Stormwater Master Plan
Lake Bomoseen Watershed, Castleton and Hubbardton, Vermont

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1.0 Introduction

The Poultney Mettowee Natural Resources Conservation District (PMNRCD), Fitzgerald Environmental Associates (FEA), Vermont DEC, the Lake Bomoseen Association (LBA), and the Towns of Hubbardton and Castleton contributed to a Stormwater Master Plan within the Lake Bomoseen Watershed. Lake Bomoseen drains to the Poultney River (via the Castleton River), which is one of the major tributaries to the South Lake of Lake Champlain. South Lake has been identified as a 'Gap' watershed, one that will not meet water quality standards under any of the proposed land management or best practices scenarios in the State's proposed TMDL Implementation Plan (November, 2014). In fact, South Lake would need to reduce phosphorus inputs by 45% to meet Water Quality Standards (M. Rupe, 4/7/15, Interagency Training, Rutland).

The State of Vermont and local conservation partners are working together to identify high-priority projects to reduce the movement of phosphorus to waterbodies. These projects have many other beneficial effects, such as decreasing stormwater flows to streams and increasing resiliency to floods. Through the Lake Bomoseen stormwater master plan, 48 potential projects were identified, 20 projects were ranked as high priority, and six projects were selected for conceptual designs. These projects were approved by the Lake Bomoseen Association and the Lake Bomoseen Water Quality Committee (LBWQC) and received support from the Castleton Planning Commission and the Castleton Select Board.

1.1 Project Background

Residents living on the Lake believe that phosphorus, sediment, and bacteria are creating water quality concerns. For example, since Tropical Storm Irene, the sediment flows via Sucker Brook have increased significantly. Resident Bill Wood measured 900 cubic yards of sediment deposition that has entered the lake through the brook since Irene (this is equivalent to 765-900 tons of soil, or 90 dump truck loads). The Lake Bomoseen Water Quality Committee reports that certain neighborhoods have a strong septic smell. The landowners cite eroding streambanks and trees from the riparian buffer that have fallen into the widening stream in the past few years, leaving a buffer with decreased functionality. Additionally, the back roads in this subwatershed are steep and parallel the streams, and the 'urban' areas can be dense, located adjacent to the lake, and in addition to areas with unknown septic efficiency, the lakeshore areas lack green stormwater infrastructure.

Originally, the partners planned to focus on the Sucker Brook watershed, since they felt that there was clear documentation of an unusually high sediment load associated with that stream, however, in subsequent talks the Lake Bomoseen Water Quality Committee identified seven additional stormwater, erosion, and septic projects in other parts of the lake, illustrating a need to expand the study to the entire lake.

1.2 Project Goals

The goal of this project was to determine anthropogenic sources of sediment and nutrients flowing to Lake Bomoseen and to identify projects to mitigate these inputs. Stormwater Master Planning involves identifying stormwater, sediment, nutrient, and septic inputs to waterways and designing projects to mitigate those inputs; either eliminating them at the source through green stormwater infrastructure, septic system improvements, back road projects or improving floodplain access within

the stream network to increase sediment attenuation. The initial project goals were to identify at least 10 projects and to create conceptual designs (roughly 30% design) for at least five projects.

In addition to the activities funded through this grant, the District and LBWQC worked with the Vermont Department of Environmental Conservation LaRosa Lab to collect and analyze phosphorus samples to determine baseline phosphorus concentrations in the tributaries flowing to Lake Bomoseen. The Rutland Regional Planning Commission (RRPC) completed education and outreach about stormwater zoning and town plan language with town officials in Castleton and Hubbardton in conjunction with this project through one of their current grants.

This public-input-driven study and planning effort eventually led to the identification of 48 potential stormwater mitigation projects. Of these projects, five were ditch erosion and runoff projects, ten were driveway erosion and runoff projects, seven were shoreline revegetation or buffer projects, sixteen were stormwater best management practices, seven were stream channel or bank erosion projects, and three were other types of projects. Of the twenty projects deemed high-priority by the project partners, four were driveway erosion and runoff, three were shoreline revegetation and buffer projects, twelve involved implementing stormwater best management practices, and one fell into the 'other' category.

2.0 Study Area Description

2.1 Castleton River Watershed

The Castleton River drains approximately 99.3 square miles of land area located in Rutland County, Vermont (Figure 1). The Castleton River joins the Poultney River at the Vermont / New York border. The Poultney River flows to South Lake north of Whitehall, New York; waters then drain to the north via South Lake to the main section of Lake Champlain (SMRC, 2007). Significant bodies of water in the Lake Bomoseen Watershed include the 2,360-acre Lake Bomoseen, 202-acre Glen Lake, 42-acre Pine Pond, 62-acre Love's Marsh, all of which drain to the Castleton River (Castleton Town Plan, p. 43).

The Castleton River watershed is located largely within the Taconic Mountains. The upper headwaters of the Castleton River watershed flow through the West Rutland Marsh. The lowest elevation in the watershed is approximately 297 feet at the confluence of the Castleton River with the Poultney River (SMRC, 2007).

The following is from SMRC's 2007 Phase 2 Geomorphic Assessment Report for the Castleton River:

> In recent geologic time (prior to 14,000 years before present) advancing and retreating glaciers occupied this landscape, with ice up to a mile or more in thickness above the present land surface in the Champlain Valley to the north. Glacial tills now blanket much of the upper bedrock-controlled slopes and headwaters of the Castleton watershed. (Stewart & MacClintock, 1969).
>
> As the global climate warmed and the glaciers receded, a large fresh-water lake (Lake Vermont) inundated the Champlain Valley, and joined Lake Albany to the south in the Hudson River valley. At its highest stage, Lake Vermont's waters extended through the low-lying Castleton River valley to the north of West Rutland and encompassed the broad valley now occupied by Lake

Bomoseen. Ancient lake sand deposits are mapped from Castleton village downstream to the confluence with the Poultney River (Stewart and MacClintock, 1969).

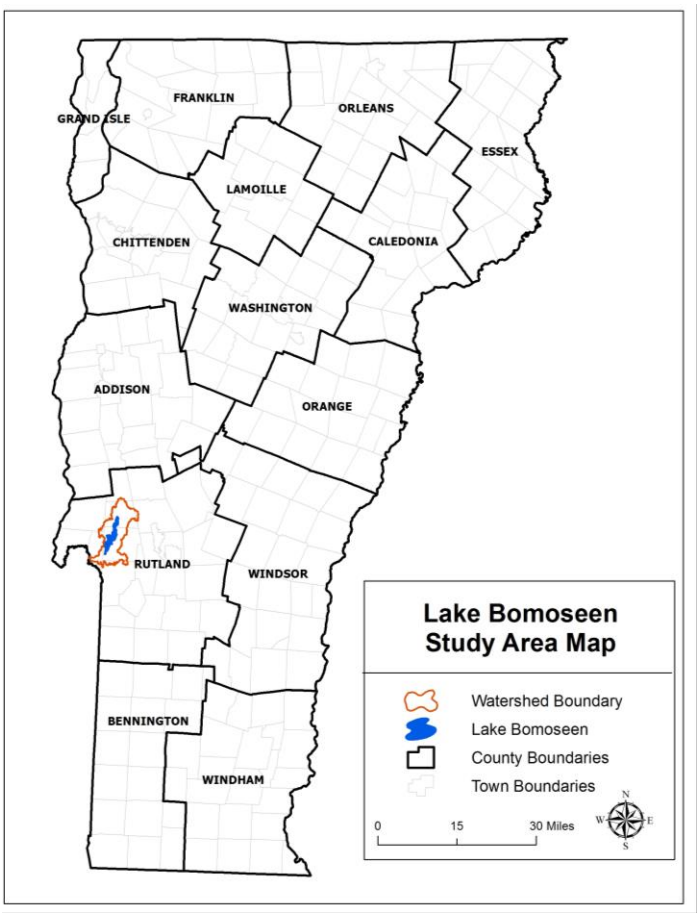


Figure 1: Castleton River watershed and Lake Bomoseen study area location map

Lake Vermont waters receded in stages and were slowly replaced with sea water from the St Laurence Seaway creating the Champlain Sea. The maximum elevation of these marine waters is not believed to have extended into the present-day Castleton River watershed (Wagner, 1972). Nevertheless, changing base levels in the Champlain Valley during this Champlain Sea event would have influenced erosional and depositional cycles in the Castleton River watershed. Champlain Sea waters had receded from the greater Champlain Valley by approximately 10,000 years before present, as the rate of land rise began to outpace the rate of sea-level rise. River systems, including the Castleton River, then continued moving and redepositing sediments left in the wake of the glaciers, and further eroding the Taconic Mountains. As base levels dropped in the Champlain Valley (and the Poultney River), the Castleton River eroded downward through the Lake Vermont delta deposits and underlying lake silts and clays. Today, in the town of Fair Haven, the Castleton River is incised up to 80 feet into these deposits. Downward incision was apparently arrested at exposures of channel-spanning bedrock in the present-day village of Fair Haven. Currently, these bedrock exposures serve as a local base level for upstream reaches of the Castleton River (SMRC, 2007).

2.2 Lake Bomoseen Watershed Description

Lake Bomoseen is 2,360 acres (the largest lake located entirely in Vermont) and its watershed is approximately 37.5 square miles (24,770 acres) located mainly in the Towns of Castleton and Hubbardton (Figure 2). Lake Bomoseen, found primarily in the northwest corner of Castleton, extends from Hydeville through Castleton's northern boundary into the Town of Hubbardton, where it covers most of the town area, then extends to its northernmost point in southern Sudbury. The upland hills and mountains remain relatively undeveloped due to their inaccessibility by town roads and the limiting influence of steep slopes and shallow soils. These areas are forested with northern hardwood forest species; forest is the dominant land cover type occupying nearly 70% of the watershed (Table 1). Waterfront property is intensively developed with seasonal homes and year-round residences as well as recreational and commercial businesses. The western shore has a few stretches that remain in a natural state. Residential development occurs throughout the remainder of the watershed located in Castleton.

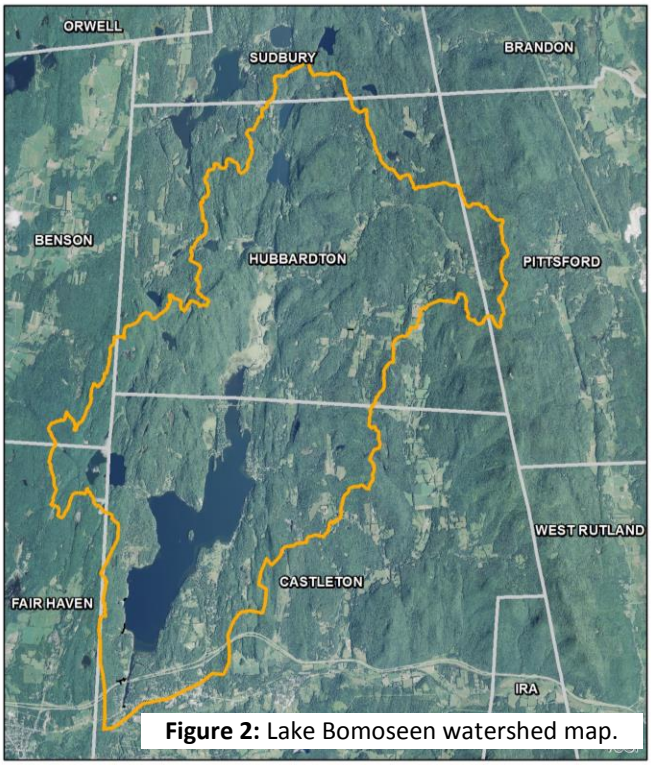


Figure 2: Lake Bomoseen watershed map.

Table 1: Land cover in the Lake Bomoseen Watershed (NOAA, 2008).

Land Cover/Land Use Type	% of Watershed
Agriculture	4.8%
Development	5.4%
Forest	69.3%
Open Water	12.3%
Scrub/Shrub	1.5%
Grassland	0.2%
Wetland	6.5%

Castleton has several extensive land areas within the Lake Bomoseen watershed that are publicly owned. Lands under the jurisdiction of the state are Love's Marsh and Blueberry Hill Wildlife Management Areas, which are managed by the Fish and Wildlife Department. Bomoseen State Park, located in West Castleton, includes a large portion of Glen Lake. Part of the park also fronts on Lake Bomoseen and is under the management of the Department of Forests Parks and Recreation. The Town of Castleton owns a town forest and short segment of shoreline in the Crystal Beach area, and a parcel on Sand Hill road that was donated by Castleton University (Castleton Town Plan, pp. 11-12). In addition

there are three boat launches owned by Vermont Department of Fish and Wildlife, one off of Spooner Johnson Road, one off of Creek Road, and one accessed by the Kehoe Camp.

2.3 Lake Bomoseen Water Quality Concerns

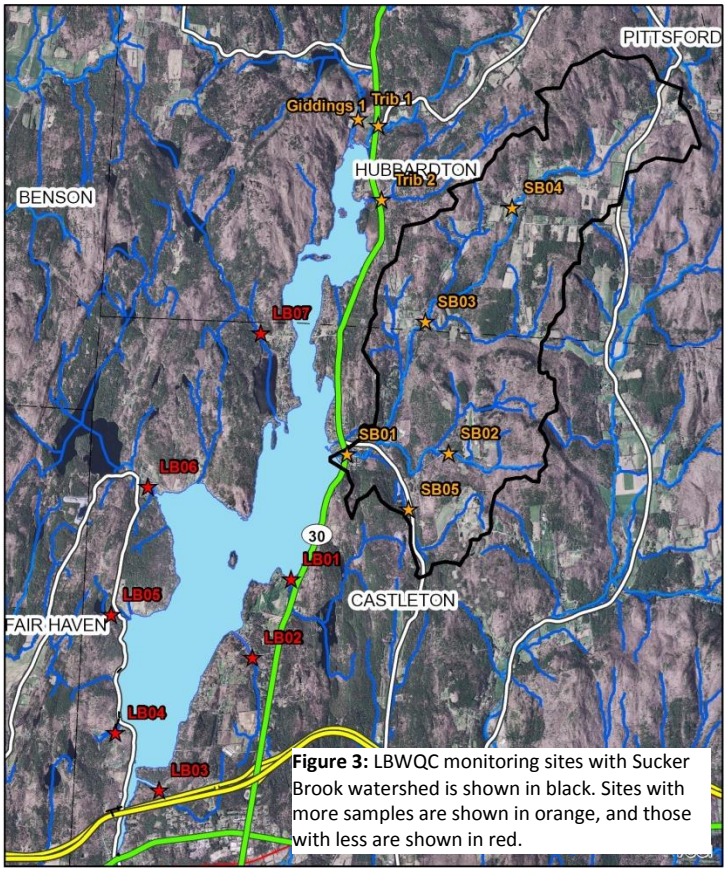


Figure 3: LBWQC monitoring sites with Sucker Brook watershed is shown in black. Sites with more samples are shown in orange, and those with less are shown in red.

In preparation for the Lake Bomoseen Stormwater Master Plan, PMNRCD met with the LBWQC in the spring of 2015 and selected eight monitoring sites to gather baseline information about nutrient and bacteria loading to the lake, the standard contaminants monitored by the District (Table 2). The nutrient and bacteria concentrations also act as a proxy for sediment levels entering the lake. Five (5) of the monitoring sites were selected within the Sucker Brook watershed, a well-known source of significant sediment loading (Figure 3). Three tributaries entering the northern portion of the Lake were also sampled (Tributary 1, Tributary 2, and Giddings Brook). All of the sites shown in orange were sampled during the 2015 and 2016 monitoring season, which consists of approximately 8 sample collection dates each summer.

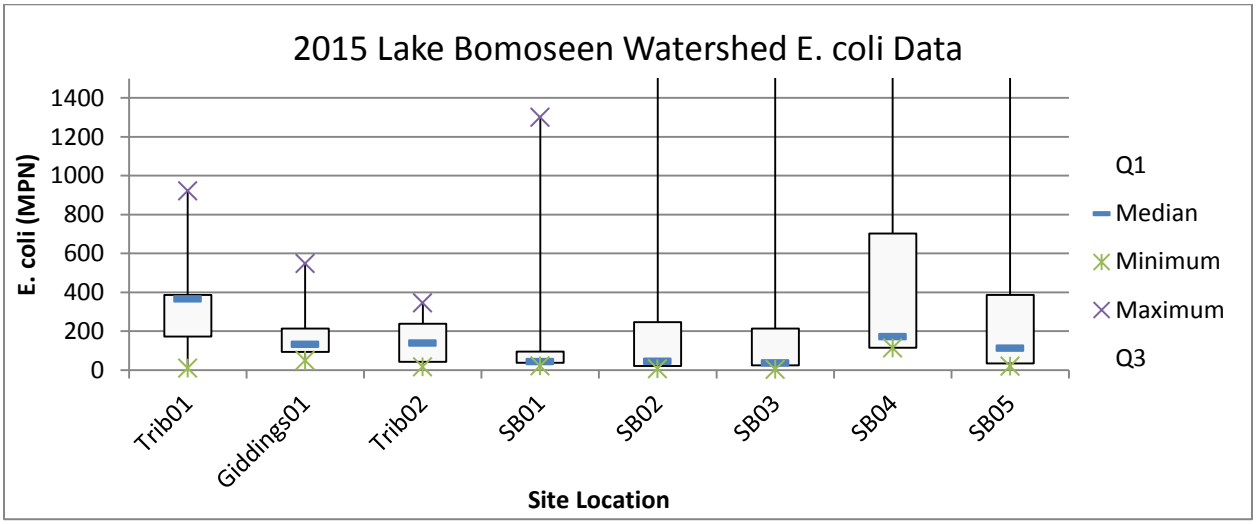
Results from the 2015 sampling efforts are shown in Figures 4-6. Bacteria concentrations were highly variable including concentrations above the detection limit (2,420 MPN) at four of the five Sucker Brook sites during at least one of the sampling days. Three of the sites (Trib 1, SB04, and SB05) were consistently above the water quality standard for the E. coli (235 MPN). Total phosphorus results were also variable with all sites having at least one sample above the water quality standard (27ug/L). The same three sites with consistently elevated bacteria also indicated elevated total phosphorus. These data suggest that human or animal waste may be significant sources of bacteria and nutrients within these tributary watersheds.

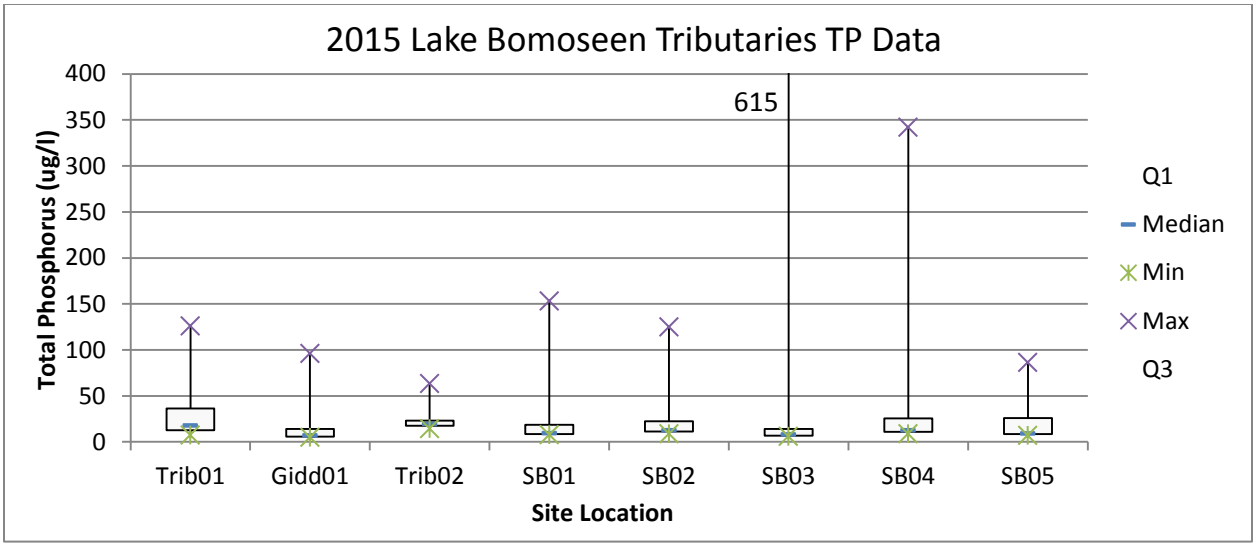
In 2016, the Lake Bomoseen Water Quality Committee suggested collecting water samples from the many smaller tributaries entering the lake, and the District chose seven additional sample locations, labeled LB01-LB07 on the above map. The locations of these seven sites are included in Table 3, below.

Table 2: Sediment and Bacteria Monitoring Sites for 2015 and 2016 sampling.

Site Name	River	Description	Significance
SB01	Sucker Brook	Sucker Brook at the Route 30 crossing/Crystal Beach access	Assessment; no previous info, but sediment source
SB02	Sucker Brook	Sucker Brook at Barker Hill Road	Assessment; no previous info, but sediment source
SB03	Sucker Brook	Sucker Brook at Gill Hill Road	Assessment; no previous info, but sediment source
SB04	Sucker Brook	Sucker Brook at St. Johns Road	Assessment; no previous info, but sediment source
SB05	Sucker Brook	Sucker Brook at North Road, past Barker Hill	Assessment; no previous info, but sediment source
Tributary 1	Trib	Trib to Lake Bomoseen at Dikeman Hill Rd and Route 30	Assessment; no previous info
Giddings01	Giddings Bk	Trib to Lake Bomoseen at Monument Hill and Rte 30	Assessment; no previous info, but animal pasture
Tributary 2	Trib	Trib to Lake Bomoseen at private road (branch of the above creek)	Assessment; no previous info, but downstream of wetland
LB01	Trib	Drainage from Pine Lake; collected at the golf course	Preliminary site and data; potential nutrient source
LB02	Trib	Small drainage entering a nutrient-rich inlet	Preliminary site and data; potential nutrient source, drainage from the rte 4 interchange
LB03	Trib	Small E-stream entering at Indian Bay Rd	Preliminary site and data; potential nutrient source
LB04	Trib	Small tributary at Point of Pines	Preliminary site and data; potential nutrient source
LB05	Trib	Small tributary, draining a pond, at Coon Hill Road	Preliminary site and data; potential nutrient source
LB06	Hazard Brook	Tributary draining Glenn Lake, at the entrance to the State Park	Preliminary site and data; potential nutrient source
LB07	Trib	Tributary draining a working forest with mountain bike trails	Preliminary site and data; potential nutrient source

Charts 1 and 2: Water Quality results for 2015 sampling season in the Lake Bomoseen Watershed.





3.0 Stormwater Management Planning Library

We began our SWMP efforts by gathering and reviewing information and documentation related to stormwater runoff and watershed management within the Lake Bomoseen watershed. The planning library is included in Appendix A. Sources for this information include:

- **Local Datasets**
  - PMNRCD Water Quality Monitoring Data - 2015
  - VTDEC Lake Bomoseen Lay Monitoring Program Water Quality Data - multiple years
  - Culvert Assessment and AOP modeling - 2011/2015
- **Town and Regional Plans**
  - Castleton Town Plan - 2010
  - Vermont Hazard Mitigation Plan, Rutland Region - 2011
  - Hubbardton Town Plan - 2012
- **Corridor Plans and Stream Geomorphic Assessments**
  - Castleton River Phase 1 Geomorphic Assessment - 2005
  - Castleton River Phase 2 Geomorphic Assessment - 2007
- **Other Datasets**
  - Vermont Water Quality Standards - 2014

4.0 Stormwater Problem Areas

One of the primary goals of the stormwater master plan is to "develop a comprehensive list of stormwater problems" within the Lake Bomoseen watershed. PMNRCD and FEA conducted a total of four (4) field tours of the project area and had meetings with representatives from the Lake Bomoseen Association (Including the Water Quality Committee), VTANR, and shoreline property owners to identify existing problem areas, evaluate and prioritize sites, and recommend potential solutions. A summary of the project identification timeline, site tours, and outreach meetings is provided in Appendix C.

4.1 Identification of Problem Areas

The initial round of problem area identification began by identifying stormwater related projects using a desktop exercise scanning the watershed with imagery, NRCS soils data, and high-resolution LiDAR contours in a GIS. Potential project areas were identified and mapped for review during site visits. A total of 48 stormwater problem areas were identified and assessed in the field (see map in Appendix B). We grouped the problem areas into six (6) project types described below.

- **Ditch Runoff & Erosion** - Ditch runoff and erosion projects were identified in many areas where runoff from steep roads (typically gravel) was causing increased sediment and nutrient loading due to ditch erosion.
- **Driveway Runoff & Erosion** - Development on steep slopes along or near the shoreline is associated with numerous steep gravel driveways which are likely significant sources of sediment loading to the lake.
- **Other Erosion** - Potential sediment loading from other erosion sources were identified remotely and during field visits. These sites include concentrated runoff from construction areas and agricultural fields.
- **Shoreline Revegetation/Buffer Improvements** - Shoreline revegetation and buffer improvement projects were identified in areas where degraded shoreline vegetation has increased the risk of shoreline erosion or in areas where improved vegetation could reduce sediment and nutrient sources from stormwater runoff.
- **Stormwater BMP** – Many sites were identified where sediment and nutrient loads could be reduced through the implementation of stormwater best management practices in areas of concentrated surface runoff or stormwater drainage infrastructure.
- **Stream Channel/Bank Erosion** - Active channel and bank erosion sites were identified remotely and during field visits on streams which drain to the lake. Many of these sites are actively eroding and are likely moderate to large sources of sediment and nutrient loads.

4.2 Evaluation and Prioritization of Problem Areas

The 48 projects described in Table 3 were prioritized based on the potential for each project to reduce nutrient and sediment inputs to Lake Bomoseen, as well as the potential to reduce flood vulnerability to municipal or state road and drainage infrastructure. The contributing drainage area was described for each site, including details about impervious cover and slope of drainage features, using the approach described below.

GIS-based Site Screening

Using the field data points collected with sub-meter GPS during our watershed tours (see Appendix C), we evaluated key characteristics for each site indicating the potential for increased stormwater runoff and pollutant loading, and the potential shoreline revegetation length where appropriate. These GIS-based observations, along with field-based observations of site characteristics, are summarized in Table 3 under the “Site Description” column and the final “Notes” column.

The following geospatial data were reviewed and evaluated as part of the GIS-based screening:

- **Aerial Photography** – We used the NAIP 1m imagery from 2014 to review the site land cover characteristics (i.e., forest, grass, impervious) and measure the total impervious area in acres draining to the project area as identified in the field. We also used the imagery to measure the potential shoreline buffer planting zone.
- **LiDAR** – We utilized the 0.7m LiDAR data for Rutland County collected in 2015. We developed 2-foot and 10-foot contours to delineate stormwater drainage areas at the subwatershed and site scale. Land cover and soils were then evaluated within these drainage boundaries. We also used the LiDAR to evaluate the slope of ditches and gravel roads as this relates to runoff potential, road/ditch stability, and potential remediation measures.
- **NRCS Soils** – We used the Rutland County Soils data to evaluate the inherent runoff and erosion potential of native soil types (i.e., hydrologic soil group, erodible land class). For project sites with potential for green stormwater infrastructure (GSI), we summarized the general runoff characteristics of the drainage area based on hydrologic soil group (HSG).
- **Parcel Data** – We used the parcel data available through VCGI to scope the limits of potential projects based on approximate parcel boundaries and road right-of-way.

Final evaluation criteria summarized in Table 3 included the following:

- **Nutrient Load Reduction** – Sites having the greatest potential for nutrient load reduction include agricultural lands along stream corridors, as well as moderate and high density residential areas with lawns along the shoreline. Runoff from low density residential areas and gravel roads were considered to have moderate to low nutrient loading, depending on the site size.
- **Sediment Load Reduction** - Sites having the greatest potential for sediment load reduction include expansive gravel surfaces near the shore (e.g., parking lots at fishing access), long stretches of steep roads with unstable ditches, poorly drained soils, and large scale bank erosion along Sucker Brook. Runoff from low density residential areas and driveways were considered to have moderate to low sediment loading, depending on the site size and proximity to the lake.
- **State/Municipal Infrastructure Resiliency** – Sites were evaluated based on their potential to impact state or municipal drainage infrastructure such as ditches, catch basins, and culverts. Sites draining to these features were prioritized based on the relative stormwater volume and sediment loads they contribute to public infrastructure.
- **Overall Prioritization** – Sites were given a final prioritization within each project type (i.e., ditches versus driveways) based on a review of the criteria listed above.

Problem area summary sheets were developed for 20 of the high-priority project sites, and are provided below following Table 3. These sites were selected based on the prioritization categories shown in Table 3 and from input from project stakeholders during the meetings described in Appendix C. The summary sheets include a site map and description, site photographs, prioritization categories, and a ranking for ease of project implementation.

Table 3: Stormwater problem areas listed by project type. Project numbers correspond to the map in Appendix B.

Project	Project Type	Site Description	Nutrient Load Reduction	Sediment Load Reduction	State/Municipal Infrastructure Resiliency	Overall Prioritization	Notes on Drainage Area, Pollutant Loading, and Buffer Planting Length
3	Ditch Runoff & Erosion	Moderate erosion in ditch along south side of Saint John Road; regrade road shoulder to get water in vegetated ditch and prevent rilling	Moderate	Moderate	Moderate	Moderate	Road and ditch has 8% slope with 0.25ac gravel road draining to ditches. Hydrologic Soil Group (HSG) C indicates some increased runoff potential upslope.
5	Ditch Runoff & Erosion	Frog Hollow Road to the east of the Sucker Brook crossing has erosion/rilling along ditches; stone-line ditches and consider check dams on ditch where slopes >5%	Low	Moderate	Moderate	Moderate	Road and ditch has 15% slope with 0.3ac gravel road draining to ditches. HSG C indicates some increased runoff potential upslope.
23	Ditch Runoff & Erosion	Ditches along upper Point of Pines Road are stone-lined and mostly stable, with a forested turn-out on the west side. Long-term monitoring and maintenance needed as slope >5%	Low	Low	Moderate	Low	Road and ditch has 8% slope with 0.2ac gravel road draining to ditches; During a site visit on 9-14-16, PMNRCD noted that the Town of Castleton had cleaned out the upper stretches of road ditch, seeded, and covered with straw mats. HSG C indicates some increased runoff potential upslope.
25	Ditch Runoff & Erosion	Recently cleaned ditch on west side of lower Point of Pines Road from Bluebell Lane down to Creek Road. Consider 3-4 stone check dams on slopes >5% on northern portion of ditch	Low	Moderate	Moderate	Moderate	Road and ditch has 5-10% slope with 0.25ac gravel road draining to ditches. HSG C indicates some increased runoff potential upslope.
42	Ditch Runoff & Erosion	The steep ditch along the north side of Float Bridge Rd is eroding and delivering fine sediment and nutrients to the Lake. A water bar along Campbell Rd is directing additional runoff to the ditch.	Moderate	High	Moderate	High	Approximately 0.3ac impervious with slopes 5-10%. HSG C and D indicate increased runoff potential upslope.
8	Driveway Runoff & Erosion	Private Driveway off Stables Road with large area of exposed earth on slopes exceeding 10%. Significant source of fine sediment entering tributary at driveway bridge observed in field.	Moderate	High	N/A	High	Gravel drive and ditch exceeds 10%. Nearly an acre of unpaved surfaces upslope in addition to large house/rooftop. HSG C indicates some increased runoff potential upslope.
13	Driveway Runoff & Erosion	Cliff Dwellers Road with 5-6 homes draining to west down very steep (10-20%) gravel drive. Fine sedimentation likely in culvert at intersection with Route 30.	Moderate	High	High	Moderate	Road and ditch has slopes >10% with 0.25ac gravel road draining to ditches, plus short driveways serving 5-6 homes. HSG D indicates increased runoff potential upslope.

Table 3: Stormwater problem areas listed by project type. Project numbers correspond to the map in Appendix B.

Project	Project Type	Site Description	Nutrient Load Reduction	Sediment Load Reduction	State/Municipal Infrastructure Resiliency	Overall Prioritization	Notes on Drainage Area, Pollutant Loading, and Buffer Planting Length
14	Driveway Runoff & Erosion	Single steep, gravel driveway serving one home off Route 30 approx 1/2 mile north of Edgewater Inn	Low	Moderate	N/A	Low	Gravel driveway (0.1ac impervious) with slope 5-10%. HSG C and D indicate increased runoff potential upslope.
16	Driveway Runoff & Erosion	Single steep, gravel driveway serving one home off end of Pine Cliff Road	Low	Low	N/A	Low	Gravel driveway (<0.1ac impervious) with slope 5-10%. HSG C indicates some increased runoff potential upslope.
17	Driveway Runoff & Erosion	Several new lakeshore homes off Little Rutland Road with short but steep driveways down to lake	Low	Moderate	N/A	Moderate	Approximately 0.25ac impervious with slopes 5-20%. HSG C indicates some increased runoff potential upslope.
24	Driveway Runoff & Erosion	Rilling on steep gravel driveway down to stream at intersection of Riehl Road and Point of Pines Road. Moderate sediment source noted in field.	Low	Moderate	N/A	Low	Gravel driveway (<0.1ac impervious) with slope 5-10%. HSG C indicates some increased runoff potential upslope.
28	Driveway Runoff & Erosion	Shared driveways west of Creek Road located 300 feet north of Point of Pines Rd. Drains to catch basin on Creek Road. Very tight, probably no space for BMPs. May need larger catch basin with sump.	Moderate	High	Moderate	High	Houses and gravel surfaces 0.25ac; Portions of gravel drive down to Creek Road >20%. HSG D indicates increased runoff potential upslope.
34	Driveway Runoff & Erosion	Large new house on Clements Point Road with steep gravel driveway down to lake.	Low	High	N/A	High	Houses and gravel surfaces 0.4ac; Portions of gravel driveway leading down to lake >15% and rilling erosion noted in field. HSG D indicates increased runoff potential upslope.
35	Driveway Runoff & Erosion	Avalon Beach Road has several steep driveways down to lake; Some driveways are gravel and some paved. Several new mound systems noted in field on west side of road.	Moderate	Moderate	N/A	Moderate	Houses and gravel surfaces >0.5ac; Portions of gravel driveways leading down to lake >15% and rilling erosion noted in field. HSG D indicates increased runoff potential upslope.
40	Driveway Runoff & Erosion	Short gravel driveway and patios (no buffer) draining to lake off Indian Point Road; Potential neighborhood opportunity for rooftop disconnects, shoreline buffer plantings, etc.	Low	Low	N/A	Low	Houses and gravel surfaces approx 0.25ac; Slopes generally <5%. HSG A indicates limited runoff potential and potential for infiltration treatment practices.

Table 3: Stormwater problem areas listed by project type. Project numbers correspond to the map in Appendix B.

Project	Project Type	Site Description	Nutrient Load Reduction	Sediment Load Reduction	State/Municipal Infrastructure Resiliency	Overall Prioritization	Notes on Drainage Area, Pollutant Loading, and Buffer Planting Length
9	Other Erosion	Likely gully site visible in aerial photos and with LiDAR. Field to south appears to be ditched leading to potential gully location. Field access difficult - need landowner permission	High	High	N/A	High	Gully side slopes >20%; Drainage area from agricultural fields approx 2 acres with obvious ditching. HSG C and D indicate increased runoff potential upslope.
18	Other Erosion	New shoreline house construction erosion off end of Noyes Road with some potential erosion to lake	Low	Moderate	N/A	Moderate	Gravel drive/rooftop approx 0.2ac; Very steep slopes (15-20%) on bank down to lake where construction taking place.
43	Other Erosion	Old sluiceway on Jim Leahmy's property per Terry Moran of LBA. May be a source of sediment during runoff events.	Low	Moderate	N/A	Low	Need more information from Terry Moran and Jim Leahmy re: sediment loading
4	Shoreline Revegetation/ Buffer Improvement	Cows in unfenced pasture along Sucker Brook north of Frog Hollow Road crossing. Need fencing and stream buffer.	High	Moderate	N/A	Moderate	3 possible projects in this area; 2,750 LF total; 500 LF at WQM site, 850 LF at the barn and 800 LF on the hill at St John Farm; 700 feet at Biddie Knob Rd
22	Shoreline Revegetation/ Buffer Improvement	Potential shoreline revegetation area along Creek Road approx 1,000 ft south of Riehl Road.	Low	Low	N/A	Low	2,000 LF
31	Shoreline Revegetation/ Buffer Improvement	Public beach known as Green Dump. Consider planting plan for shade and stormwater improvements.	Moderate	Moderate	N/A	High	1,800 LF; 400 LF at the parking area and 1400 LF along the road
33	Shoreline Revegetation/ Buffer Improvement	Montcalm Vineyards off Avalon Beach Road; Some steep drainages and wetland areas with no buffer. Hilary to conduct follow-up visit with owners.	Low	Low	N/A	Low	Jen Alexander from PMNRCD to conduct outreach to landowners
37	Shoreline Revegetation/ Buffer Improvement	Multiple houses/camps along Cedar Mountain Road with lawns and patios extending down to lake. Some buffer improvement potential. Limited stormwater runoff from ditches.	Moderate	Low	N/A	Moderate	1,300 LF in the low area, plus additional smaller areas in front of the homes

Table 3: Stormwater problem areas listed by project type. Project numbers correspond to the map in Appendix B.

Project	Project Type	Site Description	Nutrient Load Reduction	Sediment Load Reduction	State/Municipal Infrastructure Resiliency	Overall Prioritization	Notes on Drainage Area, Pollutant Loading, and Buffer Planting Length
47	Shoreline Revegetation/ Buffer Improvement	Neshobe beach has no buffer and some minor erosion. Past outreach by PMNRCD and VTDEC	Moderate	Low	N/A	Moderate	3,600 including the channel, which doesn't have good buffers either (1,000 along the lake)
48	Shoreline Revegetation/ Buffer Improvement	Fencing and buffer needed along horse pasture along Giddings Brook southwest of intersection of Monument Hill Road and Route 30.	High	Moderate	N/A	High	1,000 LF along each side of Giddings Brook
1	Stormwater BMP	Potential road ditch outflow from Johnson Spooner Road approximately 700 ft south of Float Bridge Road. Needs follow up site visit on private land.	Low	Low	N/A	Low	Houses and gravel surfaces 0.4ac; Johnson Spooner Road approx 0.2ac paved. Appears to drain into ditch leading to lake based on LiDAR review. HSG C and D indicate increased runoff potential upslope.
6	Stormwater BMP	Potential road ditch outflow from Route 30 just north of Larson Lane. Needs follow up site visit on private land.	Low	Low	N/A	Low	Houses and gravel surfaces 0.3ac; VT Route 30 approx 0.2ac paved. Appears to drain into ditch leading to lake based on LiDAR review. HSG C and D indicate increased runoff potential upslope.
7	Stormwater BMP	Potential road ditch outflow from neighborhood off East Crystal Haven Road. Needs follow up site visit on private land.	Low	Low	N/A	Low	Houses and gravel surfaces 0.2ac. Appears to drain into ditch leading to lake based on LiDAR review. HSG C indicates some increased runoff potential upslope.
15	Stormwater BMP	Upslope runoff into eutrophied pond; Confirmed no P used in golf course fertilizer; Potential in-pond aeration treatment or retrofit to improve nutrient retention/cycling.	Moderate	Moderate	N/A	High	Drainage area to golf course pond from upstream watershed (Pine Pond) is 1.52 square miles. Perennial stream and may be too large of a drainage area to effectively treat.
19	Stormwater BMP	18" HDPE culvert pipe to lake taking runoff from Point of Pines upslope and intersection with Creek Road near US-4 overpass. Point of Pines is paved. Not a major source of sediment.	Low	Low	Low	Low	Point of Pines road (0.3ac impervious) has very steep slope near intersection, exceeding 15% in some places. HSG C and D indicate increased runoff potential upslope.

Table 3: Stormwater problem areas listed by project type. Project numbers correspond to the map in Appendix B.

Project	Project Type	Site Description	Nutrient Load Reduction	Sediment Load Reduction	State/Municipal Infrastructure Resiliency	Overall Prioritization	Notes on Drainage Area, Pollutant Loading, and Buffer Planting Length
20	Stormwater BMP	Runoff from the gravel and paved parking area along the east side of the Woodard Marine storefront drains to a catch basin recently installed by the Town. The catch basin is piped directly into the lake and has been a repeat source of fine sediment loading.	Moderate	High	Moderate	High	Over 1ac impervious surface, including approx 0.5ac gravel, drain to catch basin. HSG C and D indicate increased runoff potential upslope.
21	Stormwater BMP	Several stormwater outfalls from Creek Road north of Woodard Marina. Most are cross-culverts from ditches.	Low	Low	N/A	Low	Low slope in ditches along Creek Road. Not a significant sediment source. HSG C indicates some increased runoff potential upslope.
26	Stormwater BMP	Low area with runoff from ditch to east along Creek Road located in between Riehl Road and Point of Pines. Potential retrofit opportunity with culvert under access rd. Lower priority given existing treatment.	Moderate	Low	Low	Moderate	Upslope drainage area is approx 3ac but is mostly stable with exception of recently cleaned ditch along Creek Road to east. HSG C indicates some increased runoff potential upslope.
27	Stormwater BMP	Drop inlet with catch basin just north of Creek Road and Point of Pines intersection. Catch basin takes runoff from ditch upslope. Very little sediment storage in basin due to limited sump.	Low	Moderate	Moderate	Moderate	Upslope road and ditch has 5-10% slope with 0.25ac gravel road draining to ditches. HSG C and D indicate increased runoff potential upslope.
29	Stormwater BMP	Green Dump fishing access has 2 locations where stormwater drains to low points on the shoreline and treatment of runoff could be enhanced with BMP. Highly visible public location.	Moderate	High	Moderate	High	Gravel parking area approx 0.5ac draining directly to lake. HSG D indicates increased runoff potential upslope.
30	Stormwater BMP	The gravel parking areas on the west side of Creek Rd at the Green Dump fishing access drain to two low areas that could be enhanced with BMP.	Moderate	Moderate	Moderate	Moderate	Gravel parking area approx 0.5ac draining to a low point west of Creek Road. HSG D indicates increased runoff potential upslope.
32	Stormwater BMP	Stormwater outfall along Creek Road approx 1/4mile north of Green Dump fishing access. Likely an insignificant sediment input	Low	Low	Low	Low	Low slope in ditches along Creek Road. Not a significant sediment source. HSG D indicates increased runoff potential upslope.

Table 3: Stormwater problem areas listed by project type. Project numbers correspond to the map in Appendix B.

Project	Project Type	Site Description	Nutrient Load Reduction	Sediment Load Reduction	State/Municipal Infrastructure Resiliency	Overall Prioritization	Notes on Drainage Area, Pollutant Loading, and Buffer Planting Length
36	Stormwater BMP	Avalon neighborhood stormwater project - rooftop disconnects, driveway erosion, septic systems.	Moderate	Moderate	N/A	High	Houses and gravel surfaces >0.5ac; Portions of gravel driveways leading down to lake >15% and rilling erosion noted in field. HSG D indicates increased runoff potential upslope.
38	Stormwater BMP	Runoff from fishing access off of Johnson Spooner Rd. Potential BMP along shoreline and potential runoff diversion into existing low area along road.	Moderate	High	N/A	High	Approximately 0.25ac impervious with slopes >10% on access road. HSG A indicates limited runoff potential and potential for infiltration treatment practices.
39	Stormwater BMP	Located at Woodard Marina building on east shore off East Creek Dr. Approx 1/4acre parking lot drains to grass strip and over bank to lake. Potential bioretention retrofit location. A water bar installed and maintained by Woodard Marine directs runoff from 0.4ac of gravel parking area and 0.2ac of rooftops to a low area within the lawn to the south of the property. Drainage and landscaping improvements could increase infiltration and nutrient/sediment retention at the site.	Low	Moderate	Low	Moderate	Approximately 1 ac impervious with slopes <5%. HSG A and B indicate limited runoff potential and potential for infiltration treatment practices.
41	Stormwater BMP	Edgewater Resort on Route 30. Many stormwater retrofit opportunities including rooftop disconnects, small infiltration/detention basins, and ditch improvements	High	High	High	High	Approx 2.5ac of impervious surface with many areas having slopes 5-10%. HSG C and D indicate increased runoff potential upslope.
2	Stream Channel/ Bank Erosion	Intermittent stream along Pencil Mill Road with potential channel erosion noted in GIS.	Low	Low	N/A	Low	70 acre (0.1 sqmi) drainage area upstream is mostly forested. May be worth checking erosion along Pencil Mill Road ditch but upstream drainage not worthy of treatment.

Table 3: Stormwater problem areas listed by project type. Project numbers correspond to the map in Appendix B.

Project	Project Type	Site Description	Nutrient Load Reduction	Sediment Load Reduction	State/Municipal Infrastructure Resiliency	Overall Prioritization	Notes on Drainage Area, Pollutant Loading, and Buffer Planting Length
10	Stream Channel/ Bank Erosion	Active channel widening with scour and undercutting on meander bends along tributary to Sucker Brook on upper Barker Hill Road.	Moderate	Moderate	Low	Moderate	Moderately unstable banks and moderately incised channel. Nice forested floodplain that is accessible in larger flows. Worth monitoring as a sediment source but not worth treating.
11	Stream Channel/ Bank Erosion	Active channel erosion and mass failures with channel widening downstream at Barker Hill Road crossing along a tributary to Sucker Brook.	Moderate	Moderate	Low	Moderate	Multiple large mass failures typical of low order headwaters streams. Forested riparian corridor not worth considering treatment options. Explore upstream runoff contribution from project area #12.
12	Stream Channel/ Bank Erosion	Cleared areas of steep land at end of Barker Hill Road associated with the Mortimer Brown Landing Strip. Channel and bank erosion noted on aerial photos.	High	High	Low	High	Approximately 6 acres of recently cleared land along a perennial tributary. Approx. 5 acres of impervious surfaces including gravel areas and buildings draining into a pond with sediment seen on aerial photo.
44	Stream Channel/ Bank Erosion	Multiple areas of bank erosion on Sucker Brook in between Route 30 and North Road. Some areas are moderate sources of sediment to channel and lack buffer.	Moderate	Moderate	Moderate	Moderate	Approximately 300 ft of bank erosion with height 4-5ft upstream of Route 30. Channel is moderately incised and is actively widening in areas where post-Irene sediment deposits are large.
45	Stream Channel/ Bank Erosion	Large mid channel bar - 150ft long x 25ft wide x 2-3ft deep; flood chute and floodplain access above bar. Decent floodplain access and sediment storage in channel/floodplain	Moderate	Moderate	Moderate	Moderate	Approximately 150 ft of bank erosion with height 2-3ft downstream of North Road. Channel is actively widening through post-Irene sediment deposits. Good floodplain access; flood chute is found upstream of bar.
46	Stream Channel/ Bank Erosion	Multiple areas of bank erosion and mass wasting on valley side slopes on Sucker Brook upstream of Stables Road. Some slopes are major sources of coarse and fine sediment. Abandoned slate quarry (Pencil Mill Quarry).	Moderate	High	Moderate	High	Approximately 300 ft of bank erosion and mass failures with height 6-12ft upstream of Stables Road crossing. Site is an abandoned slate quarry and sediment is mobilized downstream in moderate/large floods.

LAKE BOMOSEEN #3	PROBLEM AREA SUMMARY
Site ID: Map3	Design: No
Date Observed	6/20/2016
Location	St John Road near Frog Hollow Road
Waterbody	Sucker Brook
SGA Reach	N/A
Latitude Longitude	43.6956N 73.15934W
Land Ownership	Road ROW
Site Ranking	High

Site Description: Moderate erosion in ditch along south side of Saint John Road; regrade road shoulder to get water in vegetated ditch and prevent rilling. The road and ditch have an 8% slope with 0.25 acre of gravel road draining to the ditches.

Photo 1: Erosion and road runoff runs to Sucker Brook. Photo from top of culvert

Photo 2: Road ditch has grown in with vegetation and is not connected to the road, causing eroding along the length of the road. The road ditch can be reshaped and stabilized with rock and/ or check dams.

Project Type: Stormwater BMP / Prioritization by project type: High

Prioritization Criteria: Low, Moderate, High ranking for each category

Overall Prioritization	Nutrient Load Reduction	Sediment Load Reduction	Ease of Implementation	Municipal Infrastructure Resiliency	Area Treated
MODERATE	MODERATE	MODERATE	HIGH	MODERATE	0.25 ACRE GRAVEL ROADS, 8% SLOPE

LAKE BOMOSEEN #4 — PROBLEM AREA SUMMARY

Site ID: Map4	Design: No
Date Observed	6/20/16
Location	Frog Hollow Road
Waterbody	Sucker Brook
SGA Reach	N/A
Latitude Longitude	43.69958N 73.15318W
Land Ownership	Private
Site Ranking	High

Site Description: Livestock exclusion fencing opportunities in three sections of Sucker Brook near St. John Road. The first at the SJR crossing is 500 LF, at the next farm 1550 LF, and at Biddie Knob Rd 700 LF, for a total of 2750 LF feet of fencing opportunities.

Photo 1: Grazing pasture with Sucker brook running through middle and no fencing to keep animals out of stream.

Project Type: Revegetation and Buffer Improvement/ Prioritization by project type: High

Prioritization Criteria: Low, Moderate, High ranking for each category

Overall Prioritization	Nutrient Load Reduction	Sediment Load Reduction	Ease of Implementation	Municipal Infrastructure Resiliency	Area Treated
MODERATE	HIGH	MODERATE	HIGH	N/A	2,750 LF FENCING

LAKE BOMOSEEN #8	PROBLEM AREA SUMMARY
Site ID: Map8	Design: No
Date Observed	8/18/16
Location	Driveway off of Stables Road
Waterbody	Sucker Brook
SGA Reach	T02.05-s1.02-s1.01
Latitude Longitude	43.6628N 73.18278W
Land Ownership	Private
Site Ranking	High

Site Description: Private Driveway off Stables Road with large area of exposed earth on slopes exceeding 10%. This site contributes a significant source of fine sediment entering the tributary at the driveway bridge, as observed in field. Gravel drive and ditch exceeds 10% slope. Nearly an acre of unpaved surfaces drain to this area from upslope in addition to large house/rooftop.

Photo 1: Erosion from driveway, cleared area, and ditch drains to Sucker Brook.

Photo2: Evidence of driveway sediment is seen in the brook near the bridge.

Project Type: Driveway Runoff and Erosion, Prioritization by project type: High

Prioritization Criteria: Low, Moderate, High ranking for each category

Overall Prioritization	Nutrient Load Reduction	Sediment Load Reduction	Ease of Implementation	Municipal Infrastructure Resiliency	Area Treated
HIGH	MODERATE	HIGH	MODERATE	N/A	1.0 ACRE DISTURBED, >10% SLOPE

LAKE BOMOSEEN #9	PROBLEM AREA SUMMARY
Site ID: Map9	Design: No
Date Observed	8/18/16 ; GIS-based
Location	Tributary between North and Barker Rd
Waterbody	Sucker Brook
SGA Reach	N/A
Latitude Longitude	43.65807N 73.17745W
Land Ownership	Private
Site Ranking	High

Site Description: Likely gully site visible in aerial photos and with LiDAR. Field to south appears to be ditched leading to potential gully location. Field access difficult - need landowner permission (tried to visit on 8-18, but no one home); can see tall erosion along creek banks from the yard.

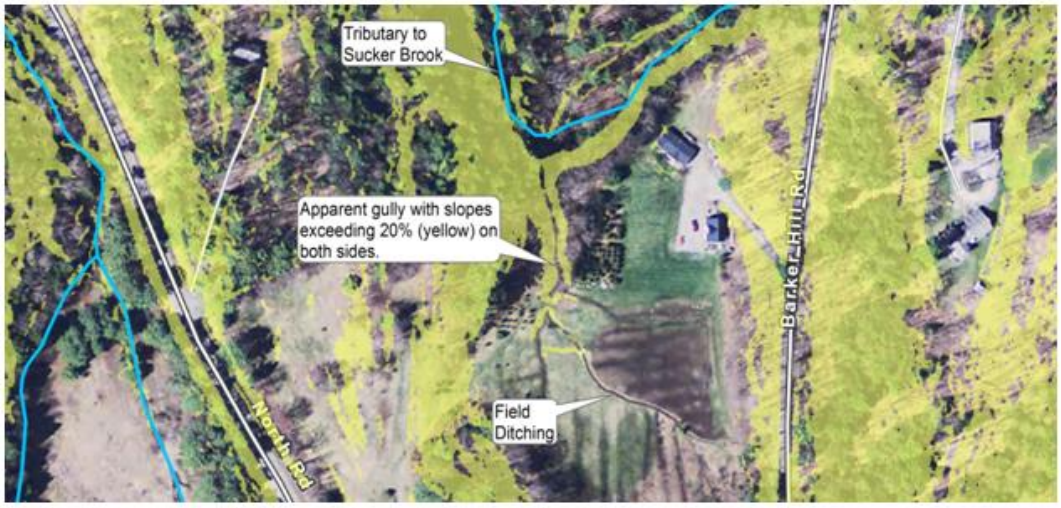


Photo 1: Aerial photo of site with steep slopes (>20%) highlighted in yellow from LiDAR.

Project Type: Other Erosion / Prioritization by project type: High

Prioritization Criteria: Low, Moderate, High ranking for each category

Overall Prioritization	Nutrient Load Reduction	Sediment Load Reduction	Ease of Implementation	Municipal Infrastructure Resiliency	Area Treated
HIGH	HIGH	HIGH	MODERATE	N/A	2.0 ACRES, GULLY SLOPES >20% SLOPE

LAKE BOMOSEEN #12 — PROBLEM AREA SUMMARY

Site ID: Map12	Design: No
Date Observed	8/18/16
Location	Barker Hill Road
Waterbody	Sucker Brook
SGA Reach	N/A
Latitude Longitude	43.66182N 73.16597W
Land Ownership	Private
Site Ranking	High

Site Description: Cleared areas of steep land at end of Barker Hill Road associated with the Mortimer Brown Landing Strip. Channel and bank erosion noted on aerial photos. Approximately 6 acres of recently cleared land along a perennial tributary. Approx. 5 acres of impervious surfaces including gravel areas and buildings draining into a pond with sediment seen on aerial photo. Need property permission to access.

Photo 1: Aerial photo of clearing adjacent stream along upper Barker Hill Road.

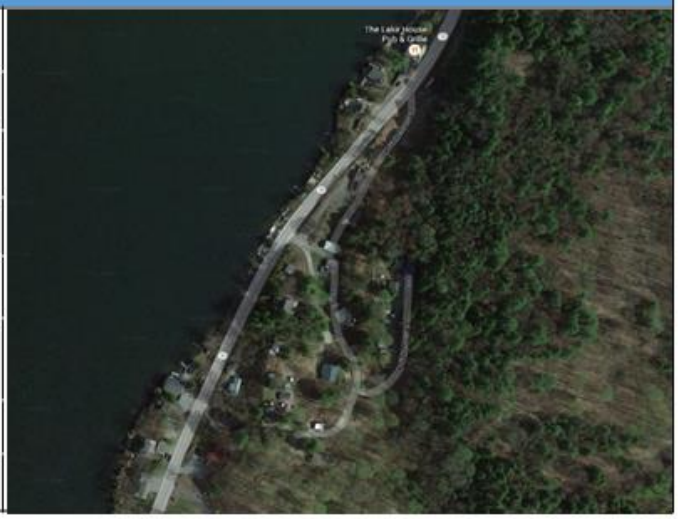
Project Type: Stormwater BMP, Prioritization by project type: High

Prioritization Criteria: Low, Moderate, High ranking for each category

Overall Prioritization	Nutrient Load Reduction	Sediment Load Reduction	Ease of Implementation	Municipal Infrastructure Resiliency	Area Treated
HIGH	HIGH	HIGH	MODERATE	LOW	5.0 ACRES IMPERVIOUS

LAKE BOMOSEEN #13 — PROBLEM AREA SUMMARY

Site ID: Map13	Design: No
Date Observed	8/18/16
Location	Cliff Dweller Road
Waterbody	Lake Bomoseen
SGA Reach	N/A
Latitude Longitude	43.65684N 73.19242W
Land Ownership	Private
Site Ranking	High



Site Description: Cliff Dwellers Road with 5-6 homes draining to the west down very steep (10-20%) gravel drive. Fine sedimentation likely in culvert at intersection with Route 30. Needs field follow-up for additional assessment. Road and ditch has slopes >10% with 0.25 acre gravel road draining to ditches, plus the drainage from short driveways serving the homes.

Photo 1: From Route 30, Cliff Dwellers Road with driveway spurs drains and erodes along the south side of the driveway.

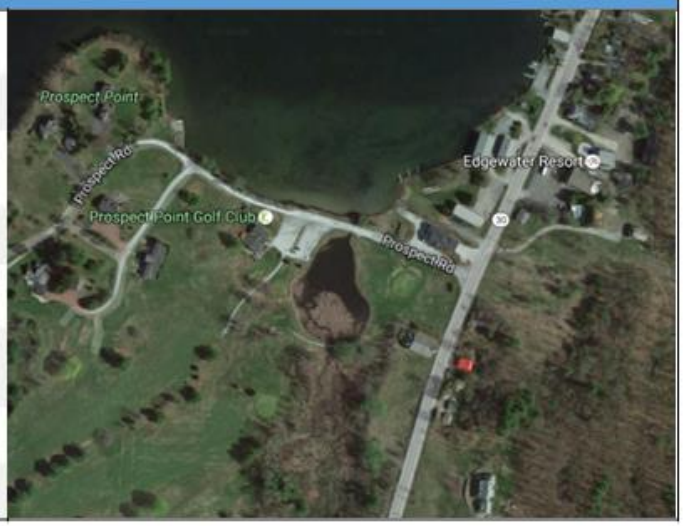
Project Type: Driveway Runoff and Erosion, Prioritization by project type: High

Prioritization Criteria: Low, Moderate, High ranking for each category

Overall Prioritization	Nutrient Load Reduction	Sediment Load Reduction	Ease of Implementation	Municipal Infrastructure Resiliency	Area Treated
MODERATE	MODERATE	HIGH	HIGH	HIGH	0.25 ACRE, GRAVEL ROADS >10% SLOPE

LAKE BOMOSEEN #15 — PROBLEM AREA SUMMARY

Site ID: Map15	Design: No
Date Observed	8/18/16
Location	Prospect Point Golf Club
Waterbody	Lake Bomoseen
SGA Reach	N/A
Latitude Longitude	43.64359N 73.20043W
Land Ownership	Private
Site Ranking	Moderate



Site Description: Upslope runoff into eutrophied pond at the Prospect Point Golf Club; Confirmed no P used in golf course fertilizer; Potential in-pond aeration treatment or retrofit to improve nutrient retention/cycling. Two phosphorus samples collected at this site over the summer (2016).

Photo 1: Pond at the Prospect Point Golf Course.

Project Type: Stormwater BMP, Prioritization by project type: Moderate

Prioritization Criteria: Low, Moderate, High ranking for each category

Overall Prioritization	Nutrient Load Reduction	Sediment Load Reduction	Ease of Implementation	Municipal Infrastructure Resiliency	Area Treated
MODERATE	MODERATE	MODERATE	MODERATE	N/A	DRAINAGE AREA TO POND = 1.5SQMI

LAKE BOMOSEEN #20	PROBLEM AREA SUMMARY
Site ID: Map20	Design: Yes
Date Observed	6/24/16
Location	Woodard Marina
Waterbody	Lake Bomoseen
SGA Reach	N/A
Latitude Longitude	43.6132N 73.23195W
Land Ownership	Private
Site Ranking	High

Site Description: New catch basin installed by Town in Woodard Marina parking lot. Potential location for Vortechs swirl unit or other enhanced catch basin.

Photo 1: Storm drain in the Woodard Marina parking lot.

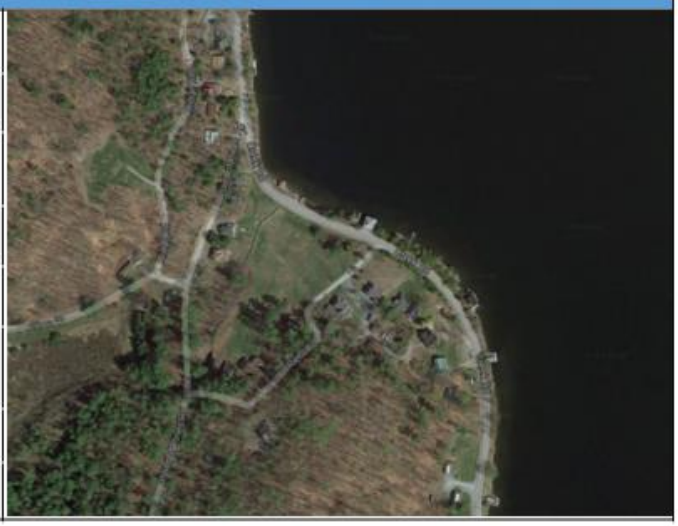
Project Type: Stormwater BMP, Prioritization by project type: High

Prioritization Criteria: Low, Moderate, High ranking for each category

Overall Prioritization	Nutrient Load Reduction	Sediment Load Reduction	Ease of Implementation	Municipal Infrastructure Resiliency	Area Treated
HIGH	MODERATE	HIGH	HIGH	MODERATE	1.0 ACRE IMPERVIOUS 0.5 ACRE OF GRAVEL

LAKE BOMOSEEN #27 — PROBLEM AREA SUMMARY

Site ID: Map27	Design: No
Date Observed	6/24/16
Location	Drop Inlet at Point of Pines
Waterbody	Lake Bomoseen
SGA Reach	N/A
Latitude Longitude	43.6246N 73.23304W
Land Ownership	Town
Site Ranking	High



Site Description: Drop inlet with catch basin just north of Creek Road and Point of Pines intersection. Catch basin takes runoff from ditch upslope. Very little sediment storage in basin due to limited sump. Upslope road and ditch has 5-10% slope with 0.25 acre gravel road draining to ditches

Photo 1: Sump needs to be cleaned out.

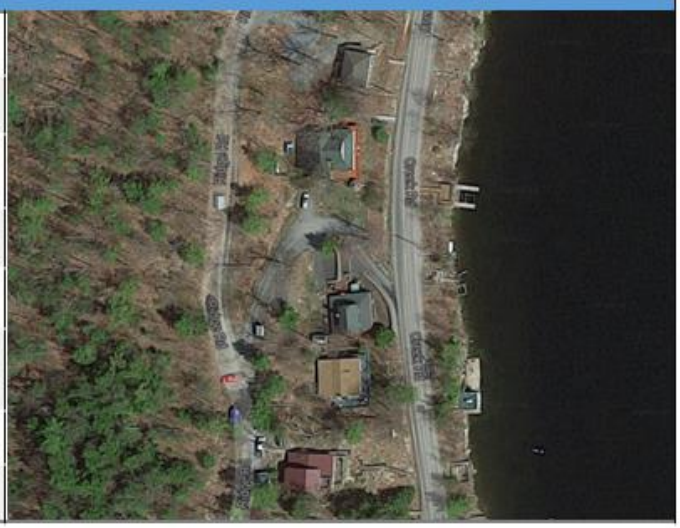
Project Type: Stormwater BMP, Prioritization by project type: High

Prioritization Criteria: Low, Moderate, High ranking for each category

Overall Prioritization	Nutrient Load Reduction	Sediment Load Reduction	Ease of Implementation	Municipal Infrastructure Resiliency	Area Treated
MODERATE	LOW	MODERATE	HIGH	MODERATE	0.25 ACRE, 5-10% SLOPE

LAKE BOMOSEEN #28 — PROBLEM AREA SUMMARY

Site ID: Map28	Design: No
Date Observed	8/18/16
Location	Connector between Ridge and Creek Rds
Waterbody	Lake Bomoseen
SGA Reach	N/A
Latitude Longitude	43.62532N 73.23328W
Land Ownership	Private
Site Ranking	High



Site Description: Shared driveways west of Creek Road, located 300 feet north of Point of Pines Road, drains to a catch basin on Creek Road. Very tight site, probably limited space for new stormwater BMPs. The site needs a larger catch basin with a sump along Creek Road. The houses and gravel surfaces cover 0.25 acre and sections of the gravel drive leading to Creek Road are >20% slope.

Photo 1: Steep driveway drains to Lake Road and the lake. Existing catch basin located behind road sign.

Photo 2: Close up of the most eroded area on the driveway.

Project Type: Driveway and Runoff Erosion, Prioritization by project type: High

Prioritization Criteria: Low, Moderate, High ranking for each category

Overall Prioritization	Nutrient Load Reduction	Sediment Load Reduction	Ease of Implementation	Municipal Infrastructure Resiliency	Area Treated
HIGH	MODERATE	HIGH	LOW	MODERATE	0.25 ACRE, >20% SLOPE

LAKE BOMOSEEN #29 — PROBLEM AREA SUMMARY

Site ID: Map29	Design: Yes
Date Observed	8/18/16
Location	Green Dump Boating Access
Waterbody	Lake Bomoseen
SGA Reach	N/A
Latitude Longitude	43.62989N 73.2334W
Land Ownership	State / Public
Site Ranking	High

Site Description: Green Dump fishing access has 2 locations where stormwater drains to low points and treatment of runoff could be enhanced with an engineered infiltration area. Highly visible public location. Gravel parking area approx 0.5ac draining directly to lake.

Photo 1: Possible infiltration area to capture runoff during storm events.

Project Type: Stormwater BMP, Prioritization by project type: High

Prioritization Criteria: Low, Moderate, High ranking for each category

Overall Prioritization	Nutrient Load Reduction	Sediment Load Reduction	Ease of Implementation	Municipal Infrastructure Resiliency	Area Treated
HIGH	MODERATE	HIGH	MODERATE	MODERATE	2.50 ACRE, 5-10% SLOPE

LAKE BOMOSEEN #31 — PROBLEM AREA SUMMARY

Site ID: Map31	Design: Yes
Date Observed	8/18/16
Location	Green Dump
Waterbody	Lake Bomoseen
SGA Reach	N/A
Latitude Longitude	43.63173N 73.23206W
Land Ownership	State/Public
Site Ranking	High

Site Description: Public beach known as Green Dump. Consider planting plan for shade and stormwater improvements.

Photo 1: Location to create an improved, landscaped buffer and walkway to provide shade, capture nutrients and sediment from the parking lot, and create a safe attractive area to walk and sit.
Photo 2: Possible infiltration area to capture runoff during storm events.

Project Type: Stormwater BMP / Prioritization by project type: High

Prioritization Criteria: Low, Moderate, High ranking for each category

Overall Prioritization	Nutrient Load Reduction	Sediment Load Reduction	Ease of Implementation	Municipal Infrastructure Resiliency	Area Treated
HIGH	MODERATE	MODERATE	HIGH	N/A	1,800 LINEAR FEET OF SHORELINE

LAKE BOMOSEEN #34 — PROBLEM AREA SUMMARY

Site ID: Map34	Design: No
Date Observed	6/24/16
Location	Driveway on Avalon Beach Rd
Waterbody	Lake Bomoseen
SGA Reach	N/A
Latitude Longitude	43.64295N 73.22237W
Land Ownership	Private
Site Ranking	High

Site Description: Large, new house on Avalon Beach Road with steep gravel driveway and boat launch down to the lake. Houses and gravel surfaces cover 0.4 acre; Portions of gravel driveway leading down to lake have >15% slope and rilling erosion was noted in field.

Photo 1: View of new home from lake with driveway and boat launch leading down to lake edge.

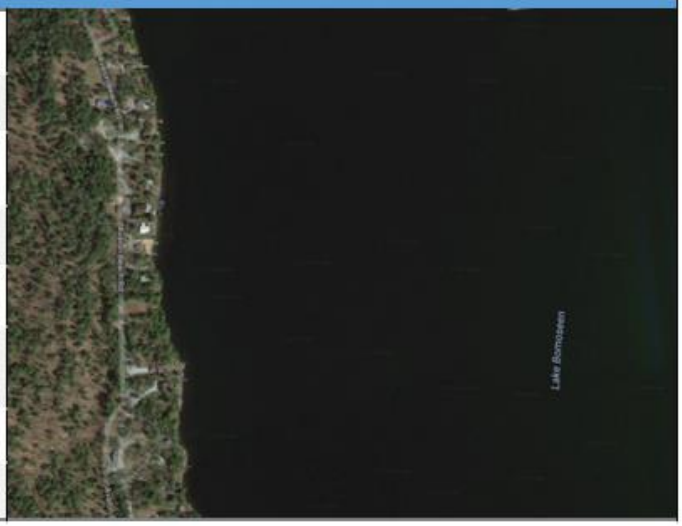
Project Type: Driveway and Erosion BMP / Prioritization by project type: High

Prioritization Criteria: Low, Moderate, High ranking for each category

Overall Prioritization	Nutrient Load Reduction	Sediment Load Reduction	Ease of Implementation	Municipal Infrastructure Resiliency	Area Treated
HIGH	LOW	HIGH	MODERATE	N/A	>0.40 ACRE, 15% SLOPE

LAKE BOMOSEEN #34/36 — PROBLEM AREA SUMMARY

Site ID: Map35/36	Design: No
Date Observed	8/18/16
Location	Avalon Beach Neighborhood
Waterbody	Lake Bomoseen
SGA Reach	N/A
Latitude Longitude	43.64447N 73.22341W
Land Ownership	Private
Site Ranking	High



Site Description: Avalon Beach Road has several steep driveways down to lake; Some driveways are gravel and some paved. Several new mound systems noted in field on west side of road. Avalon neighborhood stormwater project - rooftop disconnects, driveway erosion, septic systems. Houses and gravel surfaces cover 0.4 acre; Portions of gravel driveway leading down to lake have >15% slope and rilling erosion was noted in field.

Photo 1: Septic mound systems near Broadview Road .
Photo 2: Steep gravel driveways leading down toward the lake.

Project Type: Stormwater BMP, Prioritization by project type: High

Prioritization Criteria: Low, Moderate, High ranking for each category

Overall Prioritization	Nutrient Load Reduction	Sediment Load Reduction	Ease of Implementation	Municipal Infrastructure Resiliency	Area Treated
MODERATE/HIGH	MODERATE	MODERATE	MODERATE/LOW, BUT POSSIBLY REWARDING	N/A	0.4 ACRE, >15% SLOPE

LAKE BOMOSEEN #38 — PROBLEM AREA SUMMARY

Site ID: Map38	Design: Yes
Date Observed	11/17/15
Location	Johnson-Spooner Fishing Access
Waterbody	Lake Bomoseen
SGA Reach	N/A
Latitude Longitude	43.67405N 73.20122W
Land Ownership	State / Public
Site Ranking	High

Site Description: Runoff from a steep fishing access off of Johnson Spooner Rd is entering the lake. There is some space in the parking area (west / north near the lakeshore to implement at potential BMP along west/north side of parking lot. Space is tight. Approximately 0.25acre impervious surfaces with slopes >10% on access road.

Photo 1: Erosion and stormwater from the access road and boat launch drains to Lake Bomoseen.
Photo 2: Lake Bomoseen Association members give Evan (FEA) a tour of the potential stormwater projects around the lake, including this site at the fishing access.

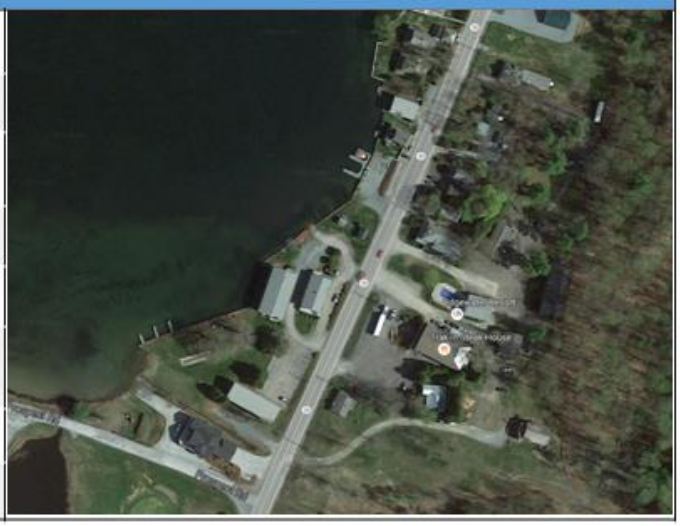
Project Type: Stormwater BMP, Prioritization by project type: High

Prioritization Criteria: Low, Moderate, High ranking for each category

Overall Prioritization	Nutrient Load Reduction	Sediment Load Reduction	Ease of Implementation	Municipal Infrastructure Resiliency	Area Treated
HIGH	MODERATE	HIGH	MODERATE	N/A	0.25 ACRE, >10% SLOPE

LAKE BOMOSEEN #41 — PROBLEM AREA SUMMARY

Site ID: Map41	Design: Yes
Date Observed	8/18/16
Location	Edgewater Resort on Route 30
Waterbody	Lake Bomoseen
SGA Reach	N/A
Latitude Longitude	43.64469N 73.19812W
Land Ownership	Private
Site Ranking	High



Site Description: Edgewater Resort on Route 30. Many stormwater retrofit opportunities including rooftop disconnects, small infiltration/detention basins, and re-routing of stormwater down to network along Rt 30. Approx 2.5ac of impervious surface with many areas having slopes 5-10%.

Photo 1: Area for possible infiltration retrofit to capture runoff during storm events prior to entering lake via storm sewer system along Route 30.

Project Type: Stormwater BMP, Prioritization by project type: High

Prioritization Criteria: Low, Moderate, High ranking for each category

Overall Prioritization	Nutrient Load Reduction	Sediment Load Reduction	Ease of Implementation	Municipal Infrastructure Resiliency	Area Treated
HIGH	HIGH	HIGH	MODERATE	HIGH	2.50 ACRE, 5-10% SLOPE

LAKE BOMOSEEN #42 — PROBLEM AREA SUMMARY

Site ID: Map42	Design: Yes
Date Observed	11/17/16
Location	Float Bridge
Waterbody	Lake Bomoseen
SGA Reach	N/A
Latitude Longitude	43.67756N 73.19682W
Land Ownership	Public
Site Ranking	High

Site Description: The steep ditch along the north side of Float Bridge Rd is eroding and delivering fine sediment and nutrients to the Lake. A water bar along Campbell Rd is directing additional runoff to the ditch. Approximately 0.3ac impervious with slopes 5-10%

Photo 1: View of fishing access from Float Bridge Road on eastern shore.
Photo 2: Close up view of fishing access.

Project Type: Stormwater BMP, Prioritization by project type: High

Prioritization Criteria: Low, Moderate, High ranking for each category

Overall Prioritization	Nutrient Load Reduction	Sediment Load Reduction	Ease of Implementation	Municipal Infrastructure Resiliency	Area Treated
HIGH	MODERATE	HIGH	MODERATE	MODERATE	0.30 ACRE, 5-10% SLOPE

LAKE BOMOSEEN #44 — PROBLEM AREA SUMMARY

Site ID: Map44	Design: Yes
Date Observed	8/18/16
Location	Edgewater Resort on Route 30
Waterbody	Lake Bomoseen
SGA Reach	N/A
Latitude Longitude	43.66165N 73.18856W
Land Ownership	Private
Site Ranking	High

Site Description: Multiple areas of bank erosion on Sucker Brook in between Route 30 and North Road. Some areas are moderate sources of sediment to channel and lack buffer. Approximately 300 ft of bank erosion with height 4-5ft upstream of Route 30. Channel is moderately incised and is actively widening in areas where post-Irene sediment deposits are large.

Photo 1: Culvert carrying Sucker Brook beneath VT Route 30.

Photo 1: Sucker Brook bank erosion along the north bank approximately 200ft upstream of Route 30 crossing

Project Type: Stream Channel/Bank Erosion, Prioritization by project type: High

Prioritization Criteria: Low, Moderate, High ranking for each category

Overall Prioritization	Nutrient Load Reduction	Sediment Load Reduction	Ease of Implementation	Municipal Infrastructure Resiliency	Area Treated
MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	300 LF, 4-5 FEET HIGH

LAKE BOMOSEEN #46 — PROBLEM AREA SUMMARY

Site ID: Map46	Design: Yes
Date Observed	8/18/16
Location	Sucker Brook
Waterbody	Sucker Brook
SGA Reach	T02.05-s1.02-s1.01
Latitude Longitude	43.66358N 73.18297W
Land Ownership	Private
Site Ranking	High

Site Description: Multiple areas of bank erosion and mass wasting on valley side slopes on Sucker Brook upstream of Stables Road. Some slopes are major sources of coarse and fine sediment. Abandoned slate quarry. Approximately 300 ft of bank erosion and mass failures with height 6-12ft upstream of Stables Road crossing. Site is an abandoned slate quarry and sediment is mobilized downstream in moderate/large floods.

Photo 1: Old slate piles from the pencil mill.

Project Type: Stream Channel/Bank Erosion. Prioritization by project type: High

Prioritization Criteria: Low, Moderate, High ranking for each category

Overall Prioritization	Nutrient Load Reduction	Sediment Load Reduction	Ease of Implementation	Municipal Infrastructure Resiliency	Area Treated
HIGH	MODERATE	HIGH	MODERATE	HIGH	300 LF, 6-12 FEET HIGH

LAKE BOMOSEEN #48 — PROBLEM AREA SUMMARY

Site ID: Map48	Design: No
Date Observed	Prior and 8/18/16
Location	Giddings Brook horse pasture
Waterbody	Lake Bomoseen
SGA Reach	N/A
Latitude Longitude	43.70698N 73.18492W
Land Ownership	Private
Site Ranking	High

Site Description: Fencing and buffer needed along horse pasture on Giddings Brook, southwest of the intersection with Monument Hill Road and Route 30 in Hubbardton.

Photo 1: Horse pasture needs exclusion fencing.

Project Type: Shoreline Revegetation and Buffer Improvements / Prioritization by project type: High

Prioritization Criteria: Low, Moderate, High ranking for each category

Overall Prioritization	Nutrient Load Reduction	Sediment Load Reduction	Ease of Implementation	Municipal Infrastructure Resiliency	Area Treated
HIGH	HIGH	MODERATE	HIGH	N/A	1,000 LF PER SIDE OF THE BROOK

4.3 Project Prioritization and Conceptual Designs

Based on input from the Lake Bomoseen SWMP six (6) projects from the list of high-priority sites were chosen for further development. Project summaries are included in Appendix D for the six highest priority projects. Each summary includes:

- A description of the site location and problems identified
- A summary of the recommended design and site plan
- A preliminary cost opinion
- A list of current and potential partners and funding
- A review of regulatory permitting requirements

The projects chosen for further design development were:

1. **Projects 20 & 39: Woodard Marina** –Approximately 1 acre of impervious (including ½ acre of gravel) contributing to runoff and sediment loading directly to the lake across Creek Road.
2. **Projects 29 & 30: Kehoe Fishing Access (aka "Green Dump")** - Approximately 1 acre of impervious (all gravel) contributing to runoff and sediment loading directly to the lake at fishing access. The gravel surfaces are found on both sides of Creek Road.
3. **Project 38: Thomas Evanoika Fishing Access** – Approximately ¼ acre of impervious surface (pavement and gravel), including a steep road, draining directly to the lake at fishing access off Johnson Spooner Lane.
4. **Project 41: Edgewater Resort and Associated Route 30 Drainage** - Approximately 1 acre of impervious (including ½ acre of gravel) contributing to runoff and sediment loading directly to the lake across Route 30.
5. **Project 42: Float Bridge Road Approaches** - Approximately ¼ acre of impervious contributing to runoff and sediment loading directly to the lake on the eastern road approach to the Float Bridge.
6. **Projects 44 & 46: Lower Sucker Brook** – Multiple areas of bank erosion and mass wasting of valley slopes along the lower reach of Sucker Brook upstream and downstream of the Stables/North Road crossings.

5.0 Next Steps

This Stormwater Master Plan represents an extensive effort to identify, describe, and evaluate stormwater problem areas affecting Lake Bomoseen. We provided a preliminary cost estimate and a site rating to aid the Poultney Mettowee Natural Resources Conservation District, the Lake Bomoseen Association and other stakeholders in planning and prioritizing restoration efforts. Many of the problem area descriptions (e.g., roadside ditches) will aid the Castleton Highway Department in proactively stabilizing and maintaining these features to avoid future stormwater problems.

We recommend that the PMNRCD, LBA, and Town of Castleton work together and with VTDEC and VTrans to secure funding for the high priority projects listed above in Section 4.3. The remaining stormwater problem areas summarized in Section 4.2 could be prioritized based on their overall impact and programmed for funding in the future.

In addition to addressing the problem areas identified in this document, the Towns of Castleton and Hubbardton can take steps to reduce future stormwater problems through planning and zoning regulations as described in each of their Town Plans (Castleton Planning Commission, 2010, and Hubbardton Planning Commission, 2012 and 2016). Many of the problem areas covered in this document are representative of typical issues encountered throughout the watershed. Lack of buffers and infiltration areas along shorelines, direct discharges of stormwater and gravel to lake waters, and lack of sediment control on gravel roads (i.e., stone check dams in ditches, culvert sizing, culvert slope, ditch maintenance) in steep watersheds. The recommended practices to address these issues should be applied to future projects to reduce the risk of stormwater runoff conflicts and sediment loading to receiving waters.

The Lake Bomoseen Association can focus on generally promoting the recommended lakeshore practices. PMNRCD and Vermont DEC can assist by presenting related water quality topics at Lake Association meetings. All the partners can provide information and assistance and encourage homeowners to create stormwater infiltration areas on their property to address rooftop and driveway runoff, to plant and maintain functional tree and shrub buffers, and to minimize and buffer exposed gravel areas. With some information and encouragement, many homeowners could implement projects on their own with little financial or planning assistance.

The Lake Bomoseen Association and PMNRCD can work with groups of contiguous landowners to implement projects that cross property boundaries, such as buffers that protect a stretch of lakeshore and continue across property lines. The other type of project that would lend to landowner groups working together are driveway projects with shared or proximal driveways. Grants for both types of projects could be secured by PMRNCD for the residents interested in participating.

Finally, though twenty projects were selected as high-priority based on selected criteria, the other identified projects (and any additional new problem areas that develop over time) are also important and should be remediated as time and resources permit.

6.0 References

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