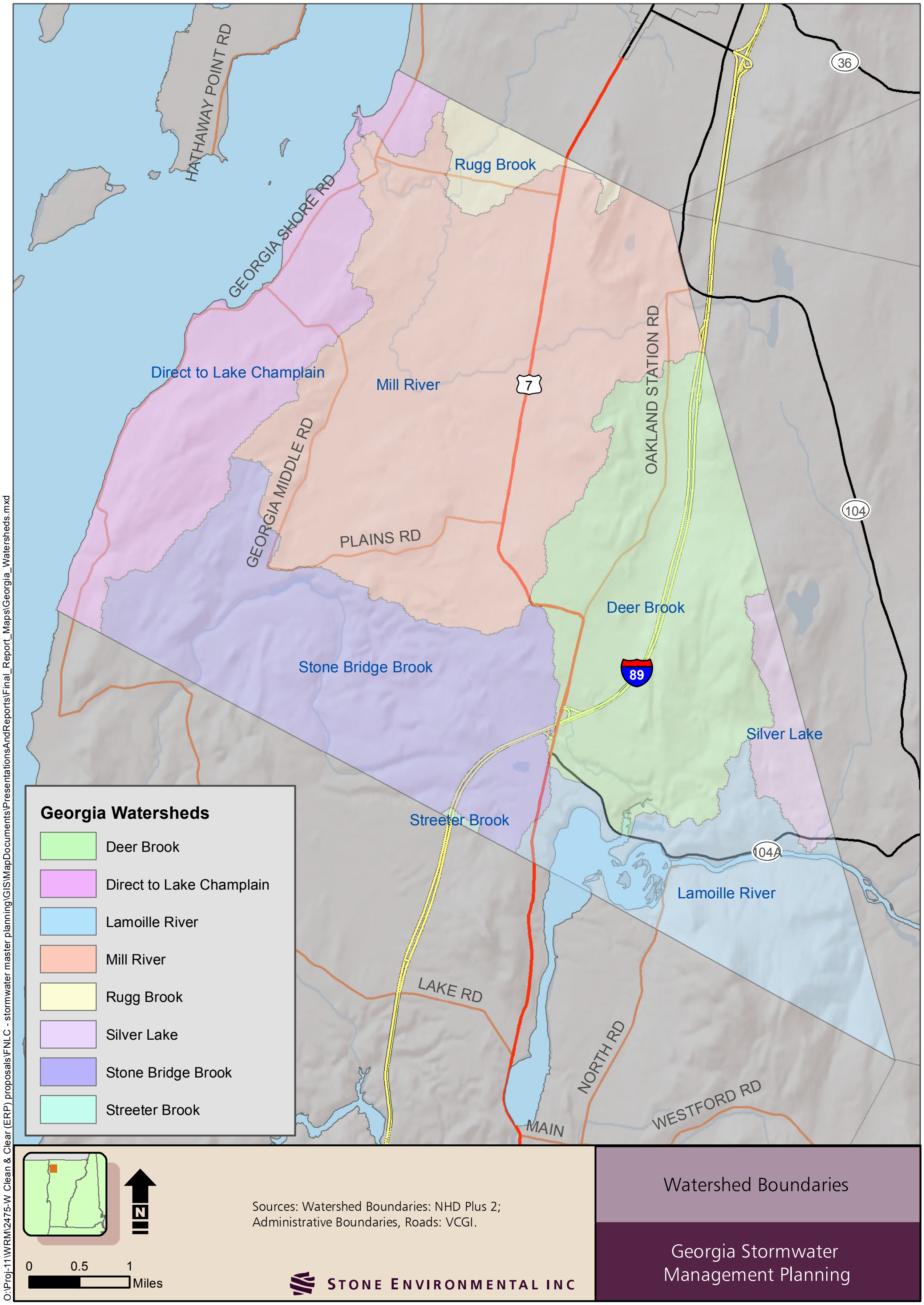
APPENDICES

APPENDIX A: WATERSHED MAP



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

APPENDIX B: STORMWATER MANAGEMENT PLANNING LIBRARY

STORMWATER MANAGEMENT PLANNING LIBRARY

TOWN OF GEORGIA, VERMONT

April 2, 2012

Revised January 21, 2013

Prepared for:

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STONE ENVIRONMENTAL INC

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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. For example, the main stem of the Lamoille River passes directly through ten towns and there are nearly twice that number which are partly or fully within the Lamoille watershed. 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, and 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 be located wholly within the Town of Georgia. It is hoped that this report will serve as the basis for developing a Georgia-specific list of strategic, prioritized projects that could be undertaken to improve water quality in and around the Town.

2. BACKGROUND

The Town of Georgia is located in Franklin County in northwest Vermont. Georgia has a total area of 45.2 square miles, and over seven miles of Lake Champlain shoreline. The population was 4,375 at the 2000 census but a more recent count puts the population at over 4,500 people[1]. Georgia has a number of rivers, streams and lakes within its boundaries. The Town of Georgia includes portions of the Lamoille River, Mill River and Rugg Brook, and all of Stone Bridge Brook, in addition to many smaller streams and brooks. Erosion is a major issue in Georgia's rivers, due in large part to unstable soil types and significant conflicts between rivers and road infrastructure.

The southwestern 1/3 of Georgia drains to Stone Bridge Brook, which drains directly to Lake Champlain; the southeastern most 1/3 of the Town drains to the Lamoille River, which eventually empties into outer Malletts Bay in Lake Champlain. Arrowhead Mountain Lake is located along the flowpath of the Lamoille River in the southeast corner of Georgia. It was formed by the construction of a dam along the river and is used as a water source for the Georgia Dairy Industrial Park as well as for recreational boating and fishing. Also flowing into the Arrowhead Mountain Lake is Deer Brook. Deer Brook originates in the area to the west of Cushman Hill on the eastern border of Georgia.

The Mill River also drains portions of the Town of Georgia; the river originates near the St. Albans Reservoir and flows out into the St. Albans Bay. The Mill River is considered to be an "impaired" waterbody, meaning it does not currently meet water quality standards[2]. The state has identified the pollutants of concern as sediment, nutrient, and *E. coli* bacteria, and has attributed these pollutants primarily to agricultural runoff and streambank erosion. Eventually the State of Vermont will develop a TMDL (total maximum daily load) or

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[1] http://en.wikipedia.org/wiki/Georgia,_Vermont

[2] http://www.vtwaterquality.org/mapp/docs/mp_303d_final_approved_2010.pdf

pollution budget for the Mill River. Rugg Brook flows into the northwest corner of Georgia from St Albans Town and quickly confluences with Mill River, before draining into St Albans Bay. Rugg Brook originates on Bellvue Hill southeast of St. Albans City. There is a diversion structure on Rugg Brook in the City of St Albans, which shunts water from Stevens Brook to Rugg Brook during high flows, increasing the volume of storm flows for all reaches downstream.

Silver Lake and its tributaries are located in the Town of Georgia; a piping system carries water from the lake to the active drinking water supply reservoir for St. Albans. Silver Lake is surrounded by woodland, but its shoreline is not currently conserved.

The Town of Georgia also has a significant amount of frontage along Lake Champlain – nearly seven miles of shoreline. Portions of Lake Champlain, including St. Albans Bay, show profound effects of on-going sediment and nutrient pollution including recurrent algae blooms and nuisance plant growth. A 2007 basin-wide study of the sources of pollution in Lake Champlain found that the stormwater runoff from developed areas and agricultural runoff are the primary sources of Lake Champlain pollution[3].

It should be noted that the Georgia Zoning Regulations require a fifty (50) ft buffer from the edge of the waterways and a "no development" buffer of two hundred (200) feet along Deer Brook and Arrowhead Mountain Lake.

Numerous and varied groups and individuals have invested considerable effort in evaluating different components of Georgia's water resources, and the important interface between water resources and local land use decisions. At times these evaluations have followed watershed boundaries and at other times they have followed political boundaries. The following sections identify evaluations that have been done to date and pull out the pieces 1) most relevant to the Town of Georgia 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 Georgia.

3. WATERSHED-BASED ASSESSMENTS

The assessments described below are generally led by the Agency of Natural Resources. 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. There are two basin plans that cover different areas within the Town of Georgia.
- 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 the Town of Georgia: Stonebridge Brook, Deer Brook and Mill River.

[3] http://www.lcbp.org/techreportPDF/54_LULC-phosphorus_2007.pdf

- In-stream water quality assessment work, including biological assessments. At least one year of assessment data has been collected at more than 20 different locations within the Town of Georgia.
- Stormwater infrastructure mapping completed by VTANR in February 2012, and the Illicit Discharge Detection and Elimination survey which is ongoing (completion expected in 2013).

3.1. Lamoille River Basin Water Quality Management Plan, ANR/DEC/WQD, 2009[4]

The Lamoille River Basin Water Quality Management Plan identifies water resource concerns within the more than 700 square miles of Vermont that drain to Lamoille River, and identifies opportunities for sustaining and improving water quality and aquatic habitat.

The Lamoille River Basin Water Quality Management Plan was finalized by VT ANR in 2009. The Plan includes 70 action items to protect high quality waters and remediation strategies to improve water quality and aquatic habitat concerns. The Plan's primary focus is addressing nonpoint source pollution threats to surface waters, wetlands, lakes and ponds, and streams throughout the Lamoille watershed.

Since 2010, ANR's Watershed Management Division has begun revising the 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 Lamoille Basin Plan when it is next revised – the revision is currently scheduled to take place in 2013.

The 2009 Lamoille River Basin Plan identifies specific action for Deer Brook in Georgia, as described below.

3.1.1. Deer Brook, Georgia

DEC identified the following implementation priorities specific to the Deer Brook watershed portion of Georgia:

- Replace or repair two interstate culverts that are corroded, are being undermined, and appear to be a source of iron and sediment pollution in Deer Brook;
    - VTrans has completed temporary repairs to one of the interstate culverts
- Gully stabilization, and stormwater best management practice implementation throughout the watershed; and
- Inventory landslide hazard areas within Deer Brook watershed.

[4] http://www.vtwaterquality.org/planning/docs/pl_basin7.finalplan.pdf

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

In addition, the Plan identifies the need to *assist the Town of Georgia with changes to the town plan and zoning ordinances in recognizing the inherent risks to developing within erosion hazard areas.*

3.2. Northern Lake Champlain Direct Drainages Water Quality Management Plan[6]

There are portions of the Town of Georgia that fall outside the Lamoille River watershed and thus are not covered by the Lamoille River Basin Water Quality Management Plan. These areas, such as the Mill River watershed, drain directly to Lake Champlain and are therefore included in the Northern Lake Champlain Direct Drainages Water Quality Management Plan ("Basin 5 Plan"). The Basin 5 Plan includes areas draining directly to the Lake from the Ferrisburgh and Charlotte town line and ending at the Canadian border, and all Vermont surface waters excepting three major river watershed that drain directly into this section of the Lake: the Missisquoi, Winooski and the Lamoille river watersheds.

The Basin 5 Plan does not identify strategies specific to the Mill River, but rather outlines a series of broad-based strategies that could be considered. These include recommendations for enhancing efforts to: protect stream corridors, improve stormwater management, reduce agricultural pollution, and prevent the spread of aquatic invasive species.

3.3. Stream Geomorphic "Tactical" Assessments Phase 1 and 2

Stream geomorphic assessments have been completed for Stone Bridge Brook, Deer Brook and Mill River and compiled in a single report (NRPC 2008). The assessment results are designed to direct future stream corridor restoration and protection measures. The nature of each section of the watershed is characterized and each reach described. Potential restoration projects identified during this work with ties to stormwater management and/or high flows are listed and briefly described below by stream and stream reach; reach maps are included as Appendix A:

3.3.1. Stone Bridge Brook SGA Phase 1 and 2

- M06B – The upper portion of this segment runs through an active farm pasture, where there is evidence that animals are directly accessing the stream. Three culverts were assessed in this segment and all were found to be channel and floodprone. Significant undermining was noted on both ends of the downstream-most culvert, as well as the upstream end of the upstream-most culvert located in the pasture. Another hotspot of major erosion along this segment was located adjacent to a residence.

- M2S2.01C – Upstream logging and road runoff were noted as significant sources of sediment to the stream in this segment.

- M5S1.01B – The majority of this segment runs through farmland, and animal access to the stream was evident. One culvert below Ballard Road was assessed in this segment. The culvert was found to be a channel and floodprone constriction, and streambed scour was found to be undermining the culvert on both ends.

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6 http://www.vtwaterquality.org/planning/docs/pl_basin5.Finalplan.pdf

3.3.2. Deer Brook SGA Phase 1 and 2

- M01 – Moderate erosion and bank slumping were noted within the reach; however, the source of at least a portion of the accumulating sediment appears to be coming from the Georgia Industrial Park stormwater runoff, which enters the stream system in segment M02.
- M02 – The majority of the stream corridor is forested in this segment; however, moderate to high erosion was noted, and multiple mass failures were observed in bare areas, most consistently on the right valley wall, which is extremely steep. The Georgia Industrial park is located immediately adjacent to the right valley wall, and is likely responsible for a portion of the sediment input causing aggradation in this segment.
- M05 – Cows were not fenced out of the stream, and were observed crossing the stream near the barn. This segment lacked any significant riparian buffer.

3.3.3. Mill River SGA Phase 1 and 2

- M02 – One culvert was assessed on this segment, which was located below an inactive cobble road farm crossing. The culvert was found to be both a channel and partial floodprone constriction, with major scout occurring downstream.
- M03 – One culvert was assessed on Polly Hubbard Rd, and was found to be a channel and floodprone constriction. Additionally, the landowner indicated that flood waters back up behind the structure and flood his fields frequently.
- M04 – One culvert, below Polly Hubbard Rd., was assessed in this segment. Major deposition was noted upstream of the culvert, and major scour was noted at the downstream end of the culvert. Three bridges were also assessed in this segment; scour was found to be occurring below two of the structures.
- M06 – The culvert below the railroad crossing has a major alignment problem, and scour was observed on the upstream and downstream ends of the culvert.
- M07 – The problem area identified in this segment is immediately downstream of the Oakland Station Rd culvert, at the upstream end of the segment. The slope of culvert was much lower than the slope of the channel, and the culvert outlet was cascading to a pool below which was causing scour and undermining of the culvert.
- M2T2.01 – The bridge located below Polly Hubbard Rd in this segment was found to have deposition occurring above, scour below, and an alignment problem as the stream approaches the bridge. According to the property owner, the bridge cases flood water to back up during high flow events, and flood his farm fields and sometime run over the road.
- M2T2.06 – This segment is significantly influenced by the flow from a long run (~1,200') of tile draining an adjacent corn field. At the outlet of the tile, a large scour hole, approximately eight feet high was observed.
- M2T2.1S1.1S1.01 – One stormwater input from a roadside ditch was noted on the downstream end of the Montcalm Rd culvert. Culverts crossings under Montcalm Rd and Georgia Middle Rd

were also assessed. Major erosion was noted downstream of the Georgia Middle Rd culvert. The stream was found to be dry upstream of the Montcalm Road culvert, and sediment accumulation has blocked the bottom half of the culvert.

- M2T2.2S1.03 – There is one stormwater input from Reynolds Rd, and the segment appears to be responding to the stormwater input by incising. The upstream portion of the segment runs through a newly cleared pasture. There is no buffer, major erosion, and many signs of animal access were observed.
- M2T2.2S1.04 – Two major stormwater inputs were observed: the first located just upstream of the Plains Rd culvert and the second is a stormwater drain tied into the Route 7 culvert. In addition, the culvert located below Plains Rd appeared to be in poor condition, with streambed scour causing undermining of the culvert on both ends.
- M2T2.2S1.S2S.01B – This segment has residential activity in the left buffer, and there were two stormwater inputs noted.
- M2T2.2S1.3S3.01 – An adjacent property owner indicated that the culvert located across a private drive just upstream from Towns Common Rd frequently plugs with sediment and causes flooding during high rainfall events. According to the property owner, this sediment accumulation has only been occurring since new home construction has increased on Carpenter Hill Rd, and did not occur when the land was in agricultural use. Additionally, in the upstream portion of the segment, the culvert below the field crossing was found to be severely undermined by scour. Four stormwater inputs were also noted along the segment including road runoff ditches and foundation drains.

3.4. Lake Champlain Long-Term Water Quality Monitoring Program

The Lake Champlain Long-Term Water Quality and Biological Monitoring Program began in 1992 and has continued each year since then. The project is conducted by the Vermont Department of Environmental Conservation (DEC) and the New York State DEC, with funding provided by the Lake Champlain Basin Program and the two states. The program includes 22 monitoring stations spread throughout the basin; in 2010, a USGS gaging station was installed on the Mill River.

3.5. Ambient Biomonitoring Data (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 same time. ANR is able to use this data to assess impacts of: wastewater treatment plants, acid rain, agricultural practices, and the removal of stream side vegetation. In Georgia, biomonitoring data has been collected from the Mill River, Deer Brook, Lamoille River, and Stone Bridge Brook; the data are summarized in the table below.

Location	SiteID	River Mile	Date	Assessment
Deer Brook	460600000016	1.6	8/1/1990	Poor
Deer Brook	460600000016	1.6	9/18/1990	Poor
Deer Brook	460600000020	2.0	9/18/1990	Poor
Deer Brook	460600000020	2.0	10/19/1999	Fair
Deer Brook	460600000020	2.0	10/9/2002	Fair/Poor
Deer Brook	460600000020	2.0	9/16/2003	Fair
Lamoille River	460000000157	15.7	9/29/1992	Excellent
Lamoille River	460000000157	15.7	10/19/1993	Excellent
Lamoille River	460000000157	15.7	9/25/2007	Excellent
Mill River	440000000007	0.7	10/18/1989	Good
Mill River	440000000007	0.7	7/31/1990	Good/Fair
Mill River	440000000007	0.7	9/18/1990	Very Good
Mill River	440000000007	0.7	9/5/1991	Poor
Mill River	440000000007	0.7	10/20/1998	Good
Mill River	440000000007	0.7	10/21/1999	Fair
Mill River	440000000007	0.7	10/15/2002	Fair
Mill River	440000000007	0.7	10/5/2004	Good
Mill River	440000000007	0.7	10/19/2009	Fair
Stone Bridge Brook	450000000055	5.5	9/22/2003	Fair

In addition, Fish Data: Data was available for the Mill River from 1992 and 2006 at river mile 0.7. The first 1992 community assessment rated as “Fair” but the subsequent assessment in 2006 was rated as “Poor”.

3.6. Lake Champlain Phosphorus TMDL

In early 2011, EPA withdrew their 2002 approval of the Vermont portion of the Lake Champlain TMDL for phosphorus. In reversing their decision, EPA noted that two elements of the TMDL did not comply with EPA regulations and guidance. Specifically, EPA found that the TMDL did not provide an adequate “margin of safety” to account for uncertainty in the true capacity of the lake to accommodate phosphorus pollution, and did not offer “reasonable assurances” that the called-for reductions in non-point source pollution would actually be achieved.

EPA has specifically noted that the 2002 TMDL allowed most of Vermont’s wastewater treatment facilities to have effluent phosphorus concentrations “well above levels that would otherwise be required in the absence of nonpoint source load reductions”. This statement suggests that additional phosphorus removal requirements for wastewater treatment facilities are likely under consideration. In addition, EPA has indicated their intention to treat MS4s as “point sources” in the revised TMDL. Other changes that EPA may be contemplating are less clear, but could involve:

- Requiring more communities to obtain MS4 (municipal separate storm sewer system) permit coverage. Currently MS4 designations are confined to the more densely populated areas of Chittenden County, with Rutland City and Town and St. Albans City and Town being added with the new MS4 permit signed in December 2012.
- Expanding the use of "residual designation authority" to require larger developed tracts to install stormwater management systems and obtain permit coverage.
- Requiring agricultural operations to obtain additional permit coverage beyond the medium-farm or large-farm operation (MFO or LFO) permits currently issued by the Agency of Agriculture.

4. MUNICIPALITY-SPECIFIC ASSESSMENTS

In addition to the watershed-based assessments, there are a number of pieces of data that are developed on a municipality-by-municipality basis that 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 the Town. These include: direct feedback from the Town, work by the Agency of Transportation, as well as past and current planning initiatives.

4.1. Town Feedback

During a meeting with the Town on March 7, 2012 a list of potential problem areas was identified. These include both areas where there are current concerns, such as localized flooding or erosion, and areas of future concerns particularly where new development may be concentrated. A series of maps was developed following the meeting; the numbers alongside the descriptions below correspond to location numbers on the maps.

4.1.1. Georgia VT—Exit 18 Map (Figure 4)

1. Flooding in the area of Manor Dr. as well as flooding and erosion on Route 7 between I-89 and Ballard Rd.
2. Proactively and comprehensively evaluating the potential stormwater/water quality impacts that future development in the "South Georgia Village" growth center could have, and evaluating strategies that could be employed to minimize any effects.
3. GIDC (Georgia Industrial Dairy Corp) and Bryce industrial areas. Need to assess the willingness of these private landowners to participate in projects and to potentially implement future (voluntary) stormwater controls.
4. Erosion along Georgia Mountain Road due to steep slopes, and streambank failure at the Lamoille River bridge crossing.
5. Ditching along Nottingham Dr; subdivision was an orphan stormwater system and the Town is a co-permittee.

4.1.2. Georgia Shore Map (Figure 5)

1. Georgia Shore Road, near the Mill River crossing. An area of streambank upstream from bridge collapsed in 2008; although the site did not experience further failures during the 2011 flooding, the bridge is a concern. A hazard mitigation grant application is being prepared (due March 16) to support implementation of stabilization measures designed by ANR.

2. Shoreland erosion along Georgia Shore Road attributable to the conversion of summer camps to larger homes and/or year-round residences along shoreline, and the attendant removal of shoreland vegetation. Educational component is an important aspect to include.

4.2. VTrans-sponsored Programs

4.2.1. Bridge and Culvert Inventory Data

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 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. Specific concerns that have been identified in the Town of Georgia include:

- Culvert on Oakland Station Rd over Deer Brook with notes about poor location and alignment. Rating states that the stream approach to this structure is a sharply angled bend and that there is avulsion following the road (erosion beyond the road). Further notes state that there is structure related damage due to erosion of the adjacent property, there is an inlet obstruction present, the structure is poorly located/aligned, and the floodplain is entirely or partially filled by roadway approaches.

- Bridge on TH45 over Deer Brook showing that the stream approach angle is a sharp bend and could be unstable. Other notes state that there is a potential failure due to ice or debris jam, there is structure related damage due to erosion of the adjacent property, the inlet is obstructed, the structure is poorly located or aligned, and the floodplain is partially or fully filled by roadway approaches.

4.2.2. Better Backroads

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

4.3. Georgia Town Plan 2011

Georgia’s Town Plan both generally recognizes the important role that the physical setting of the town plays in determining areas most suitable for development (e.g., “to protect private and public investment and maintain the natural environment by considering topography and geology when determining land use.”) and also identifies a handful of potential projects of importance to the Town that might also be able to incorporate improved stormwater management for a relatively small incremental cost. For example, potential road improvement projects identified in the Town Plan that might be well-suited to incorporate stormwater planning include:

- Transportation Facilities Recommended for Improvement: Sand Hill Road (TH #33) is being used more and more as a Minor Arterial for residences off Stonebridge Road to access the Interstate.
- Oakland Station Road (TH #4) is used extensively by residents of other towns as a Minor Arterial to access Route 7 and hence the Interstate.
- Upgrade all Y-shaped intersections including: Carpenter Hill Road (SA #4), Plains Road (SA #2), and Middle Road (SA #3)

The Town Plan also identifies areas in Town where development is planned or expected to occur in the future. Understanding this plan is important in terms of stormwater management, because it identified potential areas where increased construction related runoff as well as a permanent increase in impervious surface are likely to occur. Further, the impacts of stormwater runoff tend to be considered on a project-by-project basis. It is the cumulative impacts of stormwater runoff, however, that can be the most significant. An upfront and comprehensive evaluation of stormwater management in an area of anticipated development can help diminish the potential water quality impacts.

Areas within Georgia that have been identified as locations where development is planned/expected include:

- Georgia South Village is planned to be a mixed use (residential, commercial, businesses, professional, public spaces) area just off I-89 by following these methods:
  - Requiring buildings to be 2-3 story, minimum.
  - Establishing a zero front setback minimum and 15-ft front setback maximum.
  - Establish design criteria and standards that support appropriate design, scale, connectivity and architectural detail that will create a village with a unique sense of place.
  - Requirements for amenities include pedestrian access, street trees and outdoor lighting.
  - Requiring parking to the side or rear of a building.
- Development in Georgia Center is following the plan laid out in 2003 by Lamoureux and Dickinson; plans include future expansion of municipal and school facilities, multi-family and senior housing, and modest commercial space
- It is anticipated that more residential development may occur in the Georgia Plains area

4.4. Town of Georgia Zoning Regulations

Georgia's zoning regulations for the South Village Core include specific guidelines related to erosion control and stormwater management. Specifically, the guidelines encourage developers to incorporate low impact development techniques into plans for stormwater management and highlight the use of bioretention areas and permeable pavement (Town of Georgia, 2010).

4.5. NRPC Build-out Analysis: Georgia, 2006[7]

The Northwest Regional Planning Commission conducted a build-out analysis for communities along the I-89 corridor, including Georgia, in 2006. The analysis found:

- A total of 1,625 potential new units in Georgia, with the largest and most dense area of projected and existing residential development by Exit 18 of I-89, as well as in Georgia Plains, Georgia Center, and by Bronson Road and Mill River Road (23 percent of potential new units are located in these areas).

The analysis also included recommended changes/improvements to municipal regulations and services in order to support build-out. These include:

- Zoning Bylaws, Subdivision Regulations, Highway Department.
- Road Standards, Inventories/Analyses, Local Capacity.
- Highway Access Policies, Municipal Water System, Municipal Wastewater System, Storm Water Utilities, Law Enforcement

4.6. Georgia Wastewater Feasibility Studies 2005[8]

This report evaluated a suite of wastewater treatment options for the Town of Georgia, water supply alternatives, and suitable soil locations for wastewater disposal. It is important to understand where areas of "suitable soils" are for two reasons:

- Soils that are suitable for wastewater disposal also tend to be suitable for stormwater infiltration practices; and
- Stormwater infiltration practices and wastewater disposal may end up "competing" for the same soil resources, and therefore it is important to understand the full suite of potential uses for a particular piece to ensure that it is put to the best and highest use.

The report found that in the Historic Village and the Town Center, the majority of the soils are not suitable for conventional onsite wastewater treatment, most often because of shallow groundwater tables. The report did identify a few pockets of soils suitable for conventional systems just southeast of the Village, and noted that the area south of I-89 and east of Route 7 contain well drained soils suitable for conventional systems. The following figures from the wastewater feasibility study may be helpful in considering potential locations for stormwater infiltration:

- Figures 5 and 6 show the results of the GIS analysis results related to area requirements, depth to bedrock, and depth to high groundwater.

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[7] http://www.transportation-landuse.org/downloads/NRPCreportGeorgia.pdf

[8] http://tinyurl.com/745cy2b

- Figure 9 shows areas suitable for wastewater treatment as onsite, offsite or cluster treatment systems in Georgia Center.
- Figure 13 shows areas suitable for wastewater treatment as onsite, offsite or cluster treatment systems for the future South Georgia Village.

4.7. Environmental Research Tool[9]

ANR's Environmental Research Tool allows the user to look-up the location of hazardous waste sites, brownfields, spills, as well as the location of stormwater permits that have been issued by ANR. There are 91 documented stormwater permits that have been issued to sites in the Town of Georgia. Depending on the age, style, size and upkeep of an existing facility, it may be an excellent candidate for improvement to enhance its stormwater management capabilities.

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

APPENDIX A: FIGURES

Figure 1. Stone Bridge Brook Reach Map

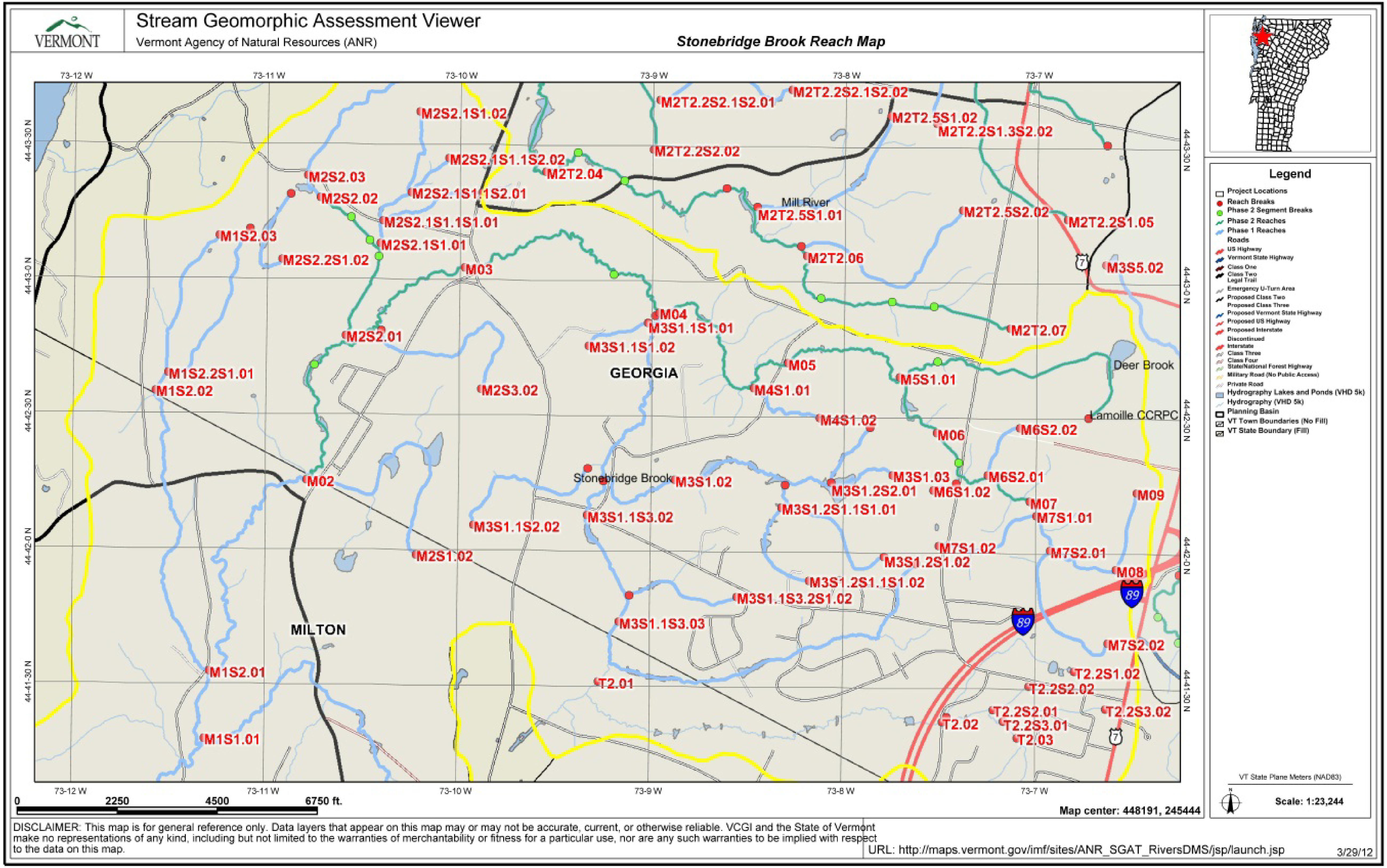

Figure 2. Deer Brook Reach Map

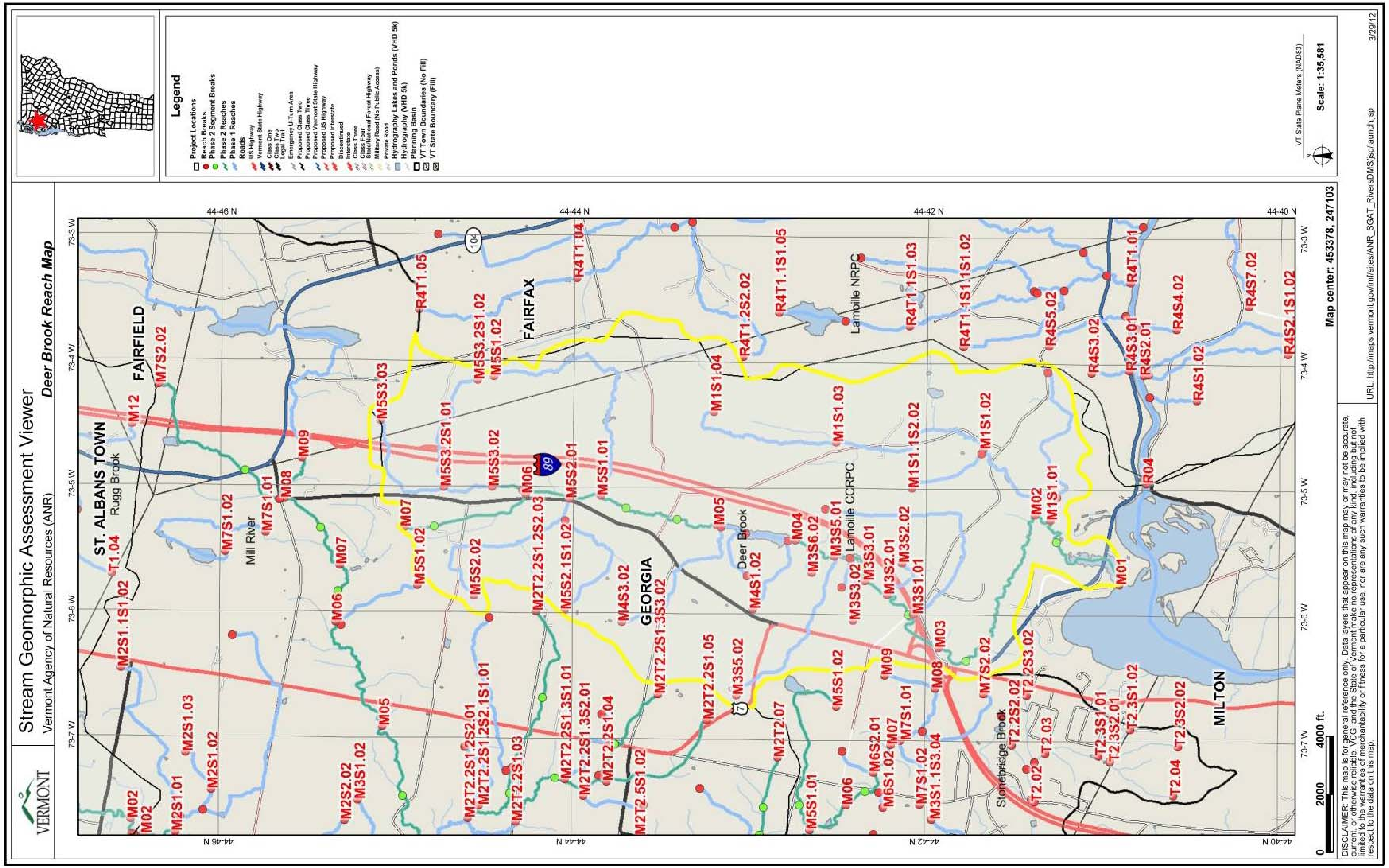

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Figure 3. Mill River Reach Map

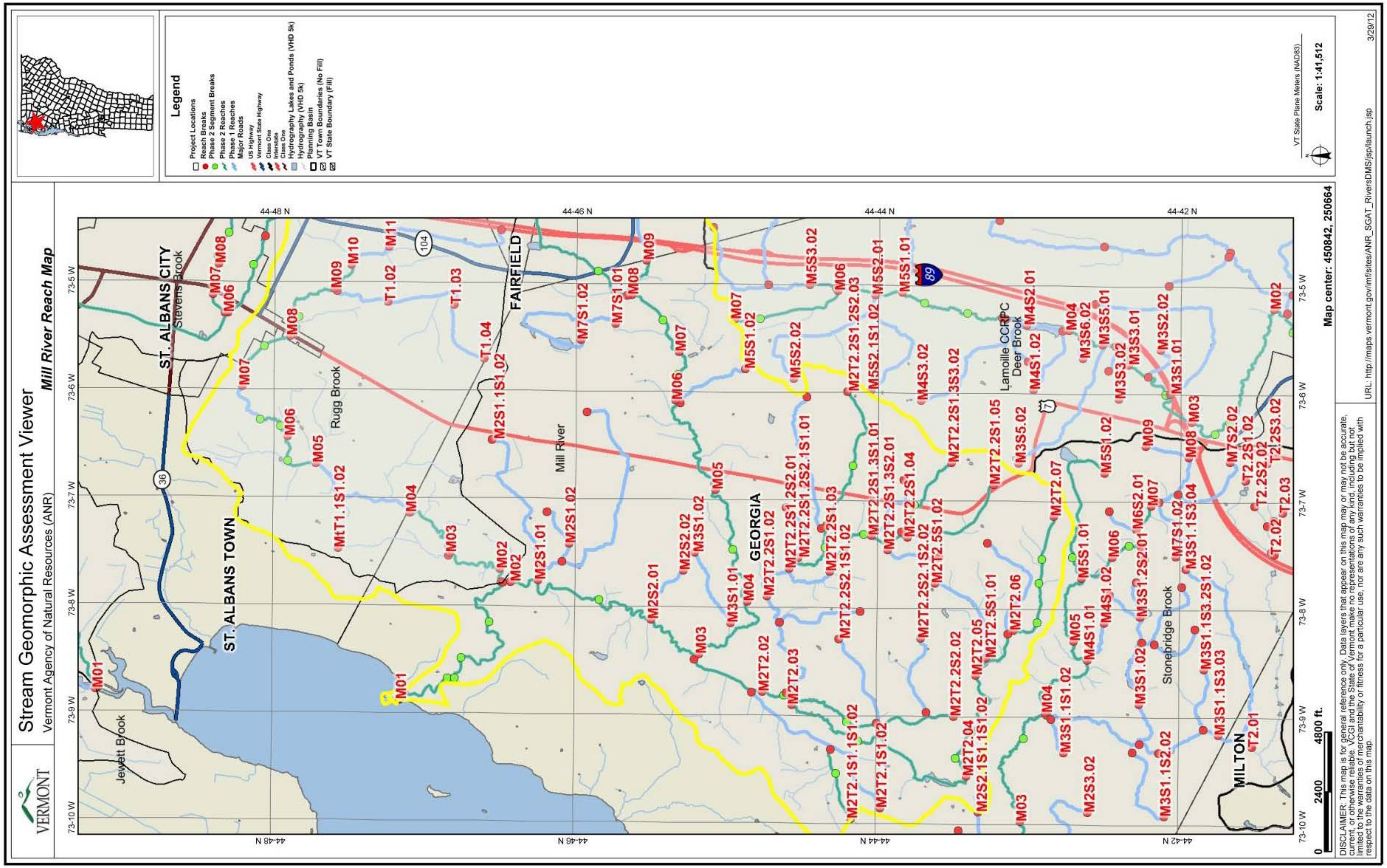

Figure 4. Areas of Interest, Georgia, VT, Exit 18

Georgia, VT - Exit 18

Georgia, VT

Sources: ESRI Imagery, DEC Stormwater Infrastructure

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Figure 5. Areas of Interest, Georgia Shore Map

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APPENDIX C: PROBLEM AREA DATA SHEETS

MEMO

STONE ENVIRONMENTAL INC

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SEI No. 112475-W, task 2

Re: REVISED Stormwater Problem Area Data Sheets for the Town of Georgia

Stone Environmental has combed through existing reports and also worked directly with the Town of Georgia 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 7th, kick-off meeting with Town Administrator
  - March 26th, Georgia Select Board reviewed preliminary problem area information and maps
  - June 12th, presentation to Georgia Select Board and Planning Commission
  - June 22nd, presentation at joint FNLC and Georgia Conservation Commission pig roast
- Targeted site visits to verify problems areas (May and June 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 Georgia 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 list of 6-10 high priority projects for implementation.

Problem Area Data Sheet

Problem Area ID: MR 5-3	Latitude: 44.737566 N	Longitude: 73.116219 W

Watershed: Mill River

Location: Reynolds Rd., just east of intersection with Route 7

Problem Type: Drainage/Culvert

Identification Source: Fluvial Erosion Hazard Mapping and Phase 2 SGA Report

Ownership: Local

Classification Level: 2b

Problem Description:

Stormwater pipe inputs along Mill River from road crossings and agriculture field drainage ditches causing incision and stream departure.

Date of Field Data Collection: 5/16/2012

Field Photos

Photo 1. Culvert deterioration, downstream end

Photo 2. Culvert, upstream end

Description of Observed Conditions:

Upstream armoring along banks with large rocks appears mostly sound. Undermining on north side of culvert along the entire length of the 5.5’ corrugated metal culvert. Culvert bottom is showing signs of deterioration. Erosion is present on road surface; shoulder of road is right on top of culvert (Photo 2).

Problem Area Data Sheet

Problem Area ID:	**MR 9-2**	Latitude: 44.736941N	Longitude: 73.115555 W

Watershed:	Mill River
Location:	Cadieux Rd., just east of intersection with Route 7
Problem Type:	Altered Geomorphology
Identification Source:	Fluvial Erosion Hazard Mapping and Phase 2 SGA Report
Ownership:	Local
Classification Level:	1 – geomorphology 3 – road runoff

Problem Description:

Gullies have formed along the roadside and are contributing sediment to Mill River. Significant erosion is occurring within this reach of the Mill River, attributed to historic channel straightening and increased flows associated with road runoff.

Date of Field Data Collection: 5/16/2012

Field Photos

Photo 1. Evidence of direct road runoff to stream

Photo 2. Looking up stream

Description of Observed Conditions:

Runoff from Rt. 7 is flowing along the west side of road and entering the stream above the downstream end of the box culvert (as shown in Photo 1). Signs of bank erosion upstream from Rt. 7 in reach running parallel to Cadieux Rd (Photo 2). Approximately 60' of bank erosion as stream winds through the woods. Downstream of box culvert that carries water under Rt. 7, water is ponding in scour pool. Bank erosion and side cutting beginning to occur around downstream armor.

Problem Area Data Sheet

Problem Area ID: **MR 5-1**

Latitude: 44.729005 N

Longitude: 73.117419 W

Watershed: Mill River

Location: Route 7, north of the intersection with Plains and Carpenter Hill Rds

Problem Type: Local Drainage

Identification Source: Fluvial Erosion Hazard Mapping and Phase 2 SGA Report

Ownership: Local/State

Classification Level: 3

Problem Description:

Stormwater pipe inputs along Mill River from road crossings and agricultural field drainage ditches causing incision and stream departure.

Date of Field Data Collection: 5/16/2012

Field Photos

Photo 1. Drainage from agricultural fields

Photo 2. Rt. 7 drainage ditch

Description of Observed Conditions:

Blue-line stream has been straightened extensively, including an ~300' stretch that is serving as a drainage ditch along Rt. 7. Standing water was observed in drainage ditch (Photo 2). Some scour can be seen where heavy flows are concentrated, both upstream of and along Rt. 7. 24" black plastic culvert under S. Town Common Rd. is damaged on top (Photo 1).

Problem Area Data Sheet

Problem Area ID:	MR 7-03	Latitude: 44.747061 N	Longitude: 73.136508 W

Watershed:	Mill River
Location:	Polly Hubbard Rd., about ½ mile east of Georgia Middle Rd
Problem Type:	Altered Geomorphology
Identification Source:	Fluvial Erosion Hazard Mapping and Phase 2 SGA Report
Ownership:	Private
Classification Level:	1 – road alignment 3 – riparian buffer

Problem Description:

Much of the original woody riparian vegetation has been removed as a result of agricultural activities, residential development, and road infrastructure – leading to significant erosion in and long the stream channel.

Date of Field Data Collection: 5/16/2012

Field Photos

Photo 1. Bank erosion upstream from crossing

Photo 2. Roadway immediately adjacent to Mill River

Description of Observed Conditions:

Upstream bank cutting as stream approaches concrete box culvert (Photo 1). Area of bank erosion approximately 3.5' high by 15' long. Downstream past box culvert stream flows along road and is beginning to undercut bank and compromise road shoulder; a 5' wide strip of bank remains between stream and road; road shows signs of cracking, which may be attributable to bank sloughing (Photo 2).

Problem Area Data Sheet

Problem Area ID:	**MR 7-04A**	Latitude: 44.749066 N	Longitude: 73.125575 W

Watershed:	Mill River
Location:	Polly Hubbard Rd., about ½ mile west of the intersection with Route 7
Problem Type:	Altered Geomorphology
Identification Source:	Fluvial Erosion Hazard Mapping and Phase 2 SGA Report
Ownership:	Private/Local
Classification Level:	1 – geomorphology 3 – road runoff

Problem Description:

Significant erosion and mass failure in mainstem in reaches.

Date of Field Data Collection: 5/16/2012

Field Photos

Photo 1. Scour and bank erosion downstream

Photo 2. Stream makes 90º turn to enter culvert

Description of Observed Conditions:

Mill River forced to make a significant turn to enter culvert under Polly Hubbard Rd (Photo 2). Armor installed at entrance but would likely be overtopped during high flow events causing erosion to bank above armor. Road damage was present, patch work has been done. Indications of possible over the road flooding during storms/snowmelt present. South/east side of Polly Hubbard Rd shows signs of rill and gully erosion likely caused by stormwater flowing overland from the road surface toward stream.

Problem Area Data Sheet

Problem Area ID:	**MR 7-08**	Latitude: 44.760661 N	Longitude: 73.085019 W

Watershed:	Mill River
Location:	Oakland Station Rd., near intersection with Conger Rd
Problem Type:	Altered Geomorphology
Identification Source:	Fluvial Erosion Hazard Mapping and Phase 2 SGA Report
Ownership:	Local
Classification Level:	1 – geomorphology 3 – road runoff

Problem Description:

Erosion and mass failure on embankment of box culvert carrying Mill River under Oakland Station Rd.

Date of Field Data Collection: 5/16/2012

Field Photos

Photo 1. Road runoff

Photo 2. Looking downstream at bank erosion

Description of Observed Conditions:

Upstream erosion along south embankment of box culvert. Erosion causing significant amount of sediment to be deposited into Mill River. Stormwater runoff from the road surface is flowing along road edge and causing a gully to form on the east-side of Oakland Station Rd, near the downstream end of the box culvert.

Problem Area Data Sheet

Problem Area ID:	SB 4	Latitude: 44.718408 N	Longitude: 73.147483 W

Watershed:	Stonebridge Brook
Location:	Decker Rd., about 1000' west of intersection with Sodom Rd
Problem Type:	Local Drainage/Erosion
Identification Source:	field visit
Ownership:	unknown
Classification Level:	3

Problem Description:

Significant quantities of fill being placed along the southside of Decker Rd.

Date of Field Data Collection: 5/16/2012

Field Photos

Photo 1. Fill on south-side of Decker Rd

Photo 2. Natural area below placed fill

Description of Observed Conditions:

Fill is being actively placed on the southside of Decker Rd. Erosion control measures were not apparent and fill has mobilized down slope into the adjacent natural area.

Problem Area Data Sheet

Problem Area ID: **MR 3**

Latitude: 44.721197 N

Longitude: 73.165130 W

Watershed: Mill River

Location: “Y” @ Plains/Middle Rd

Problem Type: Local Drainage

Identification Source: Town Feedback

Ownership: Local

Classification Level: 3

Problem Description:

Culvert occasionally plugs at “Y” intersection.

Date of Field Data Collection: 5/16/2012

Field Photos

Photo 1. “Y” intersection

Photo 2. Sediment build up in the “Y” median

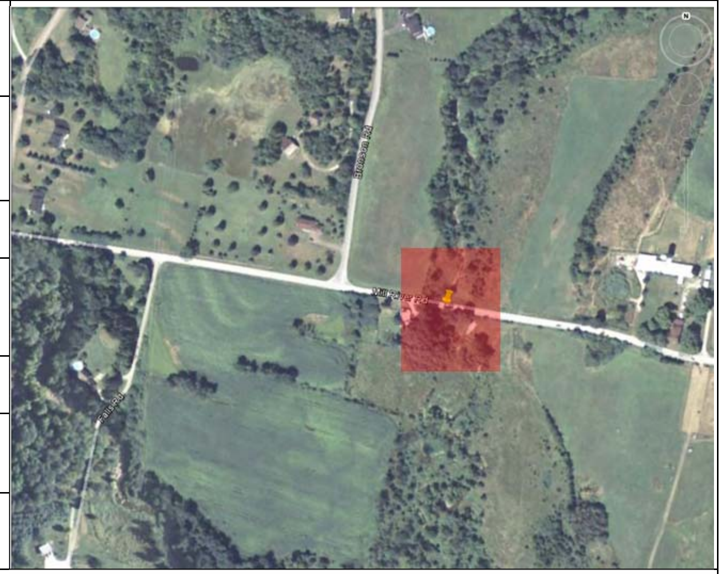
Description of Observed Conditions:

Sediment build up is occurring in the drainage ditch in the “Y” median (Photo 2). A new catch basin has been recently installed in front of youth center. Large gravel parking lot at youth center may be an important sediment source. The 2011 Town Plan recommends improvement to all Y-shaped intersections; improved stormwater management could be readily incorporated into such a project.

Problem Area Data Sheet

Problem Area ID:	RB 1	Latitude: 44.777561 N	Longitude: 73.127136 W

Watershed:	Rugg Brook
Road Name:	Mill River Rd., east of the intersection with Bronson Rd
Problem Type:	Altered Geomorphology
Identification Source:	Fluvial Erosion Hazard Mapping and Phase 2 SGA Report
Ownership:	Private/Local
Classification Level:	1 – geomorphology 3 – road runoff



Problem Description:

Erosion and mass failure on embankment of box culvert carrying Rugg Brook under Mill River Rd.

Date of Field Data Collection: 5/16/2012

Field Photos

Photo 1. Erosion caused by road runoff

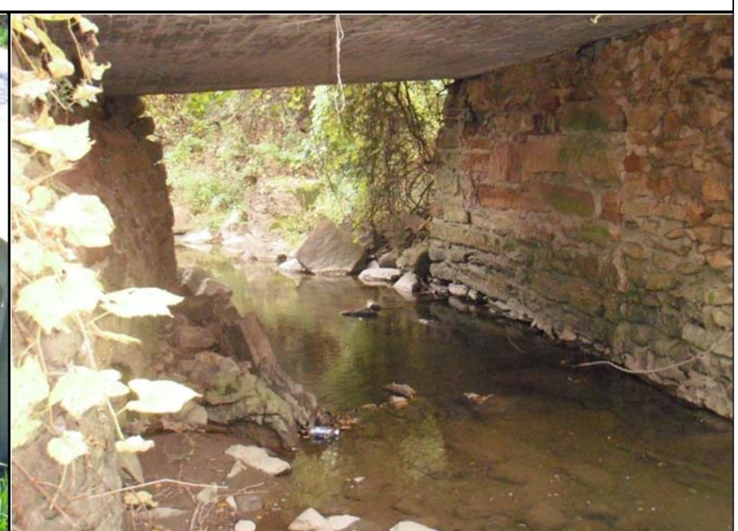


Photo 2. Failing rip-rap at outlet

Description of Observed Conditions:

Erosion on downstream (south) side of road; riprap has been installed (Photo 2). Guardrails on upstream side of bridge are deteriorating and cracking (Photo 1). Stormwater from the road surface flowing from the west along the north-side of Mill River Rd appears to be causing or contributing to the cracking and damaged concrete guardrail posts. Structural condition of the bridge was not evaluated; when the bridge is improved, however, fluvial erosion concerns should be incorporated into the project.

Problem Area Data Sheet

Problem Area ID:	**MR 2**	Latitude: 44.779972 N	Longitude: 73.143875 W

Watershed: Mill River

Location: Georgia Shore Rd., south of intersection with Mill River Rd

Problem Type: Culvert/Bridge

Identification Source: Town Feedback

Ownership: Local

Classification Level: 1

Problem Description:

On-going streambank failure(s) creating concern for the long-term stability of the bridge crossing Mill River on Georgia Shore Road.

Date of Field Data Collection: 5/16/2012

Field Photos

Photo 1. Downstream view

Photo 2. Looking south at upstream foundation

Description of Observed Conditions:

South end of foundation concrete wall has been exposed. About 3’ of once buried wall now showing, although there is limited evidence of recent erosion.

Problem Area Data Sheet

Problem Area ID: **DB GA010 and GA020**

Latitude: 44.695216 N

Longitude: 73.095488 W

Watershed: Deer Brook

Location: Industrial Park Road

Problem Type: Local Drainage

Identification Source: DEC SW Mapping

Ownership: Private

Classification Level: 3

Problem Description:

Ponds that were designed and installed prior to 2002 are used to treat stormwater runoff.

Date of Field Data Collection: 06/15/12

Field Photos

Photo 1. No photos available	**Photo 2.**

Description of Observed Conditions:

There are at least two stormwater ponds – one wet and one dry – at the PBM Nutritionals facility. Further investigation is needed to determine whether the dry pond discharges during high flow events, or whether the water simply infiltrates into the sandy soils beneath the pond. Retrofitting existing stormwater management ponds can help capture and treat additional stormwater runoff. Depending on discharge frequency and landowner interest, opportunities to improve treatment at this site could be further investigated.

Problem Area Data Sheet

Problem Area ID:	**DB GA060**	Latitude: 44.692077 N	Longitude: 73.084591 W

Watershed:	Deer Brook
Road Name:	Skunk Hill Rd., southeast of the railroad crossing
Problem Type:	Local Drainage
Identification Source:	DEC SW Mapping
Ownership:	Private
Classification Level:	3

Problem Description:

This facility is currently operating under an individual stormwater discharge permit as well as Vermont's Multi-Sector General Permit (MSGP) for Stormwater Discharges; its ultimate outfall sends stormwater over a steep embankment to Deer Brook.

Date of Field Data Collection: 06/15/12

Field Photos

Photo 1.

Photo 2.

Description of Observed Conditions:

Depending on landowner interest and assuming compliance with all current permit requirements, opportunities to improve treatment at this site could be further investigated.

Problem Area Data Sheet

Problem Area ID:	DB 7	Latitude: 44.724333 N	Longitude: 73.087519 W
Watershed:	Deer Brook		
Road Name:	TH45 Goodrich Hill Rd, east of Oakland Station Rd		
Problem Type:	Culvert/Bridge		
Identification Source:	Bridge and Culvert Inventory Data		
Ownership:	Local		
Classification Level:	1		

Problem Description:

Culvert on TH45 poorly aligned with stream approach at a sharp bend.

Date of Field Data Collection: 5/11/2012

Field Photos

Photo 1. Downstream view, ponding beyond culvert

Photo 2. Looking upstream

Description of Observed Conditions:

Both culverts in fair/good structural condition but poorly aligned with stream flow and possibly undersized. Pooling and scouring to the west and north of culverts appears to be the result of the sharp turn the stream is asked to make to enter the culverts. Pool in front of culvert approximately 4.5'. Culvert sizes: 36" and 60".

Problem Area Data Sheet

Problem Area ID: **SB 1**	Latitude: 44.689733 N	Longitude: 73.109897 W

Watershed:	Stone Bridge Brook
Location:	Manor Dr/Cedarwood Tr
Problem Type:	Local Drainage
Identification Source:	Town Feedback
Ownership:	Local
Classification Level:	3

Problem Description:

Localized flooding on Manor Drive, Cedarwood Terrace and Rt. 7.

Date of Field Data Collection: 5/11/2012

Field Photos

Photo 1. Clogged catch basin inlet, road undermining

Photo 2. Recently repaired driveway

Description of Observed Conditions:

Springs between Cedarwood Terrace, Manor Drive and Rt. 7 appear to contribute to localized flooding. Water drains towards south end of Cedarwood Tr. along road surface. Sharp curve in road causes washing out of driveways and yards along curve. Catch basin has repeatedly clogged; flow then bypasses it and goes through an eroded tunnel under the road. Residents report water run off nearly every wet weather event. Trees recently cut down in/near the springs.

Problem Area Data Sheet

Problem Area ID:	**DB 6**	Latitude: 44.737975 N	Longitude: 73.084919 W

Watershed:	Deer Brook
Location:	Oakland Station Rd., 1500' south of the intersection with Cary Rd
Problem Type:	Local Drainage/Culvert
Identification Source:	Bridge and Culvert Inventory Data
Ownership:	Local
Classification Level:	1

Problem Description:

Culvert on Oakland Station Road poorly aligned and located.

Date of Field Data Collection: 5/11/2012

Field Photos

Photo 1. Looking upstream, "L" forms @ culvert

Photo 2. Outfall

Description of Observed Conditions:

Relatively new 48" corrugated metal culvert, outlet partially obstructed. Culvert appears to be poorly aligned for stream; may have been installed in a manner to accommodate drainage ditch carrying in flow from the south.

Problem Area Data Sheet

Problem Area ID:	**DB 9**	Latitude: 44.723700 N	Longitude: 73.093369 W

Watershed:	Deer Brook
Location:	Carpenter Hill Rd., near intersection with Oakland Hill Rd
Problem Type:	Local Drainage
Identification Source:	Town Feedback
Ownership:	Local
Classification Level:	3

Problem Description:

Culvert in “Y” intersection is partially obstructed.

Date of Field Data Collection: 5/11/2012

Field Photos

Photo 1. Y intersection

Description of Observed Conditions:

Culvert from south corner of the “Y” across Carpenter Hill Road is partially obstructed; standing water in triangle. Some apparent erosion along the west shoulder of the north-south connector between Carpenter Hill and Oakland Station; drainage ditch is directly connected to the unnamed tributary to Deer Brook. The 2011 Town Plan recommends improvement to all Y-shaped intersections; improved stormwater management could be readily incorporated into such a project.

Problem Area Data Sheet

Problem Area ID:	DB 3	Latitude: 44.699038 N	Longitude: 73.104430 W
Watershed:	Deer Brook		
Location:	I-89, exit 18 interchange		
Problem Type:	Altered Geomorphology		
Identification Source:	Deer Brook SGA		
Ownership:	State		
Classification Level:	1		

Problem Description:

Brook straightened and culverted to pass under I-89.

Date of Field Data Collection: 5/11/2012

Field Photos

Photo 1.

Photo 2.

Description of Observed Conditions:

10.5' metal corrugated culvert; culvert diameter is significantly less than the width of the stream immediately downstream. Culvert invert is at least 6" above stream bottom. Scour is occurring downstream of culvert, likely due to increased stream velocities exiting culvert.

Problem Area Data Sheet

Problem Area ID:	DB 3	Latitude: 44.695330 N	Longitude: 73.107033 W

Watershed:	Deer Brook
Location:	Rt. 7/Rt.104A
Problem Type:	Local Drainage
Identification Source:	DEC Deer Brook Gully Remediation Study
Ownership:	Private, State
Classification Level:	4

Problem Description:

Stormwater runoff has created a large gully leading down to Deer Brook. The head of the gully is located near the intersection of Rt. 7 and Rt. 104A.

Date of Field Data Collection: 5/11/2012

Field Photos

Photo 1. 18” main Rt. 7 outfall

Photo 2. Eroding drainage along Route 7

Description of Observed Conditions:

Erosion visible along Route 7 (Photo 2) and along bank down to stream. Signs of sediment loading and iron staining. Flow in the gully is primarily fed by stormwater. Corrugated 18” plastic culvert crossing Rt. 7, drains ditch from west side of road (Photo 1). DEC has developed a comprehensive list of alternatives to remediate the gully. DEC’s efforts were focused on addressing the head cuts and slumping in the gully itself and reducing sediment loading to the Deer Brook and secondarily on the implementation of practices upstream of the gully, within its watershed, that would help in reducing stormwater quantity. See DB 14 for more information on “upland” options.

Problem Area Data Sheet

Problem Area ID:	**DB 14**
Latitude:	44.694700 N
Longitude:	73.107669 W
Watershed:	Deer Brook
Road Name:	Rt. 7/Rt.104A
Problem Type:	Future Opportunities
Identification Source:	Town Feedback
Ownership:	Local
Classification Level:	4

Problem Description:

The South Georgia Village may become a sub-regional growth center because of its access to Interstate-89, the Route 7 corridor, and the potential for additional industrial and commercial development. Knowing that the Town of Georgia wishes to concentrate future development in this area, strategies need to be investigated that both address current and potential future stormwater concerns.

Date of Field Data Collection: 7/31/2012

Field Photos

Photo 1. Catchbasin in 104A/Rt 7 triangle median

Photo 2. Plugged culvert at Georgia Market driveway

Description of Observed Conditions:

Stormwater from much of South Georgia's impervious surface drains to an outfall on the ravine East of Route 7 and Route 104A. Examining the surrounding ditches and storm lines/culverts, we observed evidence of significant stormwater flow. Ditches and culverts around the Georgia Market were especially poor, often having clogged culverts (Photo 2) and without vegetation to slow water flow.

Problem Area Data Sheet

Problem Area ID:	LR 1	Latitude: 44.683598N	Longitude: 73.112533 W
Watershed:	Lamoille River/Arrowhead Mtn. Lake		
Location:	Lakeview Terrace at Heritage Drive		
Problem Type:	Local Drainage		
Identification Source:	VT DEC		
Ownership:	Local/Private		
Classification Level:	4		

Problem Description:

Erosion on Lakeview Terrace near hedgerow, SW of southern barn storage facility.

Date of Field Data Collection: 7/31/2012

Field Photos

Photo 1. Paved roadside ditch

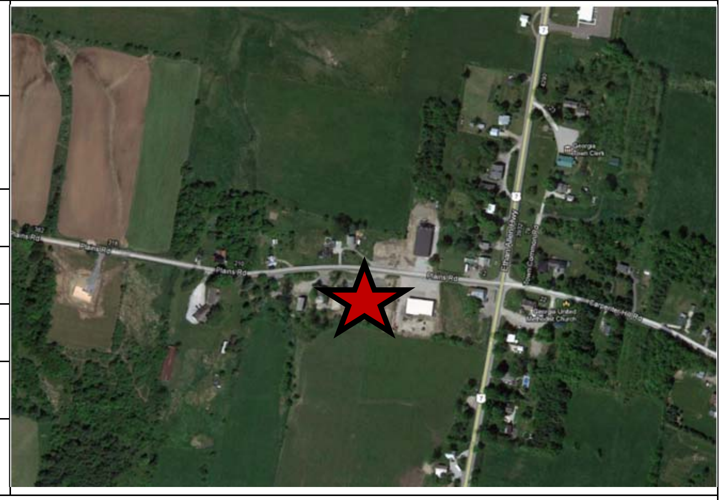
Photo 2. Erosion with utility line exposed

Description of Observed Conditions:

Runoff from the Lakeview Terrace & Meadow Ridge Ln follows roadside ditches (one with bottom paved— Photo 1) on both sides of the road. Ditch on west side of road hits a headwall, makes abrupt right turn into under-road culvert just south corner of southern barn. Flow follows hedgerow, leading to large erosion as it turns east (Photo 2) at southwest corner of barn. Continues east along hedgerow, and under Route 7 before eventually discharging into Arrowhead Lake.

Problem Area Data Sheet

Problem Area ID:	**MR 10**	Latitude: 44.727528 N	Longitude: 73.120043 W



Watershed:	Mill River
Location:	Plains Rd, near intersection with Route 7
Problem Type:	Future Opportunities
Identification Source:	Town Plan
Ownership:	Local
Classification Level:	2b

Problem Description:

A handful of oversized parking areas were identified during problem area field surveys.

Date of Field Data Collection: 7/31/2012

Field Photos

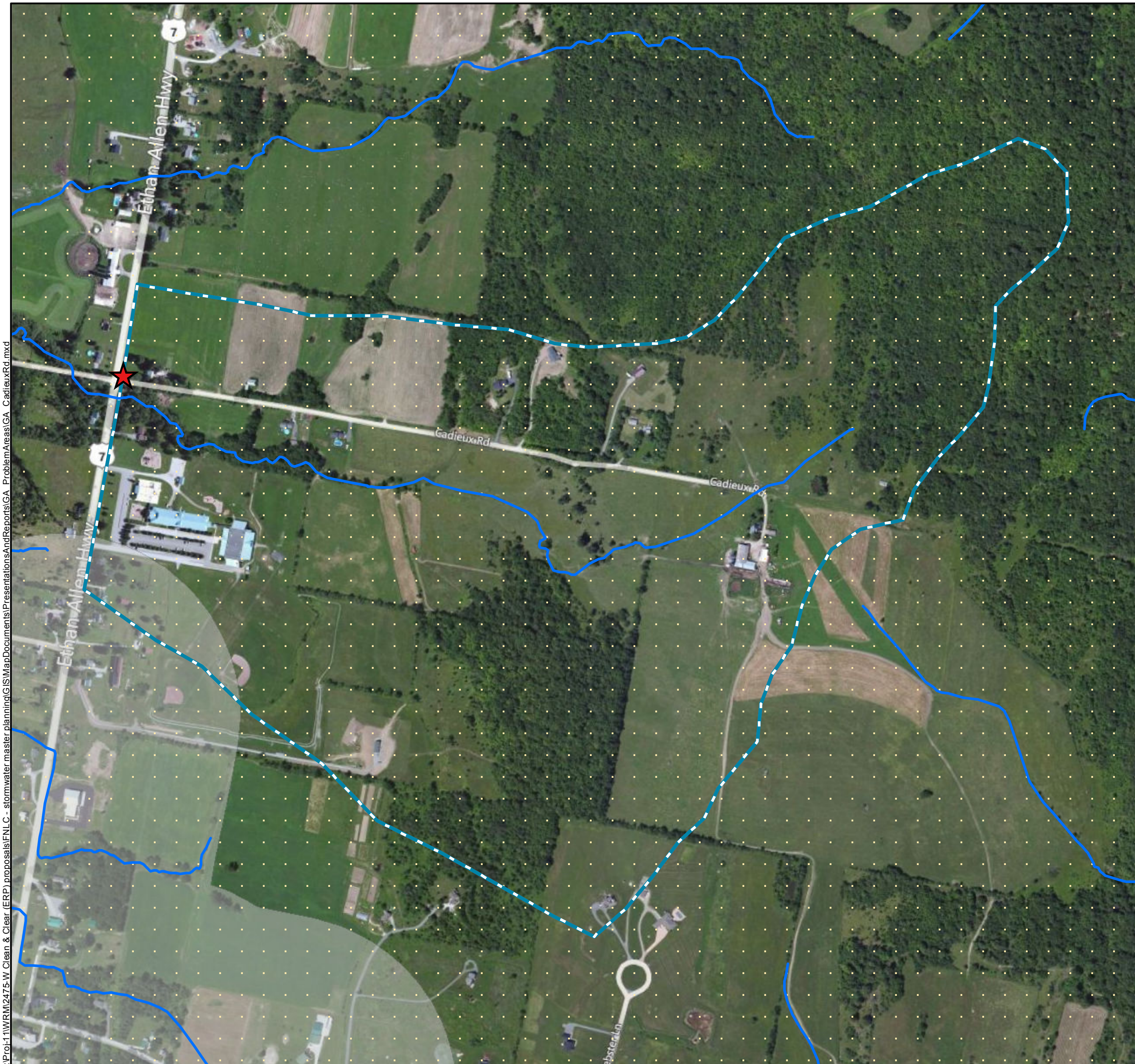
Photo 1. Parking lot at vehicle storage facility

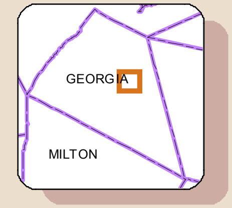
Photo 2. Unused cul-de-sac in industrial park

Description of Observed Conditions:

Particular areas of interest include the vehicle storage facility on Plains Rd in Georgia center, the cul-de-sac off Skunk Hill Rd and south of Northwest Vermont Solid Waste, and large residential parking areas on Guilder Ln. It may be that changes to zoning or subdivision regulations are needed to minimize the creation of new impervious surfaces.

APPENDIX D: DRAINAGE AREA MAPS FOR PRIORITY STORMWATER PROBLEM AREAS





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0 200 400 800
Feet

Legend

SW Treatment Opportunity
River or Stream
Drainage Area (279 Acres)
Erodible Soils (k > 0.17)
Future Growth Area

Treatment Opportunity:
Improve management of road runoff from Route 7 and Reynolds Rd.

Sources: Stormwater Infrastructure, Stormsewer Subwatersheds: VT DEC; Problem Areas: Stone; Future Growth Areas: Town of Georgia 2011 Comprehensive Municipal Plan; Potential Erosion Areas: SSURGO; Hydrography, Roads: VCGI; Imagery: Bing Maps.

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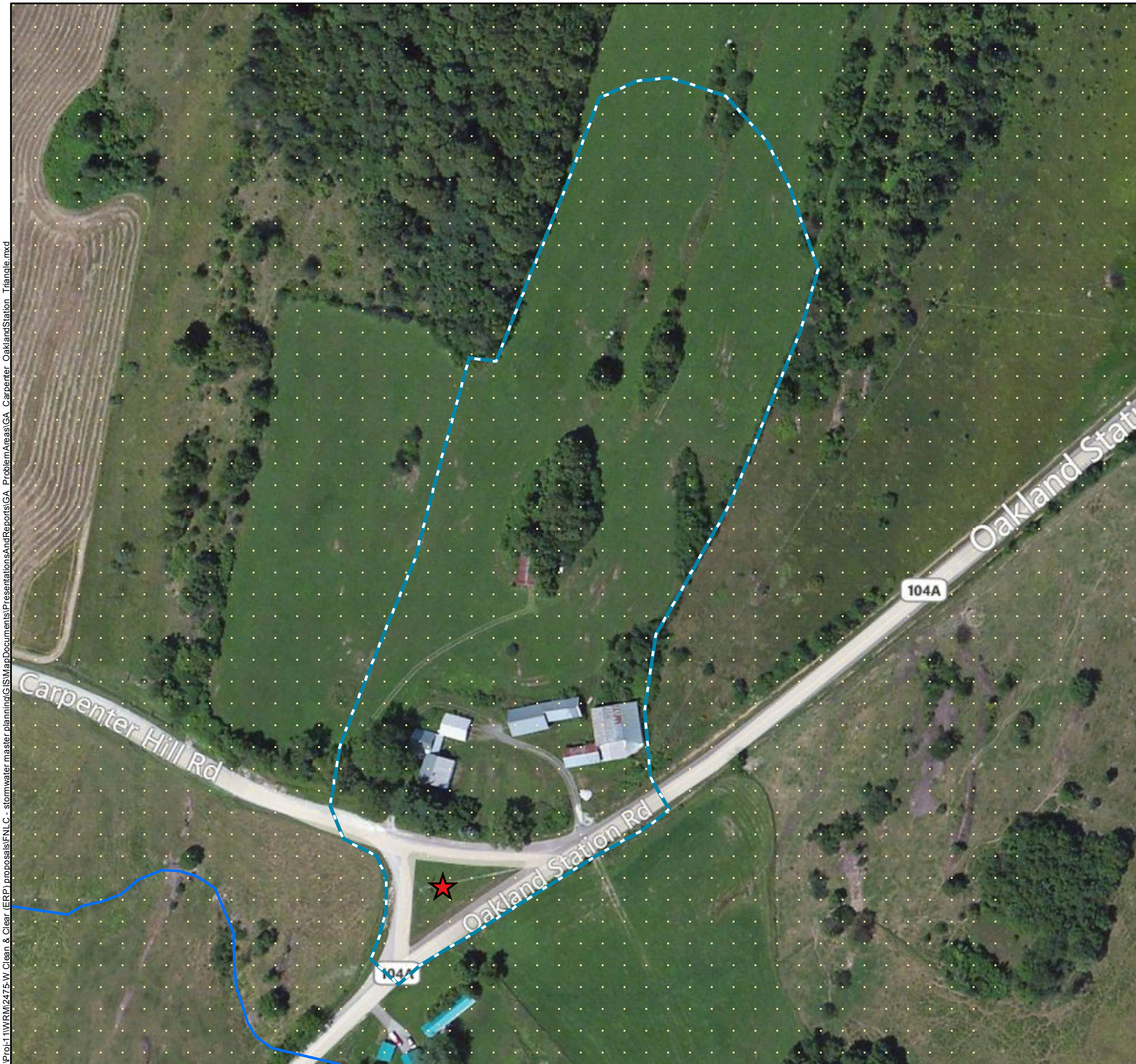
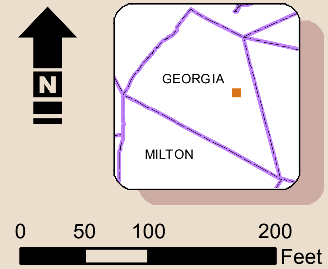
Cadieux Rd,
Mill River Watershed

MR 9-2

Georgia Stormwater Management Planning





Legend

- SW Treatment Opportunity
- River or Stream
- Drainage Area (6.9 Acres)
- Erodible Soils (k > 0.17)

Treatment Opportunity:
Existing greenspace in "Y"intersection could provide treatment for road runoff.

Sources: Stormwater Infrastructure, Stormsewer Subwatersheds: VT DEC; Problem Areas: Stone; Future Growth Areas: Town of Georgia 2011 Comprehensive Municipal Plan; Potential Erosion Areas: SSURGO; Hydrography, Roads: VCGI; Imagery: Bing Maps.

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Carpenter and Oakland Station Intersection, Lamoille River

DB 9

Georgia Stormwater Management Planning

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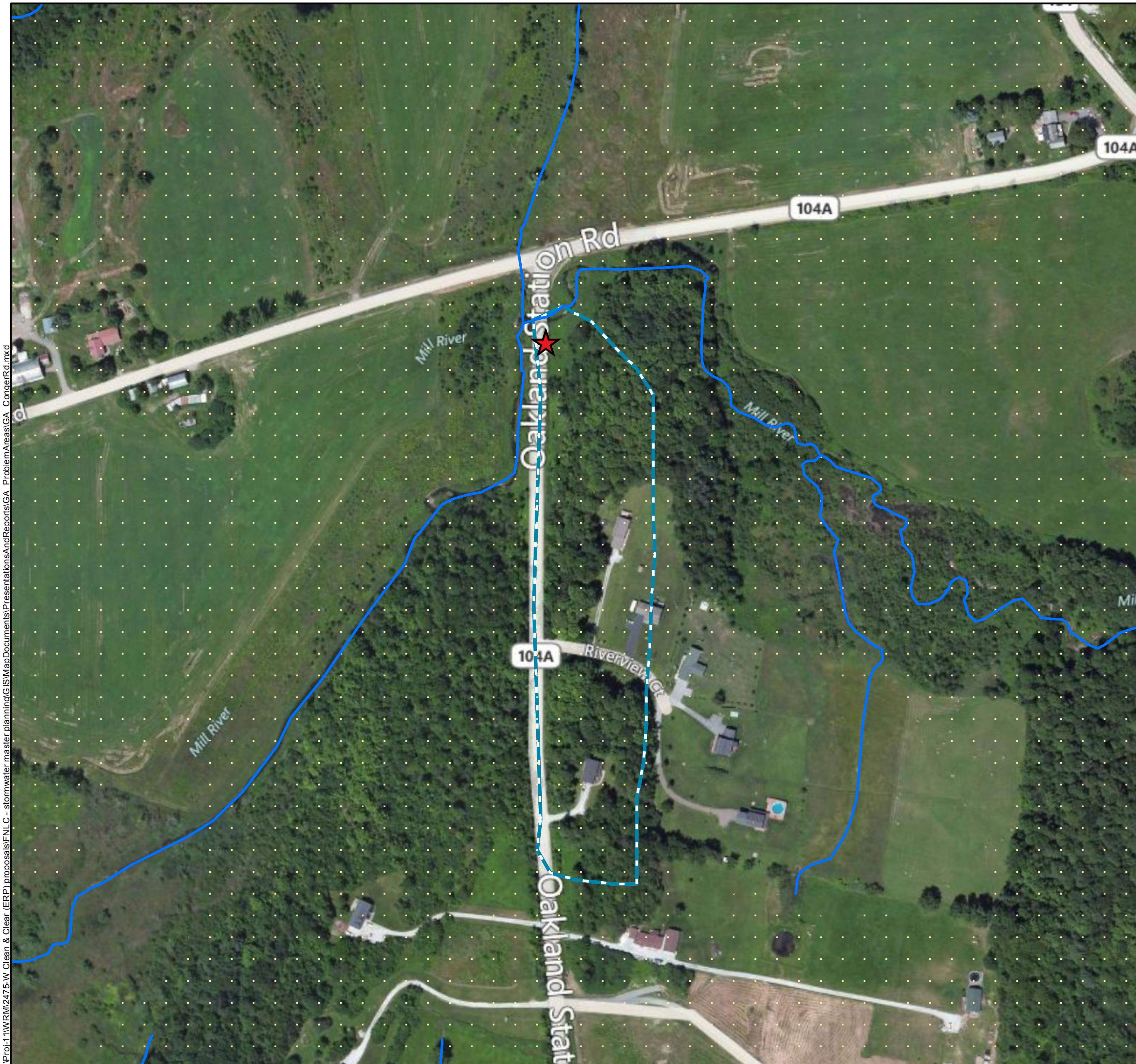

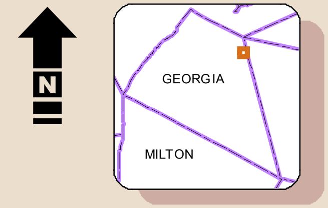

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Legend

- SW Treatment Opportunity
- River or Stream
- Drainage Area (6 Acres)
- Erodible Soils (k > 0.17)

Treatment Opportunity:
Address upstream erosion along the south embankment of box culvert due, in part, to road runoff.

Sources: Stormwater Infrastructure, Stormsewer Subwatersheds: VT DEC; Problem Areas: Stone; Future Growth Areas: Town of Georgia 2011 Comprehensive Municipal Plan; Potential Erosion Areas: SSURGO; Hydrography, Roads: VCGI; Imagery: Bing Maps.

STONE ENVIRONMENTAL INC

Conger Rd and
Oakland Station Rd
Mill River Watershed

MR 7-08

Georgia Stormwater
Management Planning

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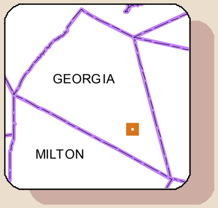

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Feet

Legend

- SW Treatment Opportunity
- River or Stream
- Drainage Area (10 Acres)
- Erodible Soils (k > 0.17)
- Catchbasin
- Junction box
- Stormwater manhole
- Outfall
- Pond outlet structure
- Storm line or culvert
- Under drain
- Infiltration pipe
- Overland flow

Treatment Opportunity:
Evaluate options to upgrade/retrofit existing stormwater management facilities to reduce the volume of overbank discharges to Deer Brook.

Sources: Stormwater Infrastructure, Stormsewer Subwatersheds: VT DEC; Problem Areas: Stone; Future Growth Areas: Town of Georgia 2011 Comprehensive Municipal Plan; Potential Erosion Areas: SSURGO; Hydrography, Roads: VCGI; Imagery: Bing Maps.

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Harrison Concrete,
Deer Brook Watershed

DB GA060

Georgia Stormwater
Management Planning

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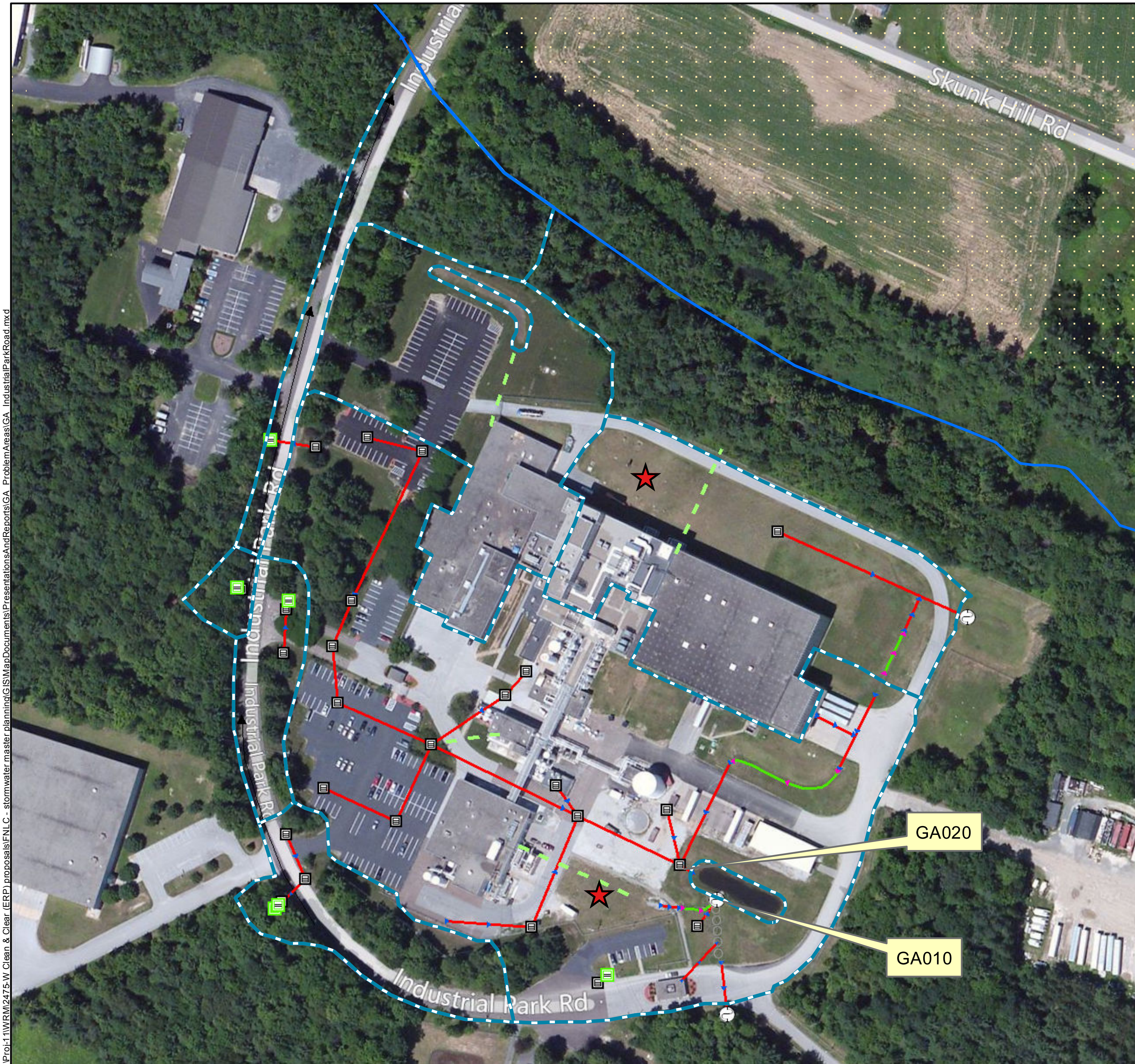


GEORGIA
MILTON

0 50 100 200
Feet

Legend

- SW Treatment Opportunity
- River or Stream
- Drainage Area (23 Acres)
- Erodible Soils (k > 0.17)
- Catchbasin
- Dry Well
- Outfall
- Storm line or culvert
- Swale
- Roof drain
- Emergency spillway
- Overland flow

Treatment Opportunity:
Evaluate opportunities for retrofiting existing stormwater management facilities (any basins)in the Georgia Industrial Park to improve performance; first step would be to assess frequency of overflow events.

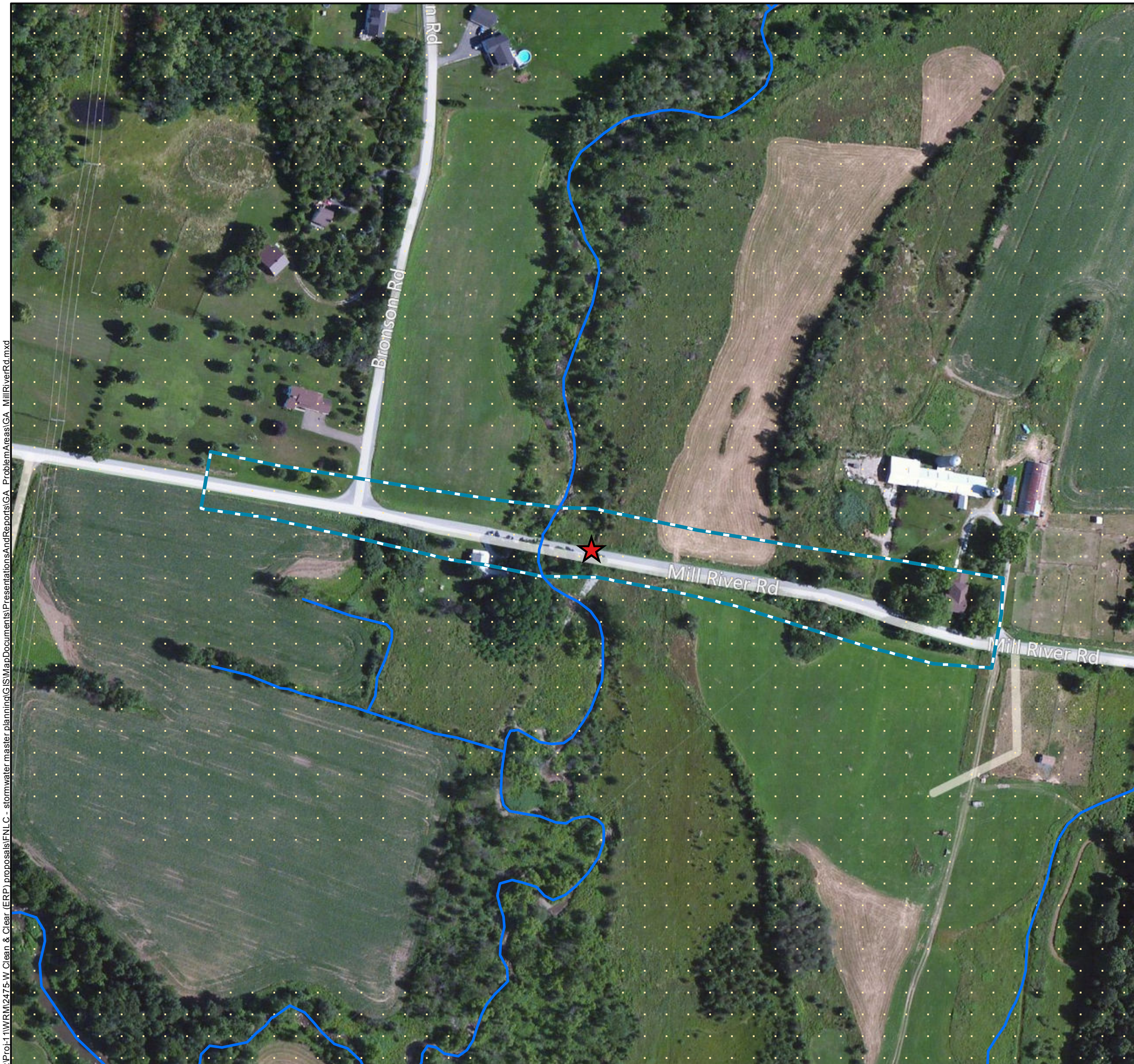
Sources: Stormwater Infrastructure, Stormsewer Subwatersheds: VT DEC; Problem Areas: Stone; Future Growth Areas: Town of Georgia 2011 Comprehensive Municipal Plan; Potential Erosion Areas: SSURGO; Hydrography, Roads: VCGI; Imagery: Bing Maps.

STONE ENVIRONMENTAL INC

Georgia Industrial Park, Deer Brook Watershed

Multiple

Georgia Stormwater Management Planning



0 75 150 300
Feet

Legend

SW Treatment Opportunity

River or Stream

Drainage Area (5 Acres)

Erodible Soils (k > 0.17)

Treatment Opportunity:
Improve management of road runoff from Mill River Rd.

Sources: Stormwater Infrastructure, Stormsewer Subwatersheds: VT DEC; Problem Areas: Stone; Future Growth Areas: Town of Georgia 2011 Comprehensive Municipal Plan; Potential Erosion Areas: SSURGO; Hydrography, Roads: VCGI; Imagery: Bing Maps.

STONE ENVIRONMENTAL INC

Mill River Rd, Georgia
Rugg Brook Watershed

RB 1

Georgia Stormwater Management Planning

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N

0 125 250 500 Feet

Legend

- SW Treatment Opportunity
- River or Stream
- Drainage Area (8 Acres)
- Erodible Soils (k > 0.17)
- Future Growth Areas

Treatment Opportunity;
Exisitng greenspace at in "Y" intersection could provide treatment for road runoff and adjacent parking lots.

Sources: Stormwater Infrastructure, Stormsewer Subwatersheds: VT DEC; Problem Areas: Stone; Future Growth Areas: Town of Georgia 2011 Comprehensive Municipal Plan; Potential Erosion Areas: SSURGO; Hydrography, Roads: VCGI; Imagery: Bing Maps.

STONE ENVIRONMENTAL INC

Georgia Plain,
Mill River Watershed

MR 3

Georgia Stormwater
Management Planning

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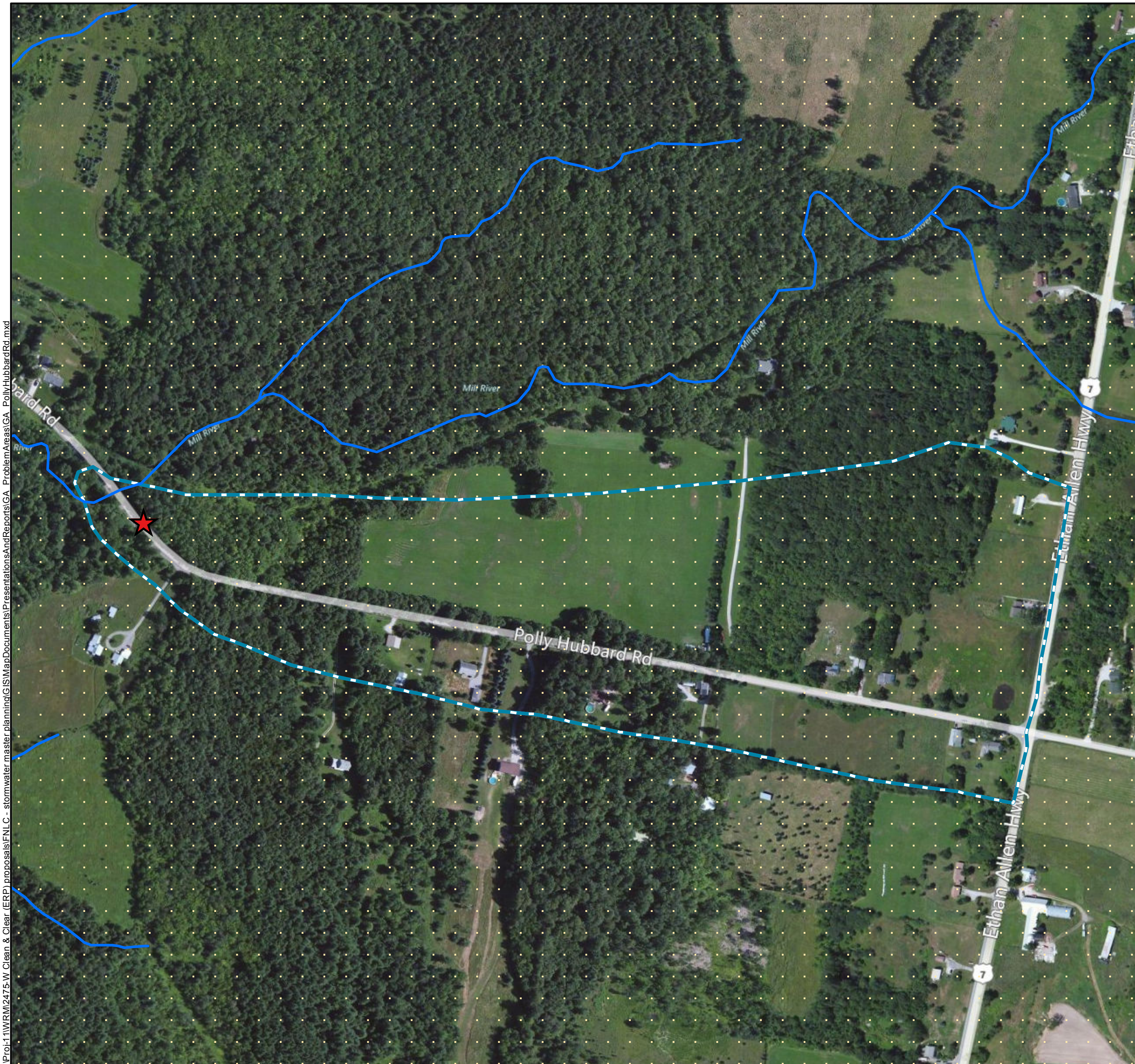

GEORGIA
MILTON

0 125 250 500 Feet

Legend

SW Treatment Opportunity
River or Stream
Drainage Area (58 Acres)
Erodible Soils (k > 0.17)

Treatment Opportunity:
Improve management of road runoff from Polly Hubbard Rd.

Sources: Stormwater Infrastructure, Stormsewer Subwatersheds: VT DEC; Problem Areas: Stone; Future Growth Areas: Town of Georgia 2011 Comprehensive Municipal Plan; Potential Erosion Areas: SSURGO; Hydrography, Roads: VCGI; Imagery: Bing Maps.

STONE ENVIRONMENTAL INC

Polly Hubbard Rd, Mill River Watershed

MR 7-04A

Georgia Stormwater Management Planning

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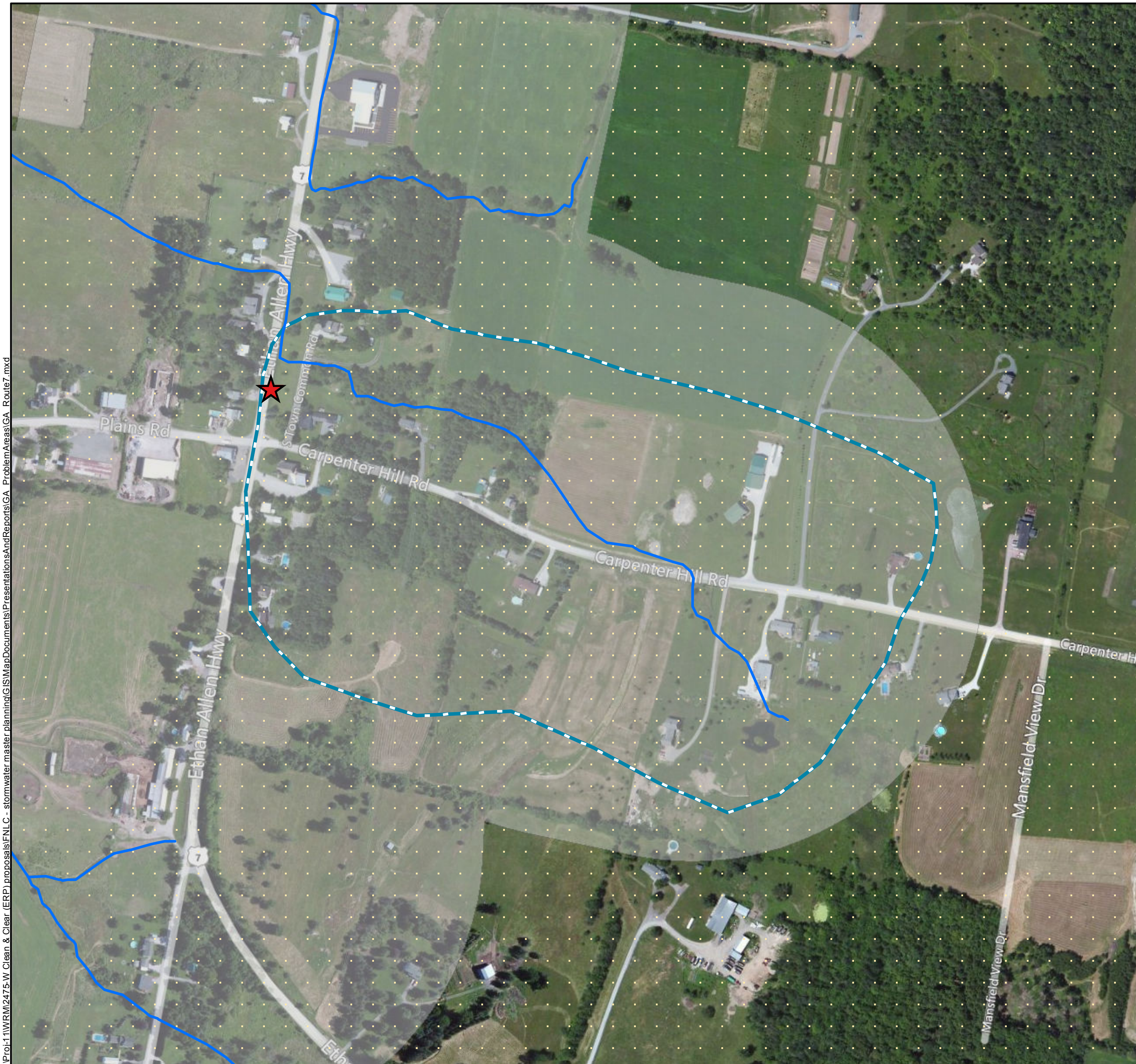

N

0 125 250 500 Feet

Legend

- SW Treatment Opportunity
- River or Stream
- Drainage Area (65 Acres)
- Erodible Soils (k > 0.17)
- Future Growth Areas

Treatment Opportunity:
Improve management of agricultural drainage and road runoff carried in ditch along Route 7.

Sources: Stormwater Infrastructure, Stormsewer Subwatersheds: VT DEC; Problem Areas: Stone; Future Growth Areas: Town of Georgia 2011 Comprehensive Municipal Plan; Potential Erosion Areas: SSURGO; Hydrography, Roads: VCGI; Imagery: Bing Maps.

STONE ENVIRONMENTAL INC

Georgia Center,
Mill River Watershed

MR 5-1

Georgia Stormwater
Management Planning

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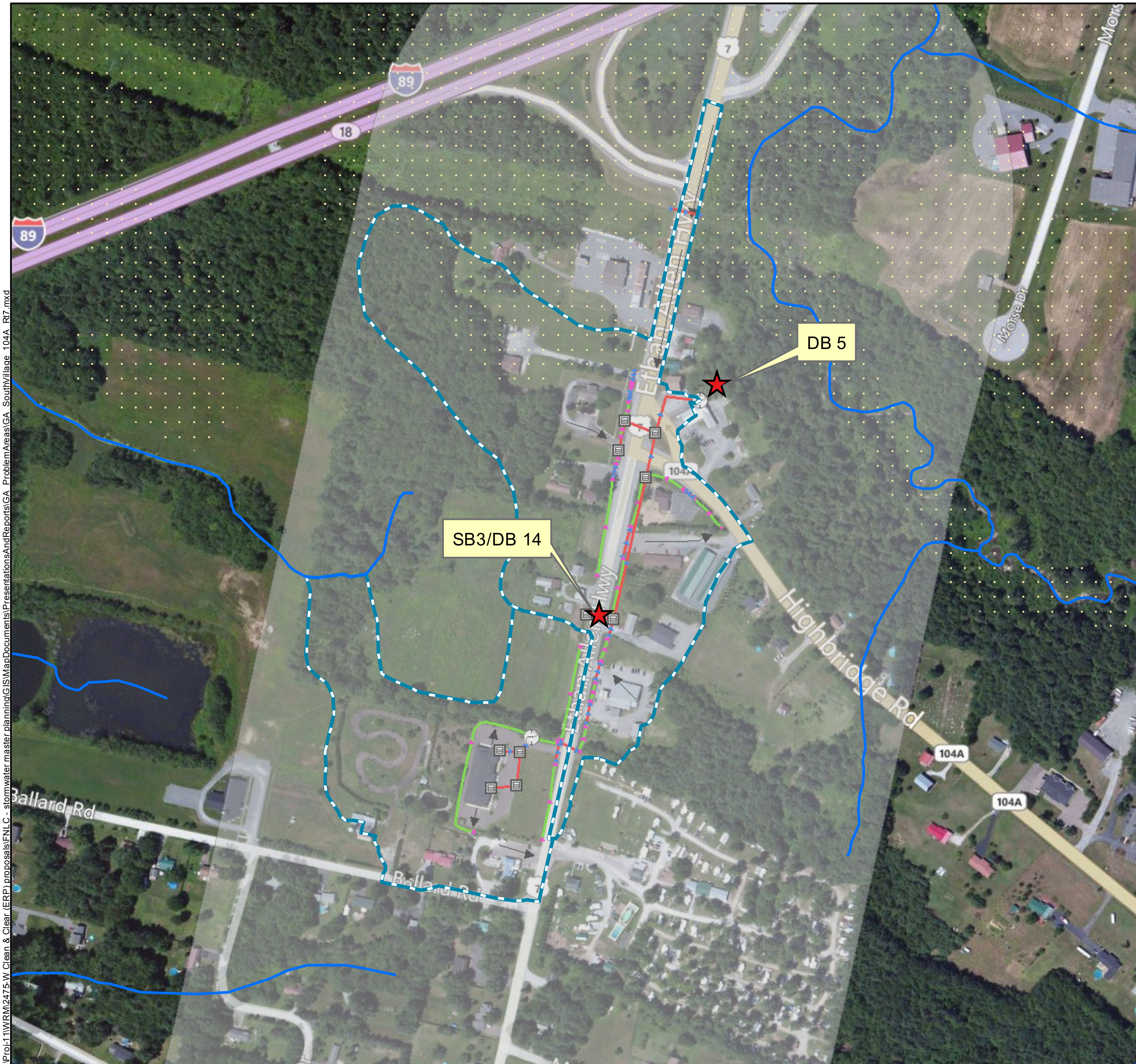

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GEORGIA
MILTON

0 125 250 500 Feet

Legend

- SW Treatment Opportunity
- River or Stream
- Drainage Area (33 Acres)
- Erodible Soils (k > 0.17)
- Future Growth Areas
- Catchbasin
- Outfall
- Storm line or culvert
- Swale
- Overland flow

Treatment Opportunities:
Stormwater runoff has created a large gully leading down to Deer Brook. Improve management of runoff from roads and adjacent impervious surfaces as well as address ongoing erosion in gully.

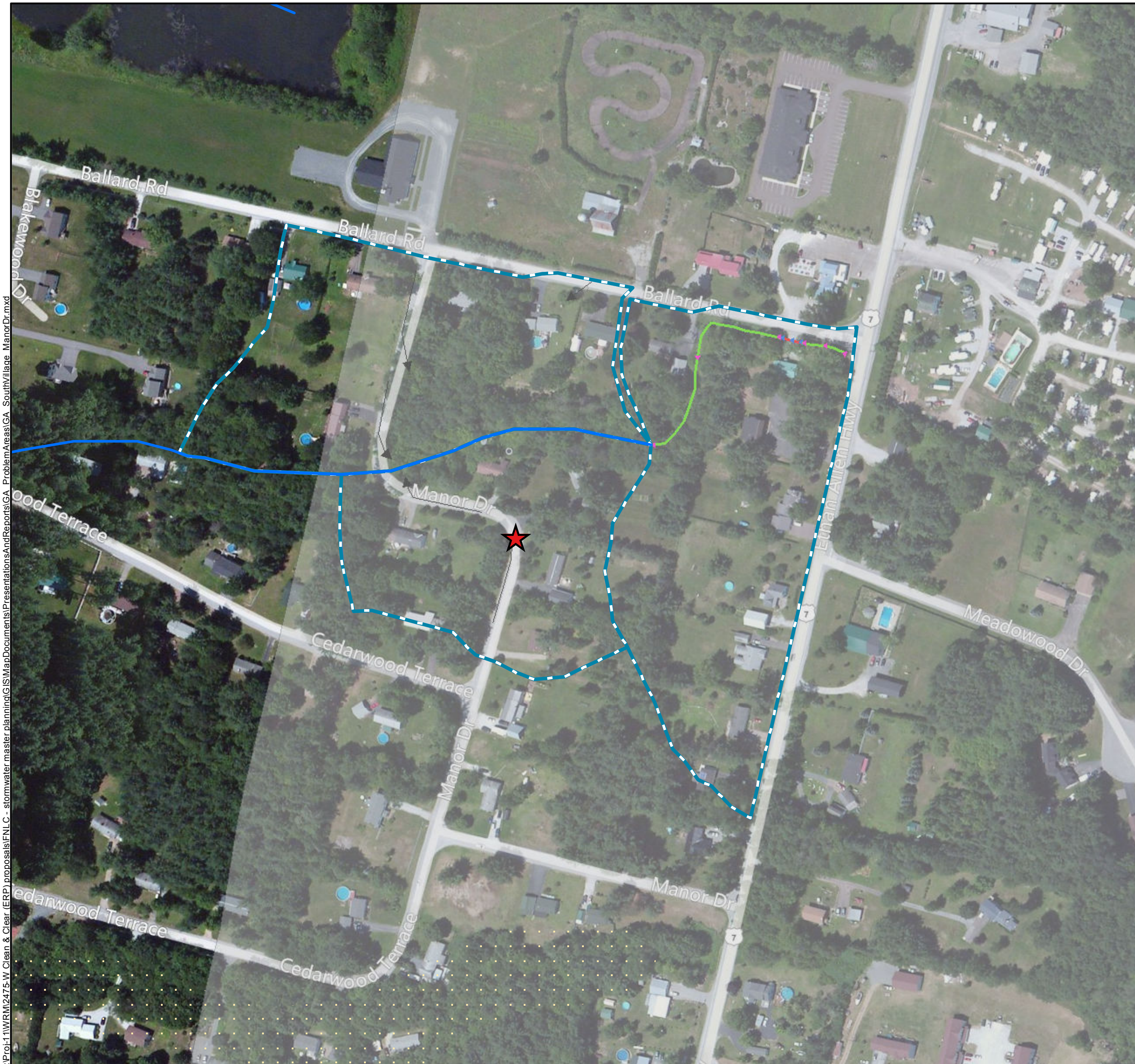
Sources: Stormwater Infrastructure, Stormsewer Subwatersheds: VT DEC; Problem Areas: Stone; Future Growth Areas: Town of Georgia 2011 Comprehensive Municipal Plan; Potential Erosion Areas: SSURGO; Hydrography, Roads: VCGI; Imagery: Bing Maps.

STONE ENVIRONMENTAL INC

Georgia South Village, Lamoille River Watershed

Multiple

Georgia Stormwater Management Planning



Legend

SW Treatment Opportunity
River or Stream
Drainage Area (19 Acres)
Erodible Soils (k > 0.17)
Future Growth Areas
Storm line or culvert
Swale
Overland flow

Treatment Opportunity:
Improve stormwater management to reduce erosion and localized flooding in Manor Drive neighborhood.

Sources: Stormwater Infrastructure, Stormsewer Subwatersheds: VT DEC; Problem Areas: Stone; Future Growth Areas: Town of Georgia 2011 Comprehensive Municipal Plan; Potential Erosion Areas: SSURGO; Hydrography, Roads: VCGI; Imagery: Bing Maps.

STONE ENVIRONMENTAL INC

Georgia South Village, Stone Bridge Brook Watershed

SB 1

Georgia Stormwater Management Planning

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N

0 50 100 200 Feet

Legend

SW Treatment Opportunity
River or Stream
Drainage Area (8 Acres)
Erodible Soils (k > 0.17)
Future Growth Areas
Storm line or culvert
Swale
Overland flow

Treatment Opportunity:
Erosion on Lakeview Terrace near hedgerow, southwest of southern barn storage facility.

Sources: Stormwater Infrastructure, Stormsewer Subwatersheds: VT DEC; Problem Areas: Stone; Future Growth Areas: Town of Georgia 2011 Comprehensive Municipal Plan; Potential Erosion Areas: SSURGO; Hydrography, Roads: VCGI; Imagery: Bing Maps.

STONE ENVIRONMENTAL INC

Georgia South Village, Lamoille River Watershed

AR 1

Georgia Stormwater Management Planning

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APPENDIX E: CONCEPTUAL SOLUTIONS FOR HIGHEST PRIORITY STORMWATER PROBLEM AREAS

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

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

SEI No. 11-2475
Re: Georgia SWMP: Priority Project List

1. INTRODUCTION

During the spring and summer of 2012, Stone staff worked with Friends of Northern Lake Champlain and Town of Georgia officials to identify and evaluate problem areas in the Town. The list of problem areas was then prioritized, highlighting those projects that would result in the greatest potential benefit to water quality and/or where effective treatment was most feasible. Stone then revisited high priority sites to further investigate treatment potential and gather information for conceptual solutions. Based on this assessment, Stone developed the following suite of conceptual solutions for improved stormwater management within the Town of Georgia.

1.1 Intersection of Routes 7 and 104A/Deer Brook Gully

A collection of treatment opportunities are concentrated along U.S. Route 7, near the intersection with Route 104A, south of the I-89 interchange. This is area is drained by a system of roadside ditches and storm sewers. The outfall from this system is at the head of the so-called "Deer Brook Gully." The Deer Brook Gully is a known, significant problem area that the Northwest Regional Planning Commission assessed and documented in a 2007 report[10]. The report describes the condition of the gully, linking the deterioration to excessive stormwater flows from the upstream impervious areas. The report also provides general recommendations for stormwater treatment practices (STPs) that could be implemented to reduce stormwater impacts. It should be noted that additional development and redevelopment has occurred in the watershed since 2007.

[10] *Deer Brook Gully Remediation and Stormwater Treatment Georgia Vermont Summary Report.* Prepared for Northwest Regional Planning Commission by ESPC Civil and Environmental Engineering; Eric Sandblom, PC. and Stone Environmental, Inc. February 2007.

The conceptual projects laid out here are intended to build upon on the recommendations of the Deer Brook Gully report. Specific areas are identified for treatment practices based on existing conditions, expected development, ease of design and construction, and expected performance potential. Proposed efforts could be divided into two larger projects:

- Addressing stormwater from private property – specifically the existing medical building and, potentially, untreated areas of the Georgia Market parking lot; and
- Retrofitting the existing roadside drainage systems to provide treatment of stormwater from the road surface.

A more detailed description of potential treatment measures is provided below.

1.1.1 Georgia Eye Center/Northwestern Occupational Health Building

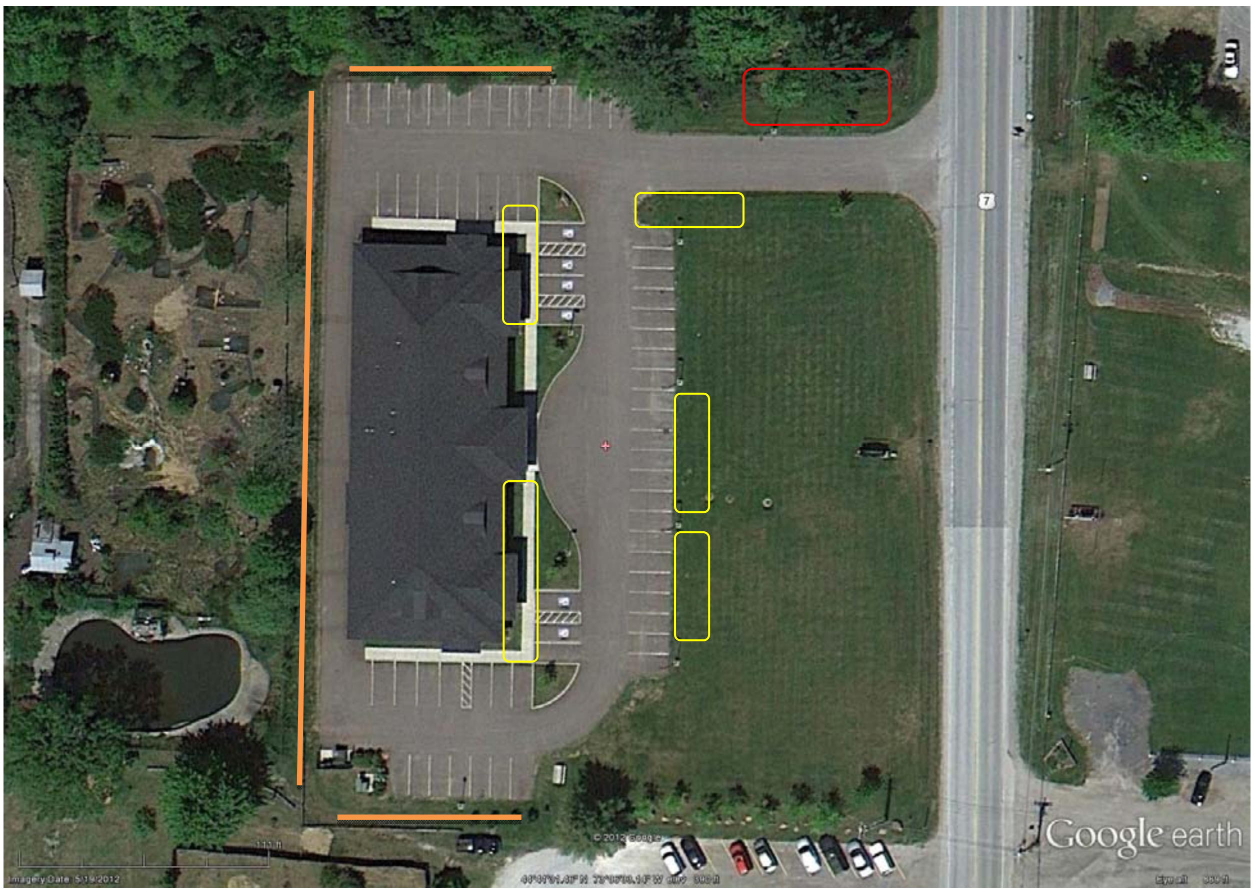

Figure 1. Potential treatment opportunities at the Georgia Eye Center/ Northwest Occupational Health Building. Rain-Garden and bioretention opportunities highlighted in yellow and open channel opportunities highlighted in orange.

The building housing the *Georgia Eye Center* and *Northwestern Occupational Health* includes approximately one acre of impervious area, which is nearly 50% of the parcel. Impervious surfaces include the building roof, sidewalk, and asphalt parking area. The roof is drained by gutters with downspouts connected to the stormwater drain. The parking lot is drained by two catch basins – one within the asphalt footprint and one in the lawn. These two catch basins drain approximately one third of the impervious surface. The remainder of the roof top and parking lot drain to a grass swale that flows along the perimeter of the property.

USDA-NRCS Soil Surveys report Deerfield loamy, fine sand. Treatment potential for this property is quite high, between well-drained soil, space for treatment practices, and existing infrastructure suitable for retrofitting.

Roof runoff could be treated by redirecting the existing downspouts to route stormwater through rain gardens or similar soak-away practices. Overflow drains could be connected to existing stormwater drain at the location of the downspouts. The result would be a relatively simple, low risk retrofit that would increase infiltration, and reduce stormwater discharge emanating from the roof top.

Figure 2. Example of area where roof runoff could be routed to a rain garden.

Runoff from the parking lot could be treated with bioretention basins designed to encourage infiltration. The southern half of the front parking area drains east, toward the front lawn and north towards to basin near the middle of the lot. Stormwater south of the catch basin could be intercepted and routed to a bioretention area designed to maximize infiltration. Drainage exceeding the capacity of the treatment practice would backup into the existing catch basin at reduced rate compared to present conditions.

Figure 3. Catch basin is located beneath red pickup truck in the photo. Stormwater from half of parking lot could be routed to lawn are shown right half of photo.

Similarly, stormwater runoff from the north half of the parking lot and access drive drains to a catch basin located in a grassed median near the access drive. A bioretention area designed to maximize infiltration could be constructed here. The existing catch basin could be being retrofitted with a flow control device while remaining to serve as the overflow outlet for the treatment.

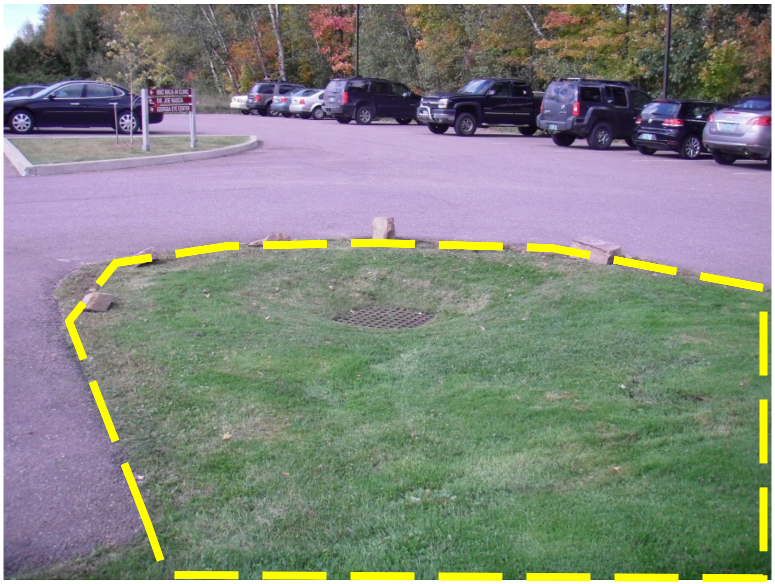

Figure 4. Existing catch basin that could be retrofitted and integrated into a stormwater treatment practice.

The remaining paved area which surrounds the building drains to a grass swale which flows clockwise from the southern end of the parking lot to the roadside ditch at the northeast corner of the property. With simple modifications such as concrete weirs or check dams, and flow control apparatus, this swale could be retrofitted to enhance infiltration.

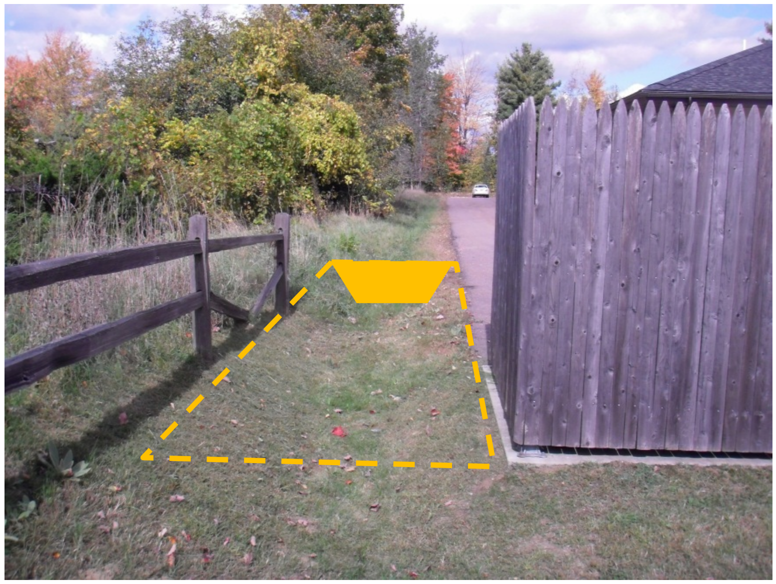

Figure 5. Existing grass swale could be modified to encourage infiltration.

An additional or alternative stormwater treatment option would be to create a bioretention/infiltration basin or similar structure at the north end of the property between the existing stormwater outfall and the existing roadside ditch along the west sided of US Route 7.

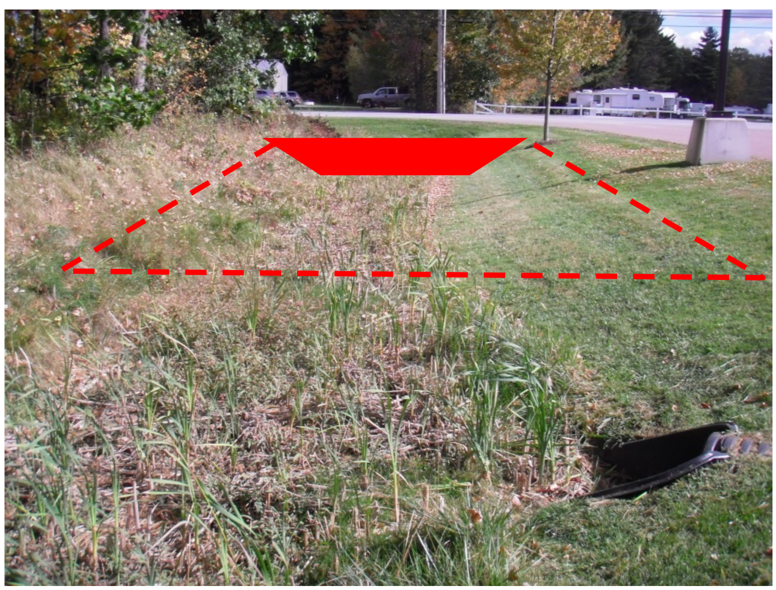

Figure 6. A bioretention basin could be located between the existing stormwater outfall and road side ditch.

1.1.2 U.S. Route 7 Roadside Drainage

Multiple treatment opportunities exist along U.S. Route 7. The roadside ditches in along this stretch of road are rather deep. Existing catch basins and driveway culverts could be retrofitted with flow-control devices; the roadside ditches, given their ample depth, could provide significant storage of stormwater. Further gains could be achieved by enhancing infiltration capabilities in these areas. Potentially suitable locations for retention and infiltration practices along Route 7 are provided in Figure 7.

Figure 7. Treatment opportunities along U.S. Route 7 near the Georgia Market Property.

The southern-most location denoted in Figure 7 receives stormwater via ditch conveyance from Rt. 7 as far south as Ballard Rd. This includes the Georgia Eye Center/Northwest Occupational Health Property. The next site to the north then includes approximately 0.25 acres of the 1 acre Georgia Market impervious area. The stormwater from the remaining 0.75 acres is treated via a recently installed vegetated swale at the back of the property.

Directly in front of the market the wide, deep roadside ditch could be used for storage and infiltration by installing a simple flow-control device on the existing culvert under the drive that accesses the back of the Georgia Market property. This could serve to treat all upstream stormwater. Figure 8 shows a photo with a rough location of the proposed treatment practice.

Figure 8. Looking south along the east side of Route 7 in front of the Georgia Market.

Location of the proposed flow control device is behind the photographer.

Heading south along the east side of Rt. 7, more opportunities exist for in-ditch treatment of stormwater. Three potential locations for treatment are shown in **Error! Reference source not found.**.

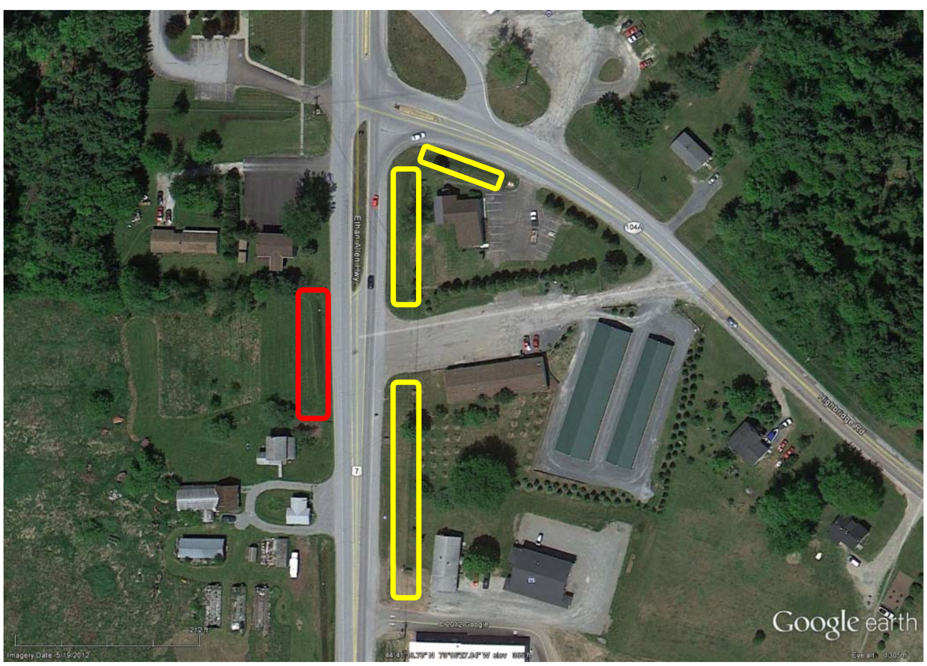

Figure 9. Potential stormwater treatment areas along U.S. Route 7 and VT Route 104A north of the Georgia Market property.

The next section of roadside ditch between the, Georgia Market and Georgia Auto Parts properties, is drained by an existing catch basin. Adding a riser with a flow control device to this catch basin, along with a downstream check dam would increase storage potential at this site and decrease flow rates (Figure 10)..

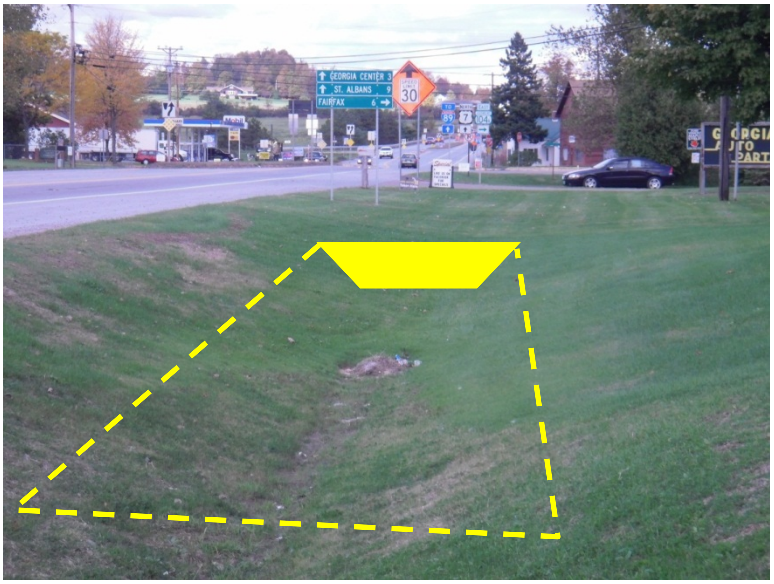

Figure 10. Looking north along Route from the Georgia Market property. The existing stormwater catch basin (center of photo) and ditch could be modified to provide temporary storage and increase infiltration.

A similar practice could be implemented near the at the Rt. 7 and VT Rt. 104A intersection; see Figure 11. Adding a riser pipe with a flow-control device to the existing catch basin would increase the storage potential and infiltration in each ditch.

Figure 11. View of roadside ditches looking south. VT Rt. 104A (left) and US Rt. 7 (right).

Two more opportunities exist along the west side of Rt. 7. The southernmost location (shown in red in Figure 12) is between KA Hairdesigns and private residence.

Figure 12. Potential treatment location along west side of Rt. 7, south of KA Hairdesigns.

The existing catch basin (surrounded by tall grass in photo) could be retrofitted with a standpipe and flow control device.

The other location is to the north of this is located between the People's Trust Bank and the Mobil gas station. See Figure 13.

Figure 13. Potential location for stormwater treatment along the west side of Route 7, north of VT Route 104A.

Similar to those previously mentioned, adding a simple, flow-control retrofit such as a weir with a flow control device prior to the driveway culvert would allow stormwater to be temporarily stored and/or infiltrated (Figure 14).

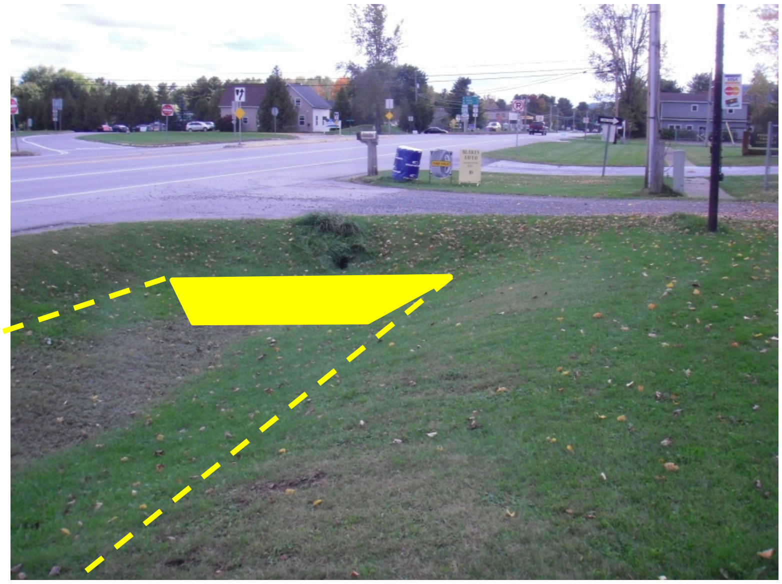

Figure 14. Potential location for stormwater treatment along Rt. 7 south of Mobil Station

1.2 Lakeview Terrace

Figure 15. Red Barn property and surrounding neighborhood. Location of existing scour hole shown in red. Potential STP locations shown in yellow and orange.

Stormwater draining down Lakeview Terrace from south to north discharges from the roadside ditch between the Red Barn Storage property and the neighboring property to the west (Figure 15). Where the channel turns west, away from the road, a significant scour hole approximately 7-8 ft wide and 3-4 ft deep has developed (Figure 16). Eroded soil is then conveyed with stormwater along the Red Barn Storage property before crossing under Rt. 7 and flowing to Arrowhead Mountain Lake via a small tributary. Two potential solutions merit consideration.

Figure 16. Headcut in road side ditch at the bottom of Lakeview Terrace.

Repair and reinforcement of the scoured channel of the scoured channel would reduce sediment loads downstream. Installation of a STP such as a bioretention basin, in the existing roadside ditch along the hedge row (upstream of the scour hole) would work to improve water quality and also prevent future degradation (i.e. erosion or scouring) of the channel (see Figure 17Figure 17). Soils in this area are Hydrologic Class B soils—well-drained and suitable for infiltration[11]. Any practice that is implemented should include features to promote infiltration.

[11] *Web Soil Survey*, USDA Natural Resources Conservation Service. http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm

Figure 17. Potential location for stormwater treatment along Lakeview Terrance near the Red Barn Rental Business property.

An alternative or addition to a solution along Lakeview Terrace would be to locate a treatment practice encouraging infiltration along the southern border of the Red Barn Storage property. Locating the treatment practice in this location would increase the available land area and potential for infiltration. Soils here are Hydrologic soil group (HSG) A—very well-drained, with a lower water table. This location would also include the added benefit of capturing the roof runoff from half of the Red Barn Rental structure (approximately 5700 ft^2). The drawback of this option is that it is outside the town right-of-way, and would require cooperation from a private landowner.

Stormwater flows at either of these sites could also be reduced by construction of smaller-scale STPs, such as rain gardens, on properties further up in this relatively small watershed. Implementation of upslope STPs could reduce the size required for either of the two suggested STPs and/or increase treatment potential (i.e. improve effluent water quality).

1.3 Industrial Park

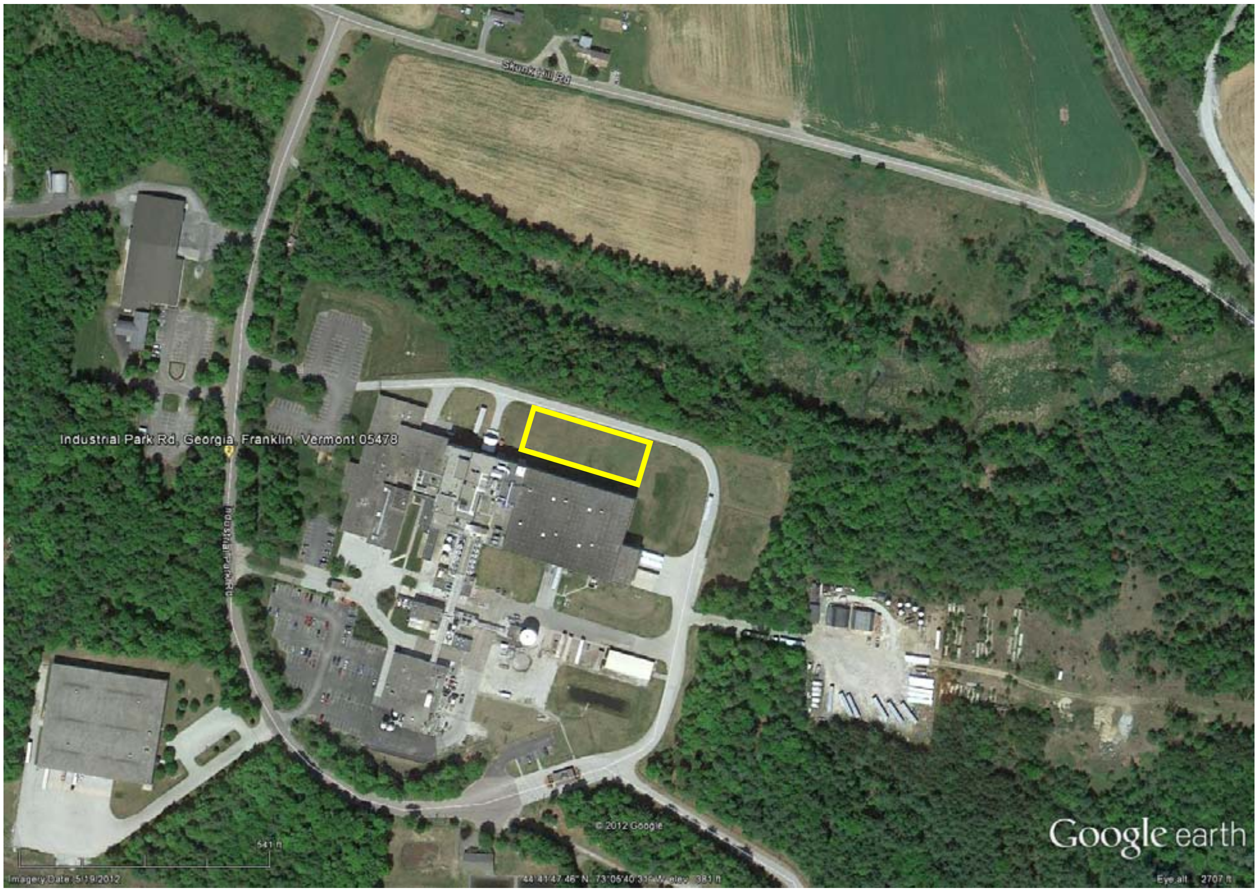

Figure 18. Georgia Industrial Park off of Skunk Hill Rd. Detention area highlighted in yellow.

The Georgia Industrial Park contains a large amount of impervious area. This property is equipped with permitted stormwater treatment facilities, largely in the form of dry wells and dry ponds (Figure 18). Soils are HSG A and therefore stored water is likely to quickly infiltrate. Before considering any potential retrofits to these facilities, we recommend monitoring to determine whether the facilities discharge. Stone suggests that these facilities be monitored for the presence of discharge following storm events with particular attention being paid to the detention pond highlighted in Figure 18. If evidence of significant discharge is found, further investigation can assess if opportunities may exist to improve the treatment by modifying the existing facility, or reducing or slowing stormwater closer to the source.

1.4 Cedarwood Terrace

Figure 19. Two compromised culverts conveying stormwater under private drives on Cedarwood Terrace (highlighted in yellow).

Reported stormwater issues were investigated in the area of Cedarwood Terrace (Figure 19). While on site, one local land owner cited significant erosion of the road shoulder claiming there was once enough room to park a vehicle where there is now only a few feet of space between the road and channel side-slope. Two compromised culverts were found under driveways providing access to two abutting private residences; there is some evidence of on-going erosion around the culverts (Figure 20).

Figure 20. Partially clogged culverts with unstable cover slopes.

One culvert is too short for the existing embankment. The other appears to be long enough; however, it is not centered under the driveway embankment. The result in both cases is that embankment side slopes are forced to be too steep in order to daylight one or both ends of the culverts. This is resulting in erosion and failure of the embankment side slopes. Haphazard attempts have been made to stabilize the slopes with little or no evidence of success. The culverts are also partially filled with aggraded material compromising their hydraulic capacity. Evidence of recent failure of one culvert and associated embankment exists.

Due to their dilapidated state and poor condition, these culverts should be considered for replacement. Properly sized in installed culverts will aid in reducing adjacent slope destabilization and minimize risk of failure. Failure of one culvert and subsequent embankment collapse can introduce as much or more sediment to a watershed as a large, significantly eroded ditch or channel. This risk can be significantly reduced with proper culvert design and installation. At a minimum, the existing channel and culverts should be cleaned to maximize the hydraulic capacity and rock rip rap added to stabilize the adjacent banks.

As with most stormwater problems, the root cause of stormwater issues in this neighborhood is increased volume and flow rate attributable to increased amounts of impervious surfaces. The opportunities for stormwater treatment practices on public land or rights-of-way in Cedarwood Terrace and Manor Drive neighborhoods are limited. Participation on the part of private homeowners, however, through practices such as rain gardens or pervious pavement would help reduce stormwater impacts and improve water quality.

1.5 Oakland Station Rd.- Mill River Box Culvert

Significant streambank erosion is occurring at the Oakland Station Rd.- Mill River crossing. Mill River crosses under Oakland Station Rd. via a concrete box culvert just south of Conger and Loomis Roads. Roadside drainage is causing erosion behind the southeast wingwall (Figure 21). Apparent stabilization attempts appear to be failing. Erosion from this source could be minimized with proper bank stabilization that includes properly sized riprap keyed-in below the scour-depth of the stream bed.

Figure 21. Failing slope near inlet to box culvert over Mill River on Oakland Station Rd.

The outlet of the box culvert drops steeply to a scour pool. This appears to be a barrier to aquatic organism passage. If this blockage creates significant ecological discontinuity retrofit options should be considered to improve connectivity. A tail-water control structure such as a rock weir and the end of the scour pool can raise the pool surface to create better passage conditions.

This structure appears to be in serviceable condition. However, when this box culvert reaches the end of its service life, it should be replaced with a structure that meets design standards set forth by the State of Vermont. This will help ensure sediment transport equilibrium, reduce erosion hazards, and maximize ecological integrity of this road-stream crossing.

1.6 Mill River Rd. Rugg Brook Bridge

The Rugg Brook-Mill River Rd. bridge, just east of Bronson Rd., consists of a concrete slab resting on two stone-masonry abutments (Figure 22). The span between abutments is narrower than bankfull width. At elevated flow rates, this causes increased velocities which lead to erosion of the stream bed and stream banks downstream of the structure. The existing structure appears to be approaching the end of the service life with undercutting apparent beneath the abutments and deterioration of the stone masonry. When the structure is replaced, particular attention should be given to assure the new structure has sufficient length to allow unimpeded flow at bankfull conditions. This ensures sediment–transport continuity and maximizes ecological integrity of the road-stream crossing while resulting in a flood resistant structure that requires reduced maintenance over the course of its service life.

Figure 22. Deteriorating stone abutments of Mill River Rd. bridge over Rugg Brook.