GREAT POND

BELGRADE & ROME, MAINE

WATERSHED-BASED MANAGEMENT PLAN

(2021-2031)

Protect and Preserve B·L·A EST. 1908

7 LAKES ALLIANCE Ensuring Our Future

Kennebec County Soil and Water Conservation District

MARCH 2021

GREAT POND WATERSHED-BASED MANAGEMENT PLAN

Prepared for:

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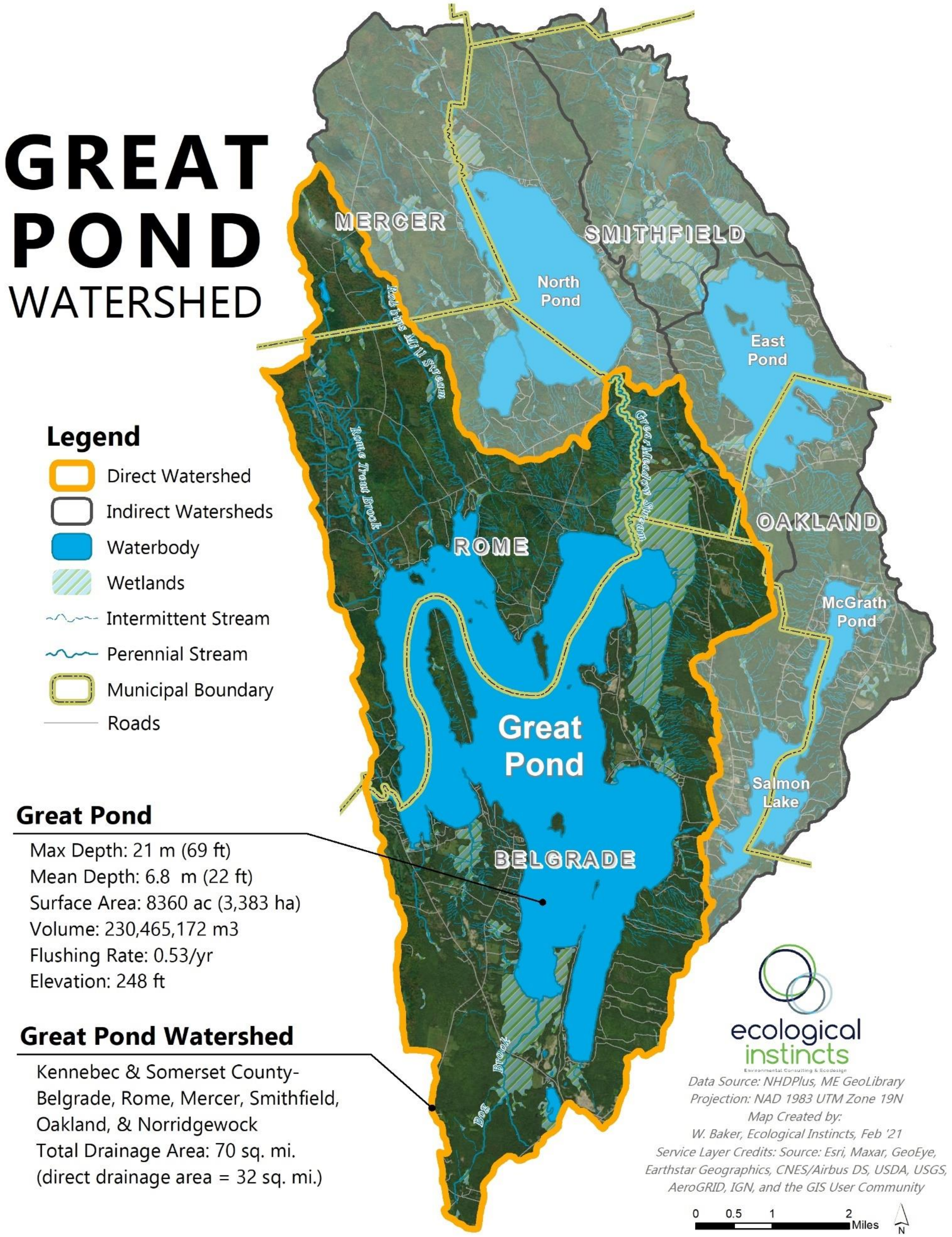
Cover Photo: *NE view of Great Pond over Hoyt Island*

Photo Credit: *Alexander Wall*


GREAT
POND
WATERSHED
Legend
Direct Watershed
Indirect Watersheds
Waterbody
Wetlands
Intermittent Stream
Perennial Stream
Municipal Boundary
Roads
MERCER
SMITHFIELD
North Pond
East Pond
OAKLAND
ROME
McGrath Pond
Great Pond
Salmon Lake
BELGRADE
Bog Brook
Great Pond
Max Depth: 21 m (69 ft)
Mean Depth: 6.8 m (22 ft)
Surface Area: 8360 ac (3,383 ha)
Volume: 230,465,172 m3
Flushing Rate: 0.53/yr
Elevation: 248 ft
Great Pond Watershed
Kennebec & Somerset County-
Belgrade, Rome, Mercer, Smithfield,
Oakland, & Norridgewock
Total Drainage Area: 70 sq. mi.
(direct drainage area = 32 sq. mi.)
ecological instincts
Data Source: NHDPlus, ME GeoLibrary
Projection: NAD 1983 UTM Zone 19N
Map Created by:
W. Baker, Ecological Instincts, Feb '21
Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
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Great Pond Steering Committee

Linda Bacon, Maine DEP
Charlie Baeder, 7 Lakes Alliance
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Watershed Modeling Review and Internal Loading Analysis: Ken Wagner, WRS, Inc.

Commonly Used Acronyms

The following are used throughout this document:

7 LAKES	7 Lakes Alliance
BLA	Belgrade Lakes Association
BMP	Best Management Practice
Chl-a	Chlorophyll-a
DO	Dissolved Oxygen
LLRM	Lake Loading Response Model
Maine DEP	Maine Department of Environmental Protection
NPS	Nonpoint Source (pollution)
NRCS	Natural Resources Conservation Service
ppb	Parts Per Billion
ppm	Parts Per Million
SDT	Secchi Disk Transparency
TAC	Technical Advisory Committee
TP / P	Total Phosphorus / Phosphorus
US EPA	United States Environmental Protection Agency
WBMP	Watershed-Based Management Plan

GREAT POND WATERSHED-BASED MANAGEMENT PLAN (2021-2031)

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PURPOSE

The Great Pond Watershed-Based Management Plan (WBMP) describes the water quality conditions, watershed characteristics, and steps that can be taken to reverse the trend of declining water quality in Great Pond. The plan outlines management strategies over the course of a 10-year implementation period (2021 – 2031), establishes water quality goals and objectives, and describes actions needed to achieve these goals. This includes strategies to:

1. Substantially increase efforts to reduce the external (watershed) phosphorus load by addressing existing nonpoint source (NPS) pollution throughout the watershed and implementing non-structural control measures to limit new sources of phosphorus from future development and climate change,
2. Assess, observe, and take action when needed, to reduce the internal phosphorus load from the lake's bottom sediments; and,
3. Expand current water quality monitoring efforts in the lake and streams to inform management recommendations, and track changes in water quality over time.

THE LAKE & WATERSHED

Great Pond (MIDAS 5274)[1] is a 13-square-mile Great Pond (Class GPA)[2] located in Belgrade and Rome, Maine. The direct watershed is located within the Belgrade Chain of Lakes, which includes a set of seven hydrologically connected lakes that form a valuable resource in the State of Maine. As the fifth and largest of the seven lakes, it occupies a central position within the larger Belgrade Lakes watershed. Water from four lakes pass through it, and water from Great Pond flows over a dam in Belgrade Lakes Village into the north basin of Long Pond. Long Pond eventually flows into Messalonskee Lake which flows to the Kennebec River via Messalonskee Stream and eventually into the Gulf of Maine near Popham Beach in Phippsburg.

Great Pond receives water from North Pond and East Pond (via Great Meadow Stream) to the north, and from McGrath Pond and Salmon Lake to the east. There are five major tributaries that flow into

[1] The unique 4-digit code assigned to a lake.

[2] Defined by MRSA Title 38 §465-A, Standards for Classification of Lakes and Ponds. Class GPA is the sole classification of great ponds (>10 acres) and natural lakes and ponds <10 acres in size. Class GPA waters must have a stable or decreasing trophic state, subject only to natural fluctuations, and must be free of culturally induced algal blooms that impair their use and enjoyment.

Great Pond (Great Meadow Stream, Robbins Mill Stream, Rome Trout Brook, Bog Brook, and the Salmon Lake outlet stream), and numerous other seasonal drainages that contribute water in the spring and fall. Including the major streams listed above, the direct watershed contains 46 miles of perennial streams and 136 miles of intermittent streams. All lakes hydrologically connected to Great Pond are either impaired, or on the DEP's NPS Priority Watersheds list.

Nonpoint Source (NPS) Pollution: Nonpoint source pollution includes diffuse sources of pollution carried in overland flow to lakes, streams and other waterbodies via stormwater runoff. NPS may include sediment from erosion sites, fertilizers, pet waste, and road salt among other pollutants.

Great Pond's direct watershed is expansive, covering 32 square miles. Adding the drainage area of North Pond (~22 square miles), East Pond (~7 square miles), and McGrath Pond/Salmon Lake (~9 square miles) increases this total to 70 square miles.[3] The direct watershed area includes four municipalities, with the largest land area in the towns of Belgrade (54%) and Rome (35%).

A recent land-cover analysis for Great Pond indicates that the majority of Great Pond's direct watershed is forested (70%), followed by freshwater wetlands (16%). Large wetlands flank the north and south ends of the lake, including the northeast corner of the watershed surrounding Great Meadow Stream, North Bay, Camp Bomazeen west of Route 8, and in the southwest around Austin Bog near Route 27.

Developed land (residential, commercial, roads) accounts for 10% of the watershed area, while agricultural land is estimated at 4%. Pockets of agricultural land are scattered around the watershed but are located in close proximity to the shoreline near Ram Island, Jamaica Point, and Hatch Cove,

View of Ram Island in northeastern Great Pond. Photo Credit: Alexander Wall, BLA.

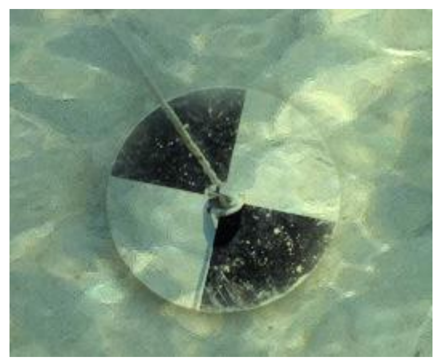
[3] Despite having a large watershed size, the watershed to lake area ratio is 5.4:1, a relatively low value. Lakes with ratios of <10:1 generally have lower flushing rates and lower watershed pollutant loading, but this does not protect them from eutrophication over time which can be accelerated by human activity and alternations in the watershed.

among other locations. Several of the lake's ten islands are developed including Pine Island, Ram Island, Chute Island and Hoyt Island.

In addition to development on the shoreline (866 lots in the shoreland zone within 250 feet of the lake), there are three large summer youth camps, two private marinas, a public boat launch, a golf course, multiple commercial properties in Belgrade Lakes Village, and several gravel pits in the watershed. Because the area provides excellent year-round recreational opportunities and is a popular summer vacation destination, the population of the Town of Belgrade (~3,000) doubles when non-residents arrive in the summer (with similar population shifts in neighboring towns in the watershed). Population and economic growth are often accompanied by development that may have an important influence on the character and environment of the community. Belgrade's growth rate, being higher than both the county and state averages, suggests that development pressure will steadily put additional stress on lake water quality.

THE PROBLEM

Great Pond is renowned as a quintessential Maine lake for its rural character, sweeping lake and mountain views, clear, cool water good for recreation during all seasons, and a healthy fishery. However, this jewel within the Belgrade Lakes area has been showing signs that all is not well. A significant decline in water clarity has occurred over the last 10 years as well as an increased presence of metaphyton and the cyanobacteria *Gloeotrichia echinulata*. Dissolved oxygen loss is occurring in the deepest areas of the lake, and invasive fish and plants have made the lake their home.



A significant decreasing trend in water clarity has been documented in Great Pond over the past 10 years as measured using a Secchi disk.

In 2010, Maine DEP added Great Pond to the state's list of impaired lakes due to increased phosphorus concentrations and declining water clarity over the previous 10-year monitoring period.

Water quality data have been collected at Great Pond since 1970 spanning 50 years in cooperation with Maine DEP, citizen scientists, Colby College, and 7 Lakes Alliance. This long-term data set, along

Maine GPA Statutory Water Quality Standard:

All Maine lakes are free of culturally induced algal blooms and have a stable or decreasing trophic state, which translates into stable or improving water & habitat quality.

with recent, more intensive monitoring over the past five years was used to conduct an analysis of the long-term (1970-2020) and short-term (2010-2020) trends. The trend analysis included Secchi disk transparency (SDT), total phosphorus (TP), Chlorophyll-a (Chl-a), dissolved oxygen and temperature. Average SDT has declined (lower water clarity over time) in both the long-term and short-term time series at Station 1, and in the short-term time series at Station 2.

Watershed modeling was used to determine the sources and relative contribution of phosphorus loading to Great Pond. The model estimates a total phosphorus load of 2,864 kg to Great Pond annually. The watershed load accounts for 72% (2,053 kg/yr) of the phosphorus getting into the lake, with 12% of the total load from atmospheric deposition (338 kg/yr), 3% from waterfowl (100 kg/yr), and 3% from septic systems (97 kg/yr), in addition to an internal load of 10% (275 kg/yr) from bottom sediments.

Developed land makes up 14% of the land area in the watershed, but accounts for close to half (49%) of the total phosphorus load from the watershed. The density of development, and proximity of the development (including buildings, roads, and parking lots) to the lake are significant factors in the amount of phosphorus being exported on an annual basis. Site-specific actions to infiltrate and treat stormwater runoff from developed areas throughout the watershed will reduce P loading from developed areas. How stormwater is managed will be key to efforts to improve water quality. A well-buffered shoreline property results in less P load than an upland property with untreated runoff that is hydrologically connected to the lake via the vast network of streams and ditches in the watershed.

Phosphorus loading from upstream (indirect) watersheds (East Pond, Serpentine Stream, North Pond, McGrath Pond/Salmon Lake) accounts for 24% (689 kg/yr) of the total phosphorus load to Great Pond, compared to 48% (1,364 kg/yr) from the direct watershed, with the largest input from upstream North Pond (11% or 308 kg/yr).

Lake volume and bathymetry have an important role to play in understanding the complex dynamics that affect water quality in Great Pond. An analysis of the extent of area with low oxygen in the lake indicates that the area of anoxia has stabilized over the past three years, is no longer growing, and has hopefully reached a new equilibrium.[4] However, should the area of low oxygen occur at shallower depths in the lake in the future, the area of the lake with potential to contribute to internal phosphorus loading could increase substantially.[5]

Factoring in development pressures and changes in climate, we might expect to see warmer water temperatures and phosphorus release from internal loading which also favors invasive species,

[4] Personal Communication, Danielle Wain, 7 Lakes Alliance, November 2020.

[5] Roughly 13% of the lake area and 6% of the lake volume is in water deeper than 12 m, compared to 27% of the lake area and 15% of the lake volume in water deeper than 9 m.

cyanobacteria, and harmful algal blooms (HABs) that produce toxins harmful to humans and wildlife. Occurance of bigger and more frequent storms presents a challenge for watershed management and exacerbates the internal loading problem as more intense rainfall will increase the amount of nutrient transport to the lake from the watershed via stormwater runoff. An increase in nutrients available for algal growth will cause reduced oxygen in bottom waters as these organisms decompose and promote phosphorus release from the sediments.

THE GOAL

An average in-lake total phosphorus concentration of 8.5 ppb is a desirable target to begin reversing the declining water clarity trend in Great Pond over the next 10 years. To meet the goal, the amount of phosphorus entering the lake will need to be reduced by 5% (130 kg P/yr). This represents a reduction of 101 kg/yr from Great Pond's direct watershed, and 29 kg/yr from the watersheds of upstream waterbodies (North Pond and Salmon Lake). Reducing this load even further would provide a margin of safety in anticipation of years with extreme heat and/or high precipitation, and to help offset an increase in phosphorus from future development. Managing the external sources of phosphorus entering the lake from the watershed will not only help prevent further declines in water clarity in the lake but will also help minimize the potential release of phosphorus from bottom sediments and diminish the need to address the internal load in the immediate future. By managing developed land in the watershed to minimize stormwater runoff, we can effectively and collectively reduce the annual phosphorus load to Great Pond, reverse negative water quality trends, and prevent algal blooms from occurring in the future.

WATER QUALITY GOAL

Great Pond has a stable or improving water quality trend.

In-Lake Phosphorus = 8.5 ppb

"P" REDUCTIONS NEEDED

Direct Watershed: 101 kg/year

Upstream Watersheds: 29 kg/year

Projects: 319, YCC, LakeSmart, Septic System Program, Buffer Campaign

Timeframe: 2021- 2031

ACTIONS NEEDED TO ACHIEVE THE GOAL

The Great Pond WBMP provides strategies for achieving the water quality goal. The loading analysis for Great Pond weighed the pros and cons of different management options for reducing in-lake phosphorus concentrations. These recommendations are outlined in detail in the plan and were presented to the Technical Advisory Committee (TAC) for review and feedback. The action plan was developed with input from both the TAC and the watershed steering committee. The action plan represents solutions for improving water quality in Great Pond based on the best available science.

The action plan is divided into six major objectives, along with the following estimated costs to complete the work:

Planning Objective	Action Item (2021-2031)	P Load Reduction Target	Cost
1	**Address the External P Load** (NPS sites, septic systems, LakeSmart, buffer campaign, upstream watersheds)	130 kg/yr	$1,178,250
2	**Internal P Load** (Sediment analysis, trends, thresholds)	n/a	$13,200
3	**Prevent New Sources of NPS Pollution** (NPS sites, land conservation, ordinances, enforcement, climate change adaptation)	n/a	$460,000
4	**Education, Outreach & Communications** (Public meetings, online videos, buffer campaign, LakeSmart, workshops, etc.)	n/a	$104,400
5	**Build Local Capacity** (Funding plan, steering committee, grant writing, relationship building- including Town government)	n/a	$32,00
6	**Long-Term Monitoring & Assessment** (Baseline monitoring, plankton monitoring, septic systems, stream monitoring, invasive plants (CBI), etc.)	n/a	$189,810
	TOTAL	**130 kg/yr**	**$1,977,660**

The action plan focuses on addressing the phosphorus load associated with stormwater runoff from the watershed by working to keep untreated stormwater runoff from getting to the lake, thereby reversing the declining trend in water clarity in Great Pond while simultaneously promoting communication between watershed groups, municipal officials, and residents. The action plan outlines pollutant reduction targets, responsible parties, potential funding sources, approximate costs, and an implementation schedule for each task within each of the six planning objectives.

A diverse source of funding and a sustainable funding strategy is needed to fully fund planned implementation activities. A large portion of the estimated cost of implementing this plan will be needed in the first 1-2 years to ramp up watershed improvement efforts. State and federal grants, towns, private landowners, and lake association members will all be called upon to address the external watershed load, and to support watershed implementation projects (319 grants), LakeSmart, and long-term monitoring. The funding strategy should be incorporated into this plan within the first year and be revisited on an annual basis by an active and engaged steering committee.

MEASURING SUCCESS

Environmental, social, and programmatic milestones were developed to reflect how well implementation activities are working and provide a means by which to track progress toward the established goals (Section 7). The steering committee will review the milestones on an annual basis, at minimum, to determine if progress is being made, and then determine if the watershed plan needs to be revised if the targets are not being met.

ADMINISTERING THE PLAN

The Great Pond WBMP provides a framework for reversing water quality trends and preventing further declines in water quality in Great Pond so that the lake meets state water quality standards. The plan will be led by 7 Lakes Alliance and the Belgrade Lakes Association with guidance and support from a watershed steering committee, Maine DEP, the towns of Belgrade and Rome, Kennebec County Soil & Water Conservation District, Colby College, local businesses, and landowners. The formation of subcommittees that focus on the six main watershed action categories will result in more efficient implementation of the plan. The steering committee will need to communicate regularly, especially during the first 1-3 years to get the plan off on solid footing.

INCORPORATING US EPA'S 9 ELEMENTS

The Great Pond WBMP includes nine key planning elements to restore waters impaired by NPS pollution. These guidelines, set forth by the U.S. Environmental Protection Agency (US EPA), highlight important steps in protecting water quality for waterbodies impacted by NPS pollution, including specific recommendations for guiding future development, and strategies for reducing the cumulative impacts of NPS pollution on lake water quality. The nine required elements can be found in the following locations in this plan:

A. Identify Causes and Sources: Sections 1, 2, 3, 4 and 6 and Appendix A highlight current programs and research that have helped frame the water quality problem (Section 1), describe the characteristics of the lake and watershed that contribute to the changes in water quality, analyze water quality data to describe changes in the water quality (Section 3), estimate watershed loading (Section 4), and present a summary of NPS sites in the Great Pond watershed (Section 6 and Appendix A).

B. Estimated Phosphorus Load Reductions Expected from Planned Management Measures (described under (C) below): **Sections 4 and 6** provide an overview of water quality and phosphorus reduction targets to reduce annual phosphorus loading to Great Pond from external sources over the next ten years, and describe the methods used to estimate phosphorus reductions. These reductions apply to watershed loading - including applying best management practices (BMPs) to documented NPS sites in the watershed (e.g., installing vegetated buffers, improving and maintaining roads, and upgrading septic systems). These actions will be supported by public education, planning and zoning activities, land conservation, and other activities that will prevent additional inputs from future development.

C. Description of Management Measures: Sections 6, 7, 8, and Appendix A identify ways to achieve the estimated phosphorus load reduction and reach water quality targets described in (B) above. The action plan covers six major topic areas that focus on NPS pollution, including: mitigating the external phosphorus load, developing a threshold for addressing the internal load, preventing new sources of phosphorus, education and outreach, building local capacity, and conducting long-term monitoring and assessment.

D. Estimate of Technical and Financial Assistance: Sections 8 and 9 and Table 16 include a description of the associated costs, sources of funding, and organizations responsible for plan implementation. The estimated cost to address NPS pollution and reduce phosphorus loading to Great Pond is estimated at $1,967,660 over the next ten years. A diverse source of funding, a sustainable funding strategy, and collaborative partnerships (state, town, lake associations, regional watershed groups, soil & water conservation district, private landowners, road associations, and local businesses) will be needed to fund planned implementation activities.

E. Information & Education & Outreach: Section 6 and Table 16 describe how the education and outreach component of the plan should be implemented to enhance public understanding of the project. This includes leadership from the Belgrade Lakes Association and 7 Lakes Alliance to promote lake/watershed stewardship.

F. Schedule for Addressing the NPS Management Measures: Section 8 and Table 16 provide a list of strategies and a set schedule that defines the timeline for each action. The schedule should be reviewed and adjusted by the steering committee on an annual basis.

G. Description of Interim Measurable Milestones: Section 8 includes the milestones that measure implementation success that will be tracked annually. Using milestones and benchmarks to measure progress makes the plan relevant and helps promote implementation of action items. The milestones are broken down into three different categories: programmatic, environmental, and social. Environmental milestones are a direct measure of environmental conditions, such as improvement in water clarity. Programmatic milestones are indirect measures of restoration activities in the watershed, such as how much funding has been secured or how many BMPs have been installed. Social milestones measure change in social behavior over time, such as the number of steering committee meetings or the number of properties participating in LakeSmart.

H. Set of criteria: Section 8 provides a list of criteria and benchmarks for determining whether load reductions are being achieved over time, and if substantial progress is being made towards water quality objectives. These benchmarks will help determine whether this plan needs to be revised.

I. Monitoring component: Section 7 provides a description of planned monitoring activities for Great Pond, the results of which can be used to evaluate the effectiveness of implementation efforts over time as measured against the criteria in (H) above. The ultimate objective of this plan is to reverse the trend of declining water quality. This requires ramping up efforts to reduce the amount of phosphorus getting into the lake from the watershed. The success of this plan cannot be evaluated without expanding current monitoring and assessment activities and careful tracking of load reductions following successful implementation projects.

1. Background

For several decades there has been a growing concern about declining water quality in Great Pond. The signs were subtle, but they were there - small changes in water clarity, a decrease in oxygen in deep areas of the lake, and the presence of algae in shallow areas of the lake where it hadn't been before. In 2006, downstream Long Pond was added to the Maine DEP's list of impaired lakes due to declining water clarity and an increase in total phosphorus over the previous 10 years. In 2008, US EPA approved a Total Maximum Daily Load (TMDL) report for Long Pond which examined sources of phosphorus in the lake and included an assessment of upstream Great Pond. The TMDL determined that phosphorus inputs from Great Pond represented a major source of the total phosphorus getting into Long Pond - with Great Pond and its watershed contributing 53% of the total load to the north basin of Long Pond (KCSWCD, 2009). In 2008, Maine DEP awarded a

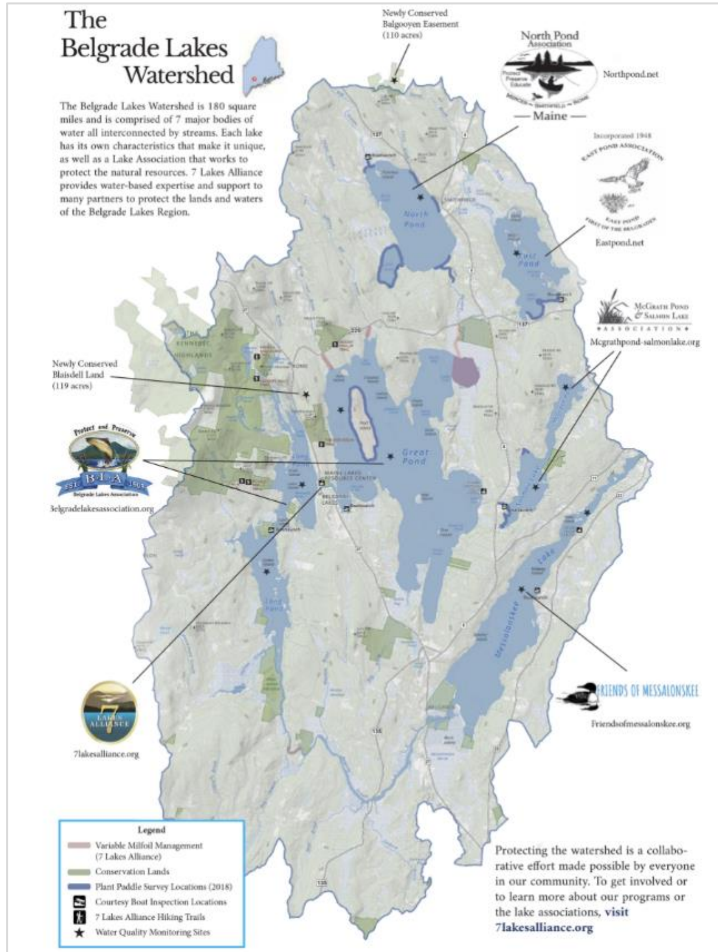


Figure 1. Belgrade Lakes watershed (Source: 7 Lakes).

Belgrade Lakes WQ Listing Status and Relationship to Great Pond

East Pond	Impaired until Alum treatment in 2018; likely to be moved to Watch List in 2022.	Indirect watershed; flows to North Pond via Serpentine Wetland
North Pond	NPS Priority List; Development threat; Watch list due to recent algal blooms and likely on impaired list in 2022	Indirect watershed; flows to Great Pond via Great Meadow Stream
McGrath Pond	NPS Priority List; Sensitive	Indirect watershed; flows to Salmon Lake
Salmon Lake	NPS Priority List; Watch List; Sensitive (sediment chemistry)	Indirect watershed; flows to Great Pond via Salmon Pond outlet stream
Long Pond	Impaired	Immediate downstream waterbody
Messalonskee Lake	NPS Priority List; Watch list; Sensitive (sediment chemistry)	Downstream of Long Pond

grant to Kennebec County Soil & Water Conservation District (KCSWCD) and the Belgrade Regional Conservation Alliance (BRCA, now 7 Lakes Alliance) to develop a Watershed-Based Management Plan (WBMP) for Long Pond. Recognizing the complex relationship between water quality in Long Pond and Great Pond, the 2009 plan included recommendations and management strategies for the watersheds of both Long and Great Pond.

The completion of the Long Pond/Great Pond WBMP set the stage for three phases of watershed improvement projects **funded in part by USEPA under Section 319 of the Clean Water Act** between 2011 – 2019 to achieve the phosphorus reductions recommended in the 2009 WBMP. Though some management measures for Great Pond were included in the 2009 Long Pond WBMP, a full analysis for Great Pond was not completed, mainly because Great Pond was not on the state's impaired lakes list at that time.

In 2010, Maine DEP added Great Pond to the state's list of impaired lakes due to increased phosphorus concentrations and declining water clarity over the previous 10-year monitoring period. The complex dynamics fueling Great Pond's water quality decline have now been established. Phosphorus entering the lake as stormwater runoff from the Great Pond's direct watershed and phosphorus flowing in from the watersheds of upstream lakes (East Pond, North Pond, and Salmon Lake) deliver a large portion of the total phosphorus load entering Great Pond each year. The 2016 Maine DEP Integrated Report calls for development of a TMDL or Alternative Restoration Approach to restore Great Pond. This Great Pond WBMP provides a solid foundation for watershed restoration over the next 10 years.

Despite several phases of watershed improvement projects to address nonpoint source (NPS) pollution in the watershed, water quality continues to decline. The large size of the watershed, ongoing development along the shoreline and the watershed, the effects of a changing climate, coupled with limited financial resources shared among several impaired and threatened lakes, all play a role in this decline.

A watershed survey was led by the Belgrade Lakes Association (BLA) in 2018 to identify high priority NPS pollution sites in the watershed in order to reduce phosphorus loading to Great Pond. The survey identified 237 NPS sites. Residential properties along the shoreline made up the majority of these sites. There are scores more properties on the shoreline in need of vegetated shoreline buffers to prevent runoff from getting into the lake.

Development of the Great Pond WBMP included a water quality analysis, an internal loading analysis, sediment analysis, land-cover update, watershed nutrient modeling, soil vulnerability analysis, development of watershed maps, many stakeholder meetings, and a public meeting. Since phosphorus is the nutrient driving declining water quality trends in Great Pond, it was used as the primary parameter for setting the water quality goal for the next 10-year planning period.

PURPOSE

The purpose of this Watershed-Based Management Plan is to guide the implementation efforts needed over the next 10 years (2021-2031) to reverse current water quality trends so that Great Pond has a stable trophic state and can be removed from the Maine DEP's impaired lakes list. The Plan outlines strategies to:

1. Substantially increase efforts to reduce the external (watershed) phosphorus load by addressing NPS pollution throughout the watershed and implementing non-structural control measures to limit new sources of phosphorus from future development and climate change;
2. Assess, observe, and propose action when needed, to address the internal phosphorus load from the lake's bottom sediments; and,
3. Expand current water quality monitoring efforts in the lake and streams to inform management recommendations, and track changes in water quality over time.

WATERSHED PLANNING GOALS

(2021-2031)

1. **PREVENT UNTREATED STORMWATER RUNOFF FROM GETTING TO THE LAKE!**
2. **REVERSE THE DECLINING WATER QUALITY TREND!**

This Plan was developed to satisfy national watershed planning guidelines provided by the US EPA. An approved nine-element plan is a prerequisite for future Federally funded work in impaired watersheds. Great Pond meets these eligibility criteria because the plan was developed to include these required planning elements.

STATEMENT OF GOAL

The goal of this Plan is to reverse the declining water clarity trend in Great Pond. Planning recommendations include decreasing the watershed phosphorus load by 5% (130 kg/yr), reducing the average annual in-lake phosphorus concentration by 0.5 ppb, and improving water clarity (by at least 0.1 m on average) over the next 10 years.

PLAN DEVELOPMENT & COMMUNITY PARTICIPATION

This plan was developed with input from a diverse group of local stakeholders and scientists over a two-year period. Recommendations are the result of multiple Technical Advisory Committee, Steering

Committee, subcommittee meetings, and conference calls between professional consultants, 7 Lakes, KCSWCD, Colby College, BLA, the towns of Belgrade and Rome, and Maine DEP. A description of each of the three Steering Committee and TAC meetings is provided in Appendix C.

Photo Credit: 7 Lakes

An interactive online public meeting was held on December 10, 2020 to present the Great Pond WBMP. The meeting, viewed by more than 150 attendees, highlighted water quality concerns and presented recommended actions needed to reverse the current declining water quality trend. Panelists outlined actions needed to prevent untreated stormwater runoff (and associated phosphorus) from getting into the lake.

A link to the recording from the public meeting and a write-up of the Zoom Question & Answer Session is included in Appendix D.

WATERSHED PROJECTS, PROGRAMS & RESEARCH

Great Pond is at the center of ongoing scientific research and monitoring as a result of many years of private/public partnerships involving numerous watershed partners effectively working together to document and understand the changes in Great Pond's water quality and identify the best ways to protect it. The list of projects below represents watershed activities that have taken place since the development of the Long Pond WBMP in 2009. Development of a comprehensive list of projects and an accessible database will be created to track activities conducted by the numerous project partners that work in the watershed.

PLANNING/RESEARCH

(2009) Long Pond Watershed-Based Management Plan- Kennebec County Soil & Water Conservation District (KCSWCD) in cooperation with the BRCA developed a management plan for Long Pond which called for 45% reduction in phosphorus to restore water quality including reduction of phosphorus from upstream/indirect watersheds including Great Pond - which accounted for 53% of the total phosphorus load to the north basin of Long Pond. The plan recommended a 17% reduction (278 kg) in annual phosphorus loading from Great Pond to restore water quality in Long Pond. However, these recommendations did not identify water quality thresholds for Great Pond, only the needed reductions to meet loading reduction targets in Long Pond. The project was funded by a Clean Water Act (CWA) Section 604(b) grant from EPA.

(2010-2014) Belgrade Lakes Watershed Sustainability Project- An interdisciplinary team of scientists and local stakeholders worked together to understand the impact of landscape and lake-ecosystem changes in the Belgrade Lakes region. Work on Great Pond included modeling the lake ecosystem, understanding inter-lake dynamics through various monitoring and assessment projects, and water quality monitoring among other projects.

(2012) Changing Water Quality in Great Pond- The Colby Environmental Assessment Team (CEAT) collected lake, stream and sediment samples to assess water quality in Great Pond, examined land-use patterns, and completed an erosion impact model to determine areas with highest risk for nutrient loading. The report estimates that developed areas (roads, residences, camps, and commercial properties) and agricultural land represented 10.7% of the watershed.

(2016) Phosphorus Loading and Related Lake Management Considerations for Great Pond- Water Resource Services reviewed available sources of data to bracket likely loads of phosphorus from identifiable sources and to determine how these affect Great Pond. A phosphorus loading summary estimated average annual loading of 3,500 kg P/year, with internal loading accounting for 34% of the total load. The report stressed the need for a combination of management strategies that address both external and internal loading to achieve desired water quality improvements.

(2018) Great Pond Watershed Survey- The BLA led a locally-funded watershed survey in September 2018 in collaboration with KCSWCD, 7 Lakes, the towns, and Maine DEP. The survey documented a total of 237 different nonpoint source pollution sites around the watershed that affect the water quality of Great Pond. Sites were prioritized by a steering committee, and follow-up letters were mailed to landowners having an identified site with incentives for completing recommendations.

CLEAN WATER ACT (CWA) SECTION 319 FUNDS

Since 2009, four CWA Section 319 implementation grants (Phase I, II, III, and IV) have supported 51 town and camp road construction projects in the Long Pond and Great Pond watershed. Under these grants, over 300 BMPs have been installed at 190 sites, including 108 sites on Great Pond. Pollutant Controlled Reports have documented a reduction of 401 pounds (182 kg) of phosphorus loading annually, including an estimated reduction of 251 pounds (114 kg) to Great Pond.[6]

Woodland Camps achieving their LakeSmart goals in 2016. Photo Credit: Dick Greenan, BLA.

[6] Long Pond Watershed NPS Restoration Project Phase I (2009RT07), Phase II (2011RT07), Phase III (2014RT06), and Phase VI (2016RT05) final project reports, provided by C. Baeder, 7 Lakes.

LAKESMART AND YCC

In 2004, in response to documented changes in water quality in Great and Long ponds, BLA adopted a LakeSmart program. Since 2004, 359 shorefront properties have been evaluated and 145 LakeSmart awards have been distributed, with 82 properties on Great Pond receiving LakeSmart awards to-date. 7 Lakes coordinates the largest Youth Conservation Corps (YCC) in the State of Maine that employs high school and college students to engage in watershed stewardship by implementing lakeshore conservation and erosion control projects. 7 Lakes implements more than 100 projects every year in the Belgrade Lakes watershed.[7] Since 2010, the 7 Lakes YCC has installed over 150 projects[8] in the Great Pond watershed (see map of completed YCC projects and certified LakeSmart properties in Appendix B).

LAND CONSERVATION

7 Lakes has conserved 10,000 acres in the Belgrade Lakes, 30 Mile River, and Sandy River watersheds since its founding in 1988, including 1,806 acres in the Great Pond watershed. Land conservation is an important watershed management strategy because it protects sensitive headwater streams, riparian corridors, and lake shorelines. The cumulative total of conservation land in the Great Pond watershed accounts for 9% of the watershed area compared to 14% of the watershed that is developed (Figure 2).

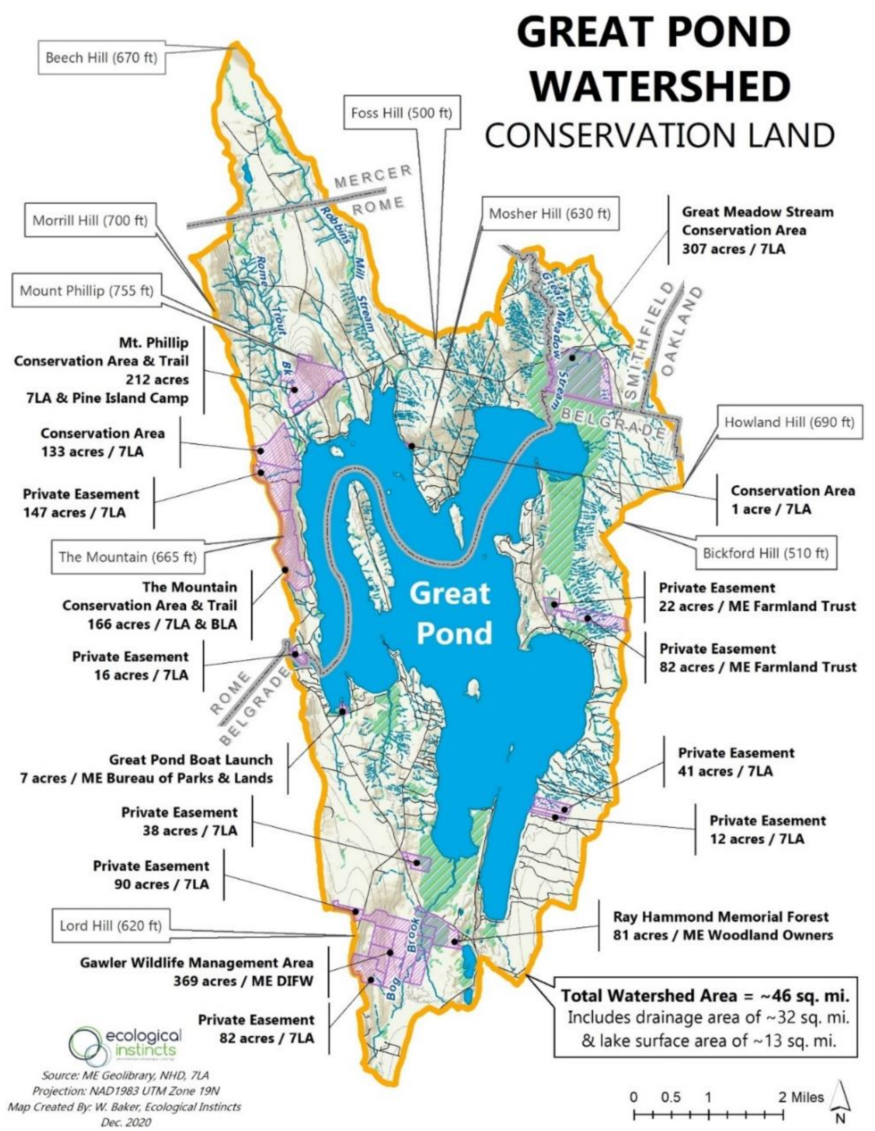


Figure 2. Conservation land in the Great Pond watershed.

[7] 7 Lakes Alliance YCC webpage: https://www.7lakesalliance.org/erosion.

[8] YCC Projects GIS file provided by 7 Lakes.

PUBLIC OUTREACH

The Belgrade Lakes Association and 7 Lakes Alliance are the primary entities conducting public outreach in the watershed. BLA hosts an annual meeting each summer for all interested watershed residents, provides watershed updates on its website, and distributes an annual newsletter each summer. BLA does extensive outreach through their Stop Milfoil Campaign and leads the LakeSmart program for Great Pond and Long Pond, among other outreach activities. 7 Lakes provides technical assistance to the association and the watershed towns to protect and preserve the natural resources within the watershed. 7 Lakes administers the YCC, the Courtesy Boat Inspection (CBI) program, and provides public lectures, and guided nature walks. General and targeted outreach and education activities recommended for the next 10 years are presented in Section 6.

WATER QUALITY MONITORING

Water quality data has been collected by Maine DEP and Lake Stewards of Maine (Formerly the Volunteer Lake Monitoring Program) in cooperation with the Belgrade Lakes Association since 1970. More recent, and more intensive monitoring has been completed by Colby College including deployment of "Goldie" in 2014 - a research buoy that collects information about the physical and biological conditions in the lake. Great Pond's buoy is a node in an international observation network (GLEON) to assess lakes across the world. In addition, a five-year intensive water quality study (2015-2020) was conducted by Colby and 7 Lakes researchers which included weekly collection of dissolved oxygen/temperature/pH profiles, water clarity, nutrients, metals and phytoplankton, as well as sediment sampling. Water quality will be discussed in Section 3.

Plankton sample collection in Great Pond. Photo Credit: BLA

BATHYMETRIC MAP

Bathymetric mapping was completed by Colby College using georeferenced depth data collected in Great Pond in 2011 and 2012. Colby students used a Lowrance GPS-sonar chart plotter to collect depth data every second while surveying the lake by boat. Depth surveys focused on the areas of the pond with greatest topographic variability. Approximately 500,000 data points were collected and manipulated by various GIS products to create the most thorough bathymetric map for Great Pond yet. The bathymetric map has been helpful for understanding the extent of anoxia, estimating internal load, and conducting phosphorus mass balance exercises among other purposes.

SEDIMENT CHEMISTRY

Lake sediments were collected by 7 Lakes/BLA in 2019 and 7 Lakes/Colby College in 2020 from five locations in Great Pond to determine the total iron and aluminum concentrations, and available phosphorus in the sediment. Extracted iron, aluminum, and phosphorus were compared in units of μmol element/g sediment. The purpose of the analysis is to attain Al:Fe and Al:P ratios in the sediments to determine the capacity of sediments to hold onto phosphorus under anoxic (low oxygen) conditions at the sediment/water interface. Complete analysis of the 2019/2020 samples is pending. Sediments were also collected in 2016 by Colby College at 36 locations. Sediment chemistry is discussed in Section 2.

2. Lake & Watershed Characteristics

Great Pond (MIDAS 5274)[9] is a 13-square-mile Great Pond (Class GPA)[10] located in Belgrade and Rome, Maine. The watershed is located within the Belgrade chain of lakes, which includes a set of seven hydrologically connected lakes that form a valuable resource in the State of Maine. As the fifth and largest of the seven lakes, it occupies a central position within the larger Belgrade Lakes watershed. Water from multiple lakes pass through it, and water from Great Pond flows over a dam in Belgrade Lakes Village into the north basin of Long Pond. Long Pond eventually flows into Messalonskee Lake which flows to the Kennebec River via Messalonskee Stream and eventually into the Gulf of Maine near Popham Beach in Phippsburg.

Great Pond receives water from North Pond and East Pond (via Great Meadow Stream) to the north, and from McGrath Pond and Salmon Lake to the east. There are five major tributaries that flow into Great Pond (Great Meadow Stream, Robbins Mill Stream, Rome Trout Brook, Bog Brook, and the Salmon Lake outlet stream), and numerous other seasonal drainages that contribute water in the spring and fall. All lakes hydrologically connected to Great Pond are either impaired, or on the DEP's Priority NPS Watersheds list.

LAKE & WATERSHED FACTS

Towns:	**Belgrade, Rome, Mercer, Smithfield, Oakland**
Watershed Area:	**70 sq. mi. (total), 32 sq. mi. (direct)**
Surface Area:	**13 square miles (8,360 acres)**
Max Depth:	**69 ft (21 m)**
Mean Depth:	**24 ft (7 m)**
Flushing Rate:	**0.5 flushes/yr**
Lake Elevation:	**248 ft**
Peak Elevation:	**755 ft (Mount Phillip)**
Avg. Clarity:	**21 ft (6.4 m)**
Invasive Plants:	**Variable Leaf Milfoil**

Photo Credit: Alexander Wall, BLA

[9] The unique 4-digit code assigned to a lake.

[10] Defined by MRSA Title 38 §465-A, Maine Standards for Classification of Lakes and Ponds: Class GPA is the sole classification of great ponds (>10 acres) and natural lakes and ponds <10 acres in size. Class GPA waters must have a stable or decreasing trophic state, subject only to natural fluctuations, and must be free of culturally induced algal blooms that impair their use and enjoyment.

Great Pond's direct watershed is expansive, covering 32 square miles (Figure 3). Adding the drainage area of North Pond (~22 square miles), East Pond (~7 square miles), and McGrath Pond/Salmon Lake (~9 square miles) increases this total to 70 square miles. However, despite being large, the watershed to lake area ratio is 5.4:1. Lakes with ratios of <10:1 generally have lower flushing rates and lower watershed pollutant loads. This does not protect them from eutrophication over time which can be accelerated by human activity and watershed alternations. This is an important metric that suggests proper watershed management can improve the water quality in Great Pond. The watershed includes four municipalities, with the largest land area in the towns of Belgrade (54%) and Rome (35%). There are 866 lots in the shoreland zone (within 250 feet) of Great Pond, and 2,226 lots within the entire direct watershed.

A recent land-cover analysis for Great Pond indicates that forestland makes up the majority of the watershed (70%), followed by wetlands at approximately 16%. Large wetlands flank the north and south ends of the lake, including the large wetland complex in the northeast around Great Meadow Stream and Camp Bomazeen west of Route 8, and in the southwest around Austin Bog near Route 27.

Developed land (residential, commercial, roads) accounts for 10% of the area in the watershed, while agricultural land is estimated to cover just 4%. Agricultural land is scattered around the watershed but is located in close proximity to the shoreline near Ram Island, Jamaica Point, and Hatch Cove, among other locations. Several of the Pond's ten islands are developed including Pine Island, Ram Island, Chute Island and Hoyt Island.

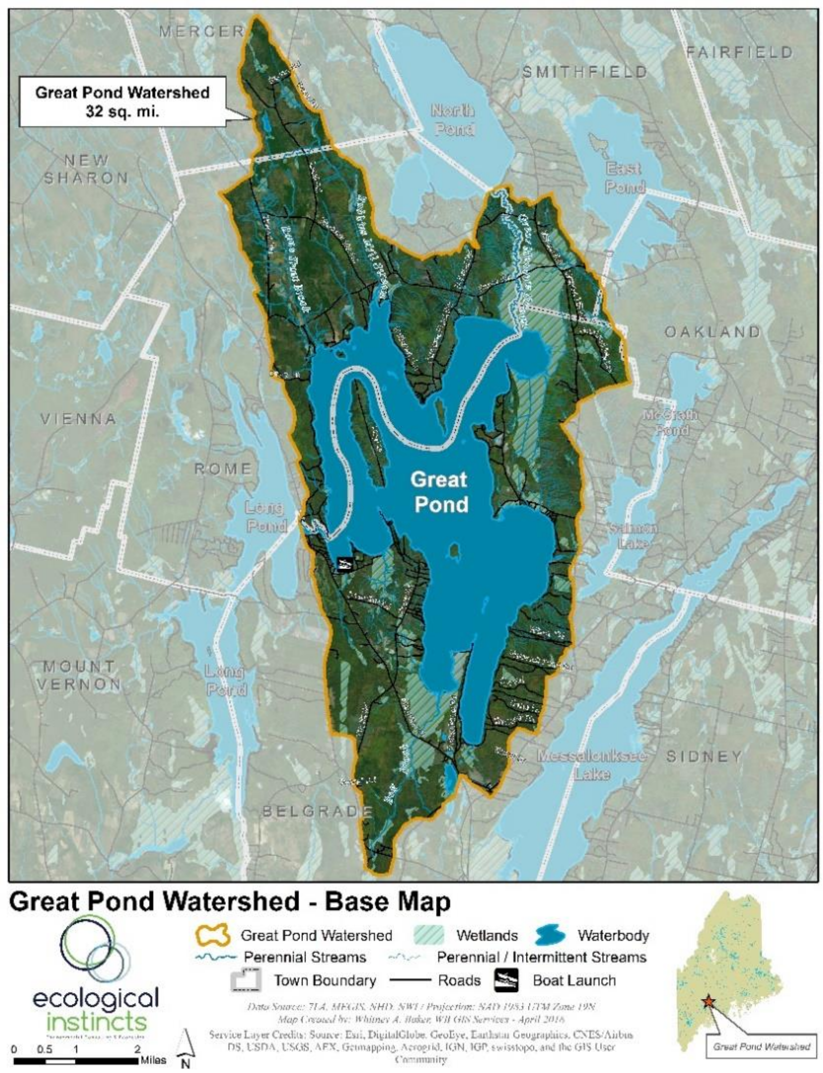


Figure 3. Great Pond direct watershed base map.

POPULATION, GROWTH, & MUNICIPAL ORDINANCES

POPULATION

View south on Augusta Road (Route 27) in Belgrade Lakes Village. Although not visible, Great Pond lies to the left and Long Pond to the right of this narrow strip of land. Photo Credit: Alexander Wall, BLA.

The Belgrade Lakes area provides excellent year-round recreational opportunities and is a highly desirable as a popular summer vacation destination. The population of the Town of Belgrade (~3,000) doubles when non-residents arrive in the summer, and the Town of Rome's population is estimated to triple or quadruple in the summer.[11] Approximately 1/3 (34%) of all homes in the larger Belgrade Lakes watershed are seasonal.[12] Most of these seasonal homes are shorefront properties. In Belgrade, 86% of all shorefront properties are either seasonal or second homes. Shorefront properties account for 60% of the property tax valuation in Belgrade and 75% in Rome.[13] This seasonal influx of recreational users is a major contributor to the towns and the local economy, providing numerous economic benefits for local businesses and residents. These businesses rely heavily on good water quality to support the tourist economy.

The watershed contains numerous private beaches, scenic islands, two private marinas, a public boat launch, three summer youth camps, numerous commercial businesses, a golf course, residential homes, and small farms. Great Pond and its surrounding watershed are used extensively for swimming, fishing, and boating as well as bird watching and hiking in the summer, and, ice fishing, skiing, and snowmobiling in the winter. Great Pond is a prominent scenic fixture in the landscape as it is located adjacent to Belgrade Lakes Village and provides the backdrop for the sweeping lake views from the top of the Kennebec Highlands and 7 Lakes' hiking trails which overlook the watershed.

As of 2016, Kennebec County's population was 121,328, an increase of 4,214 people, or 3.6% since 2000. From 2000 to 2016, the population growth rates for the Towns of Belgrade and Rome were 6%

[11] Personal communication. Andy Marble, Town of Rome Code Enforcement Officer. January 27, 2021.
[12] This extends to waterfront camps on the shoreline in the Town of Rome as estimated by Andy Marble, the town's code enforcement officer.
[13] 2012 Statistical Abstract of the Belgrade Lakes Watershed, Colby College; and personal communication, Charlie Baeder, 7 Lakes Alliance, February 6, 2021.

and 2%, respectively. The Town of Belgrade is growing faster than both the County rate, and the 4% increase for the State of Maine as a whole (Maine State Economist, 2018; Table 1). These historic watershed towns consist of economically diverse residential and waterfront development, working farms, commercial development and recreation, many small businesses, natural habitats, and rural landscapes. However, population and economic growth is accompanied by development that may have an important influence on the character and environment of the community. Belgrade's growth rate, being higher than both the county and state averages, suggests that development pressure may be steadily increasing.

Table 1. Population demographics for the towns of Belgrade & Rome, Kennebec County, and the State of Maine.

	Total Population 2000	**Total Population 2006**	**Total Population 2011**	**Total Population 2016**	**% Change 2000-2016**
Belgrade, ME	2,978	3,143	3,178	3,144	6%
Rome, ME	980	1,006	1,005	1,002	2%
Kennebec Co.	117,114	121,197	121,765	121,328	4%
State of ME	1,274,923	1,323,593	1,327,968	1,330,232	4%

Due to the large number of shorefront camps and development being seasonal, changes in population in Belgrade and Rome likely do not accurately illustrate the growth/impact around the lakes. For example, a 2021 review of Belgrade and Rome tax commitment records indicate that Great Pond has a total of 866 shorefront lots, 90% of which are developed. Conversion of seasonal or second homes to year-round homes would result in a significant change in use of the developed shoreline, increasing the potential for increased stormwater runoff and impacts from septic systems among other factors.

The desirability of Great Pond to attract new seasonal and year-round residents will likely be related to lake water quality. Should management recommendations achieve desired results of preventing further decline in water quality trends, Great Pond will maintain its role as a premier recreational destination in Maine. Landowners, businesses, and the watershed towns will likely see a monetary benefit from improved water quality over time. Factors such as increased property values will also improve the town's tax base. A study on 36 Maine lakes found that lakes with one meter greater clarities have higher property values on the order of 2.6% - 6.5%. Similarly, lakes with a one meter decrease in minimum transparencies cause property values to decrease anywhere from 3.1% to 8.5% (Boyle and Bouchard, 2003). On a lake like Great Pond, any improvement in water clarity will be highly desirable.

A build-out analysis was conducted for the Great Pond watershed in 2009 (FBE, 2009a). The analysis combined the use of GIS modeling, parcel data, municipal land-use ordinances, and natural resource constraints (e.g., wetlands, shoreland zone, steep slopes, conservation land) to determine where development may occur and on what time scale based on historical growth rates. Factors such as minimum lot sizes, lot coverage, building size, and setback requirements were factored in for each town in the watershed. The build out estimated 12,579 acres of developable land in the watershed (Figure 4), which represents 43% of the watershed area. Despite much of the shoreline already being developed, there is ample opportunity for additional development in the watershed, reinforcing the need for comprehensive watershed-scale planning. The analysis projected 322 new buildings by 2030. **At 30% buildout (year 2113), an additional 92 kg of phosphorus would be added to the watershed load as a result of development**, or 74 kg/yr if municipal ordinances were updated to require P controls for all new development (see below).

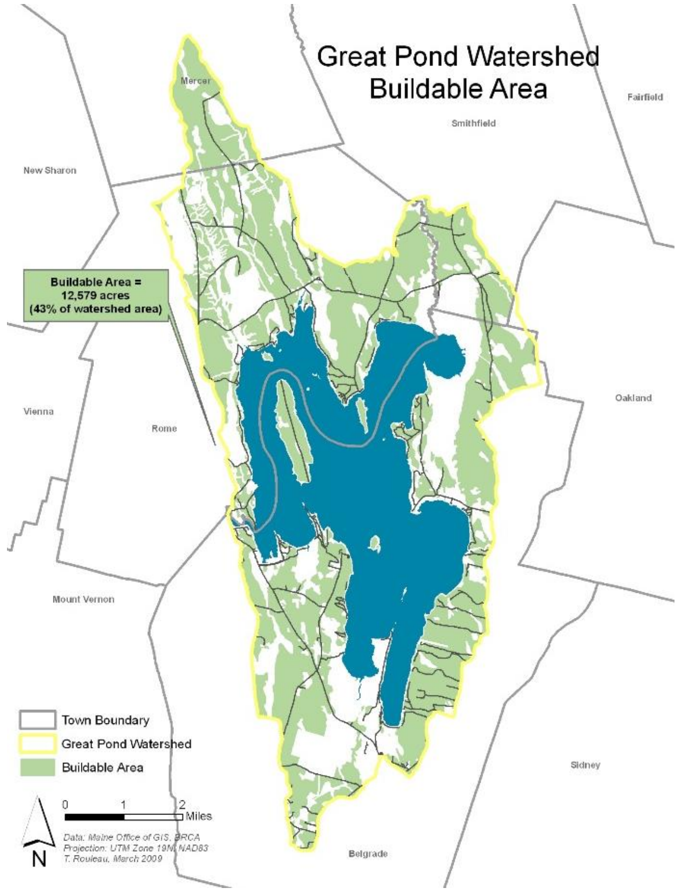


Figure 4. Buildable area in the Great Pond watershed.

MUNICIPAL ORDINANCES

There is an immediate need to reduce the amount of phosphorus getting to the lake- not only from current development, but also from future development given the extent of developable land in the watershed, and the popularity of the area for prospective buyers- especially since 2020 when more people began working from home as a result of COVID-19. Maine saw an immediate jump in out-of-state real estate transactions in 2020 as people fled from urban settings to rural settings. As the watershed continues to develop over time, erosion from disturbed areas will deliver new, and previously unaccounted for phosphorus into Great Pond, thereby affecting the success of planned management strategies to improve water quality.

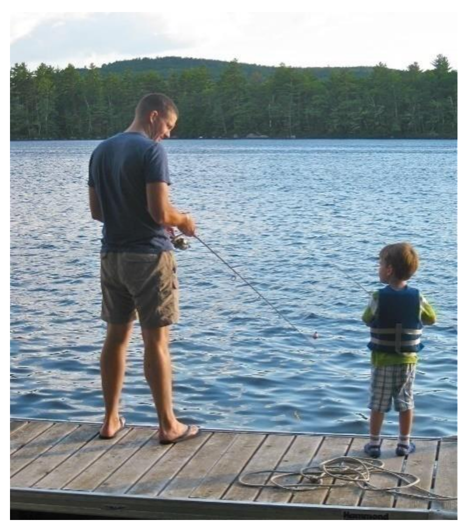


Photo Credit: Dick Greenan, BLA.

The towns in the watershed (primarily Belgrade and Rome) need to carefully consider to what extent existing municipal land-use regulations protect Great Pond from further degradation. In 2009, a municipal ordinance review was conducted for Belgrade and Rome as part of the Long Pond/Great Pond WBMP (FBE, 2009b). The ordinance review included 22 recommendations for minimizing stormwater runoff and reducing the amount of phosphorus stemming from new residential and commercial development. At the time of the analysis, Belgrade was working on updating their Comprehensive Plan. A follow-up analysis of current ordinances in both towns is needed to determine what improvements have been made, and what work is still needed to improve current practices that protect water quality. Ultimately, it will be less expensive and more efficient to make smart decisions about how and where development occurs, and to require P controls on all new development now, than to try and retrofit development that was not designed to protect water quality. More than 50 Maine communities have adopted P control ordinances for all types of development including lake watersheds at risk from development, so the precedent has been set- now is the time for watershed towns to step up and make a difference.

Below are a few of the major recommendations from both the 2009 ordinance review and feedback from the 2020-2021 Great Pond Watershed Plan Steering Committee related to reducing impacts from future development:

1. Conduct a **review of current municipal ordinances** in both towns to determine what improvements have been made since the 2009 assessment, and what work is still needed to improve ordinances.
2. **Urge towns to give more time to code enforcement officers** to enforce current ordinances. Currently, local CEO's are given 1-3 days in each of the area towns. During the summer, this demand increases considerably as the population increases.
3. **Develop a watershed-wide P control ordinance for all new development** (including single family residential units and roads).[14] Each town should adopt similar P control standards. Includ provisions for 3rd party site review, and long-term maintenance.
4. **Require Low-Impact Development (LID)** principles with individual building permits.
5. **Change ordinances** to encourage cluster development & preserve open space.

[14] Maine DEP requires per acre P allocations are currently only required by the State under the Site Location of Development Law which requires P controls for residential subdivisions with 15 or more lots on 30 or more acres, or commercial developments with 5 lots on 20 or more acres, or under shoreland zoning rules. Belgrade requires P control plans for major subdivisions, commercial development, or minor subdivisions in the Salmon Lake/McGrath Pond watershed.

6. **Set higher standards for septic systems** than are required by the state. Require proof that septic systems have been installed to code when properties change from seasonal to year-round status, and require replacement if proof is not available.
7. **Create a system for adequately tracking septic inspections** conducted for all real estate transactions in the shoreland zone. This may include an ordinance that requires new homeowners to submit a copy of their inspection report to the town.
8. **Create requirements for P controls on all building permits** in the shoreland zone including conversion of seasonal to year-round homes.
9. **Upgrade GIS-linked shoreline photo database** every 3-5 years to help CEOs with evaluating compliance within the shoreland zone.
10. **Create a permitting system and registration requirement for rental properties** on the shoreline to minimize impacts from undersized septic systems.

In addition to phosphorus control standards for all new development, long-term strategies such as enforcement of existing shoreland ordinances, and permanent protection of sensitive riparian zones and undeveloped forests, are all important municipal management considerations.

LAND COVER UPDATE

Land cover is the essential element in determining the extent of nutrients and sediments entering the lake from its watershed. More intensive development such as highly-impervious commercial development typically contributes more runoff than a low-density residential property with natural landscaping. In addition, changes in land cover occur over time in a watershed as forests are cleared for lumber, agricultural land is left fallow or developed, and infill development occurs along the shoreline and existing roads. Since no formal estimate of phosphorus loading from Great Pond's watershed existed prior to 2020, a land-cover update was needed before completing the watershed modeling.

Table 2. Great Pond watershed land-cover types.

LAND COVER TYPE	Area (ha)	%
Forest 1 (Upland Forest)	5,174	63%
Forest 4 (Forested Wetland)	1,130	14%
Other 2 (Timber Harvesting)	556	7%
Urban 1 (Low Density Res)	318	4%
Agric 3 (Agriculture)	301	4%
Urban 5 (Dev Open Space)	138	2%
Open 1 (Water)	134	2%
Other 3 (Unpaved Roads)	132	2%
Urban 3 (Paved Roads)	105	1%
Other 1 (Emergent Wetland)	97	1%
Open 3 (Excavation)	86	1%
Urban 2 (Med Density Res/Com)	56	1%
Forest 5 (Scrub-Shrub)	33	0.4%
TOTAL	**8,260**	**100%**

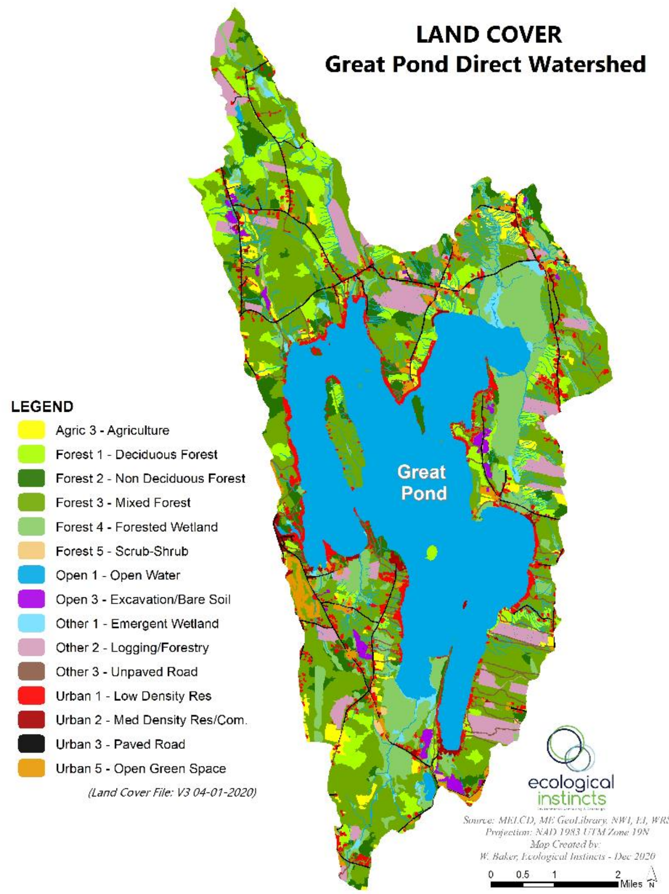


Figure 5. Updated land-cover map for Great Pond.

Maine Land Cover Dataset 2004 [MELCD] was used as a baseline for the updated land-cover layer. ESRI World Imagery aerials[15] were uploaded and compared to Google Earth satellite images, and 2018 NAIP imagery for Kennebec County, Maine[16] to determine major land cover changes. If discrepancies

[15] https://www.arcgis.com/home/item.html?id=10df2279f9684e4a9f6a7f08febac2a9
[16] https://datagateway.nrcs.usda.gov/GDGHome_DirectDownLoad.aspx

between the aerials and the MELCD file were found, changes were made by manually editing polygons. The State road layer (NG911 roads), stream layer, and an NWI wetlands layer were overlaid on the updated land-cover layer and relabeled appropriately.

The resulting updated land-cover file provides a more accurate representation of current land cover within the Great Pond watershed (Figure 5, Table 2). The most significant changes to land cover were the addition of low- and mid-density residential and commercial development throughout the watershed (Figure 6). These data are foundational in the watershed model used to estimate phosphorus loading in Great Pond (Section 4). In the model, a phosphorus export coefficient is assigned to each land-cover type to represent typical concentrations of phosphorus in runoff from those land-cover types. Unmanaged forested land, for example, tends to deliver very little phosphorus downstream when it rains, while row crops and high-density urban land export significantly more phosphorus due to fertilizer use, soil erosion, car and factory exhaust, pet waste, and many other sources. Smaller amounts of phosphorus are also exported to lakes and streams during dry weather under base flow conditions. A breakdown of land-cover types by area and contributing phosphorus loads to the lake is presented in Section 4.

Figure 6. "Before" (left) and "After" (right) land-cover file modifications.

SOILS

68% of soils in the Great Pond watershed (Figure 7) are formed from glacial till parent material containing mica schist with granite, gneiss, and phyllite. These soils are primarily loamy and deep, well-drained soils (Berkshire, Paxton) or moderately well drained (Woodbridge, Peru) with moderate or rapid permeability (Berkshire, Paxton), or slow permeability (Woodbridge, Peru). Smaller portions of these soils consist of the Ridgebury series, which is a deep, poorly-drained soil with slow permeability, and the Lyman series, a shallow, somewhat excessively-drained soil with rapid permeability.

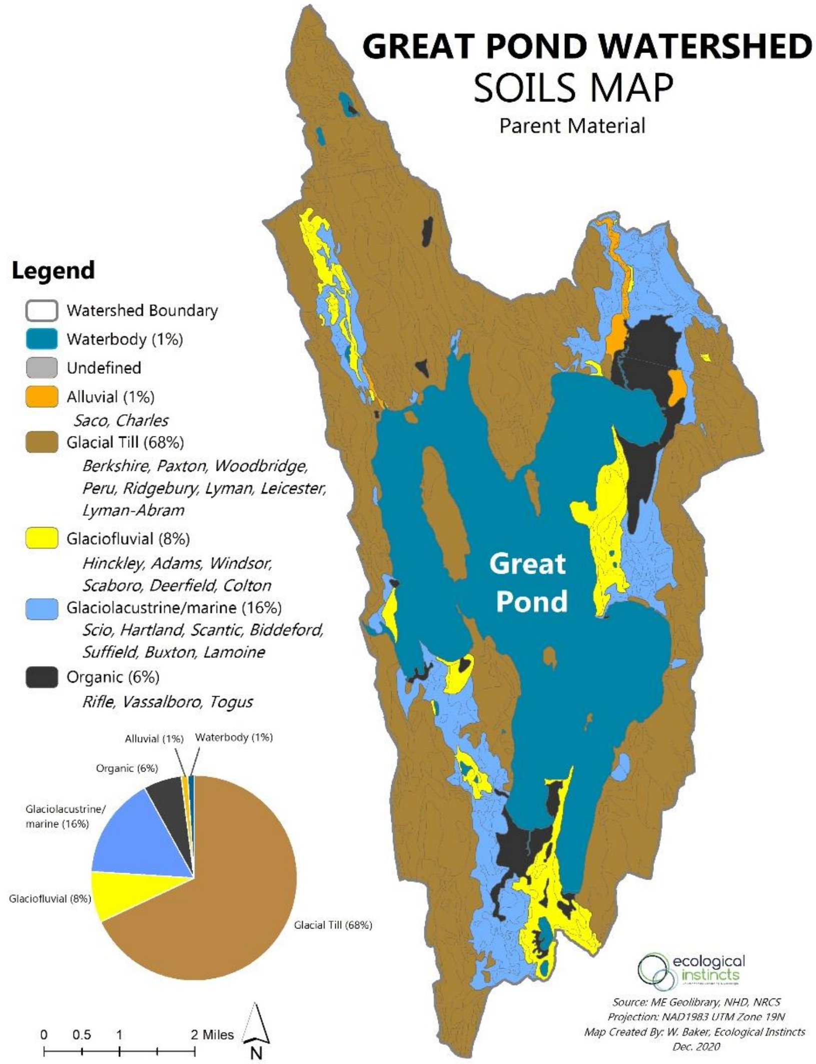


Figure 7. NRCS soil series displayed by parent material in the Great Pond watershed.

Soils surrounding wetlands and streams (Great Meadow Stream/wetland, western shoreline between North Bay and Hatch Cove, Rome Trout Brook, and the southwestern watershed between Foster Point and Hersom Point) are formed mainly from glaciofluvial (Hinckley) and glaciomarine or glaciolacustrine (Scio, Hartland, Scantic) parent material. Glaciofluvial soils in the Great Pond watershed are formed from granite, gneiss and schist, and are generally very sandy in texture. The Hinckley series is most common, is excessively drained, and formed in outwash terraces, plains, deltas, kames, and eskers. Saturated hydraulic conductivity is high and available water capacity is low in the Hinckley series. Glaciolacustrine/marine soils in the Great Pond watershed (Scio, Hartland, Scantic) consist of finer sediments formed in silt, clay, and very fine sand deposits. The Scio and Hartland series are silty, and the Scantic series consists of both silt and clay.

Organic soils within wetlands are primarily Togus, Rifle, and Vassalboro soils. These soils consist of very deep, very poorly drained organic soils. The Vassalboro series is found in bogs and kettle holes and is formed from a mixture of herbaceous, woody, and sphagnum material. Togus soils are formed in the mantle of slightly decomposed organic soil over sandy mineral material and can be found in watershed bogs and along the shoreline of Great Pond. The Rifle series is found in bogs and depressional areas within moraines, outwash plains, and lake plains.[17]

Understanding dominant soil types (Figure 8) that surround Great Pond and their location within the watershed is important. Factors such as topography, soil quality, erosion potential, and degree of alternation on various soils types will dictate the magnitude of erosion that occurs, and the resulting impact to water quality. Soil type will also dictate the suitability for certain infrastructure, specifically for septic systemsif not designed or installed properly.

The composition of each soil type dictates the amount of phosphorus, iron, and aluminum exported to the lake from the watershed soils. Watershed soils define the sediment composition within Great Pond as over 80% of the phosphorus, iron, and aluminum that enters the lake is accumulated within the sediment at the lake bottom (King, 2020).

Appendix E provides a breakdown of each soil series within the Great Pond watershed, associated areas, hydrologic soil grouping, and parent material.

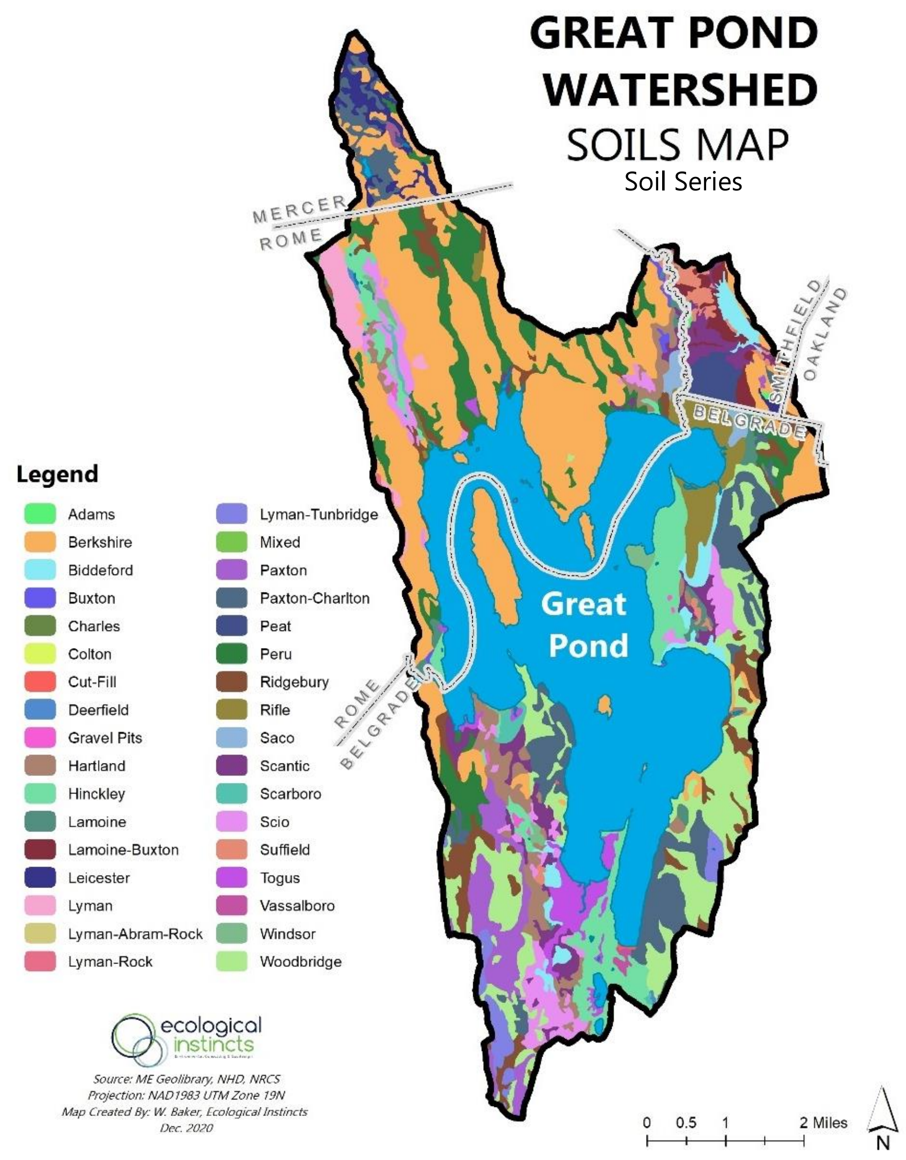


Figure 8. NRCS soil series displayed by major soil unit in the Great Pond watershed.

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[17] https://soilseries.sc.egov.usda.gov/

AT-RISK SOILS AND SUBSURFACE WASTEWATER SYSTEMS

Detailed information about the state of septic systems and their potential impact on the water quality does not currently exist for Great Pond. Typically, the first step in targeting pollutants from failing, malfunctioning, or poorly designed systems is to develop a list of all septic systems within the shoreland zone and adjacent to tributaries draining to the lake.

Soils can act as an efficient filter of phosphorus, nitrogen, and bacteria, especially if properly designed and installed. However, rapid permeability in some soil types located near a lake, stream, or wetland may lead to pollution of the groundwater because the filtration rate is too fast for sufficient treatment of septic effluent and the proper formation of the biological mat or "biomat" (a.k.a., a short-circuiting leach field).

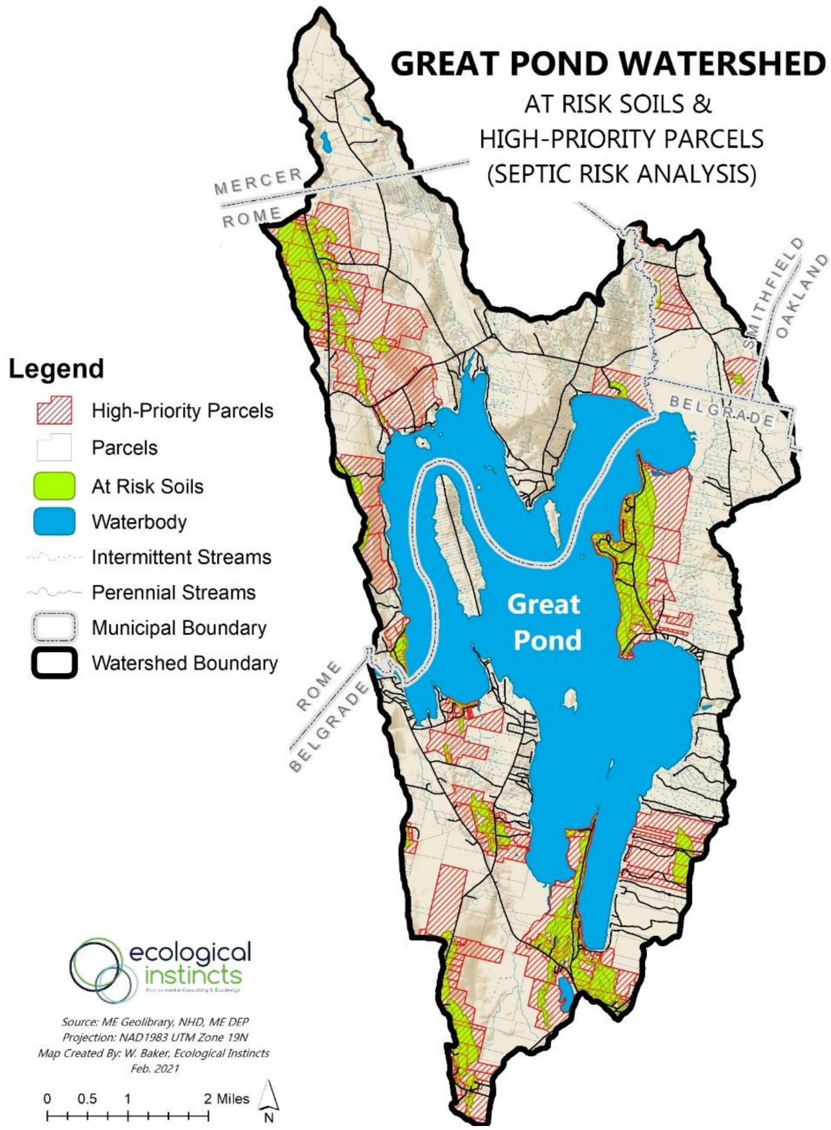


Figure 9. Great Pond at risk soils and associated parcels.

Coarse, highly-permeable soils lack the finer silts and clay that provide for the attenuation of phosphorus in leach field soils. Finely-textured soils provide the best filtration and retention of microbes and phosphorus because aerobic and anaerobic digestion within and surrounding the biomat, and filtration in the surrounding soils removes pollutants from the effluent before reaching groundwater.

Old systems that were built prior to 1974 are the highest priority and most at risk of contributing pollutants to groundwater, and ultimately Great Pond. However, it is not just old systems that can contribute phosphorus to the lake. **Properly-designed systems installed between 1974 (subsurface wastewater rules enacted) and 1995** (rules amended) did not properly address the issue of rapid percolation in coarse and gravelly soils.

Maine DEP conducted a septic risk analysis of soils in the Great Pond watershed in 2020. Coarse soils along the shoreline of Great Pond (and near tributary streams) are considered "at-risk soils" when an improperly designed septic system leach field is installed in these soils. This is due to the rapid permeability of these soils that may result in a "short-circuit" to groundwater. Short-circuiting occurs when septic tank effluent is not properly treated in the leach field because the soils are coarse and porous, which allows the effluent to move through them too quickly. Additionally, soils with shallow water tables and shallow to bedrock soils that abut or are hydrologically connected to the lake are also considered at-risk due to lack of treatment area where the leach field might rest on fractured bedrock resulting in no treatment of effluent before reaching groundwater which might then flow into the lake.[18]

Soils in the Great Pond watershed that are most susceptible to short-circuiting are presented in bright green in Figure 9 (above and noted in Appendix E in bolded red text). The highlighted 'high-priority parcels' (561 properties) are the top priority for future subsurface wastewater investigations, with the greatest priority for parcels within the shoreland zone of Great Pond (206 properties).

Priority of Septic System Evaluations in the Great Pond Watershed

1. Old systems (pre-1974) within the watershed, with priority to systems located on at-risk soils;
2. Systems (pre-1995) located on at-risk soils located within 250 feet of lake; and
3. Systems (pre-1995) located on at-risk soils within 75 feet of any tributary stream and/or wetland draining to Great Pond.

[18] Shallow to bedrock soils were not included in the 2020 Great Pond watershed soils analysis by Maine DEP.

BATHYMETRY

A bathymetric map was created for Great Pond by Colby College using data collected in 2011 and 2012 (Figure 10). Colby students used a Lowrance GPS-sonar chart plotter to collect depth data every second while surveying the lake by boat. Depth surveys focused on the areas of the pond with greatest topographic variation. Approximately 500,000 data points were collected and manipulated by various GIS products to create the most thorough bathymetric map for Great Pond yet.

Great Pond Bathymetric Map

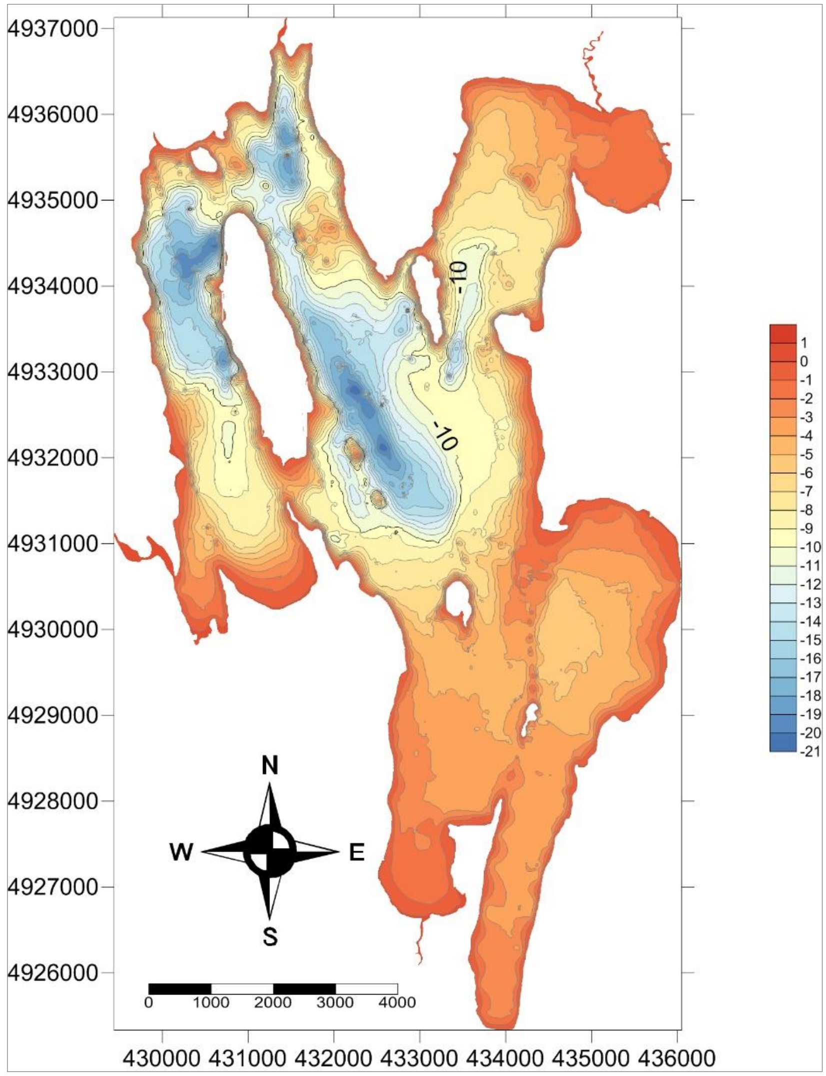


Figure 10. Great Pond bathymetric map (Source: W. King, Colby College)

Though Great Pond has a very large surface area, the majority of the pond is relatively shallow with approximately 80% of the lake area shallower than 10 meters (33 feet). This is important to understanding the internal load, because in recent years, monitoring data has indicated that anoxia occurs in Great Pond in late summer at depths between 9 and 12 m.

Roughly 13% of the lake area and 6% of the lake volume is in water deeper than 12 m compared to 27% of the lake area and 15% of the lake volume in water deeper than 9 m. Analysis of the extent of area with low oxygen in the lake indicates that the area of anoxia has stabilized over the past three years and is no longer growing, hopefully finding a new equilibrium.[19] However, should the area of low oxygen include shallower depths in the future, the area of the lake with potential to contribute to internal phosphorus loading

[19] Personal Communication, Danielle Wain, 7 Lakes Alliance, November 2020.

could increase substantially (Figures 11 and 12). After thorough review and comparison of temperature and dissolved oxygen data collected at Station 1 and Station 2, it was clear that the thermal dynamics at each deep hole in Great Pond are different. The project Technical Advisory Committee has recommended dividing the lake into two separate regions before finalizing a phosphorus mass analysis for Great Pond to better understand the concentration and distribution of phosphorus in the water column May – September.

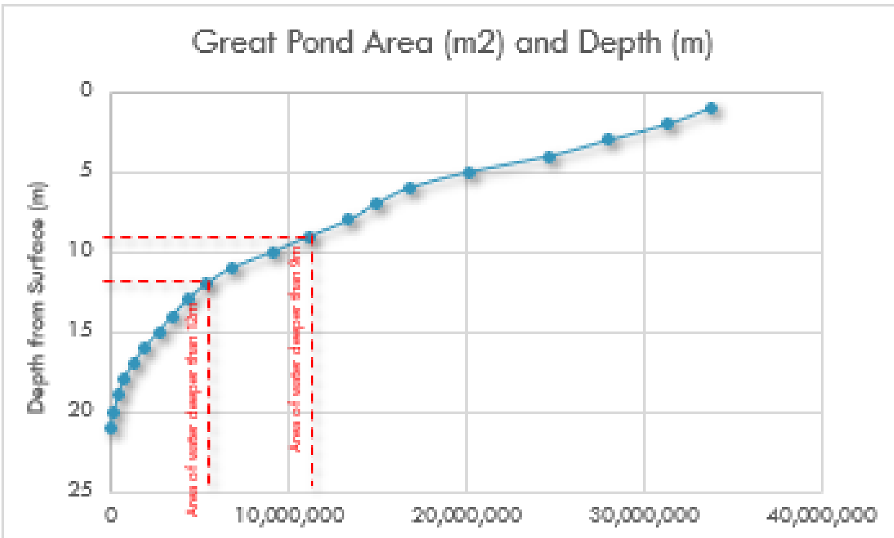


Figure 11. Hypsographic curve displaying the relationship between depth (m) and area (m^2) in Great Pond.

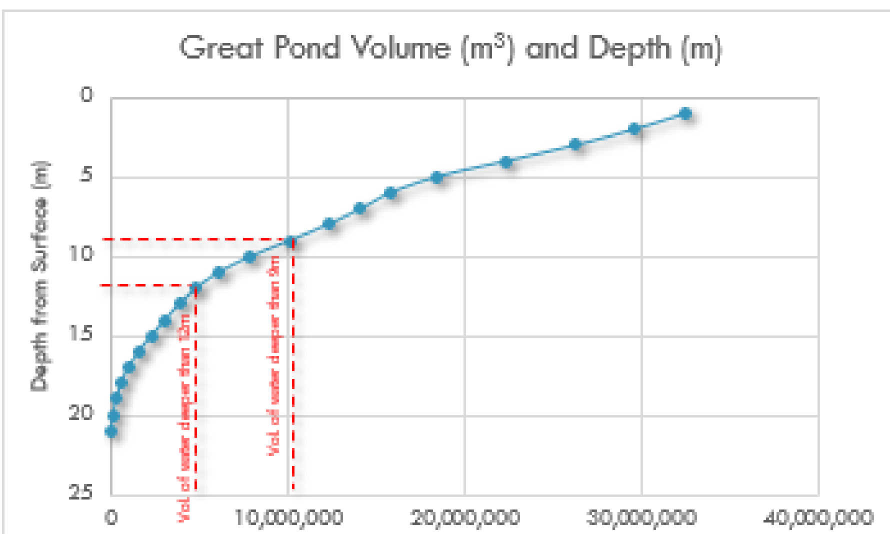


Figure 12. Hypsographic curve displaying the relationship between depth (m) and volume (m3) in Great Pond.

SEDIMENT CHEMISTRY

Sediments were collected from the bottom of Great Pond at five locations (Figure 13) in 2019 and 2020 by 7 Lakes within the area of the lake where sediments are exposed to anoxic conditions (water deeper than 9 m).[20] In 2016, benthic sediments were collected at 36 locations by Colby College. The samples were used to measure Aluminum:Iron (Al:Fe) and Aluminum:Phosphorus (Al:P) ratios to gain a better understanding of the capacity of the sediments to hold onto phosphorus under anoxic conditions, and the potential for internal phosphorus recycling in Great Pond.[21]

The 2016 samples were analyzed at Colby College to determine the total Fe, Al, and P concentrations. Extracted Fe, Al, and P were compared in units of μmol element/g sediment. Sediment testing results indicate conditions in Great Pond may favor internal loading as ratios indicate substantial amounts of iron-bound phosphorus in the sediments of Great Pond.[22] Fortunately, anoxia documented in Great Pond has been confined to the deepest waters. However, should conditions worsen over time, and the area of sediment exposed to anoxia increase in size, there is enough phosphorus currently bound to iron that would be released into the system and potentially fuel chronic internal loading in Great Pond.

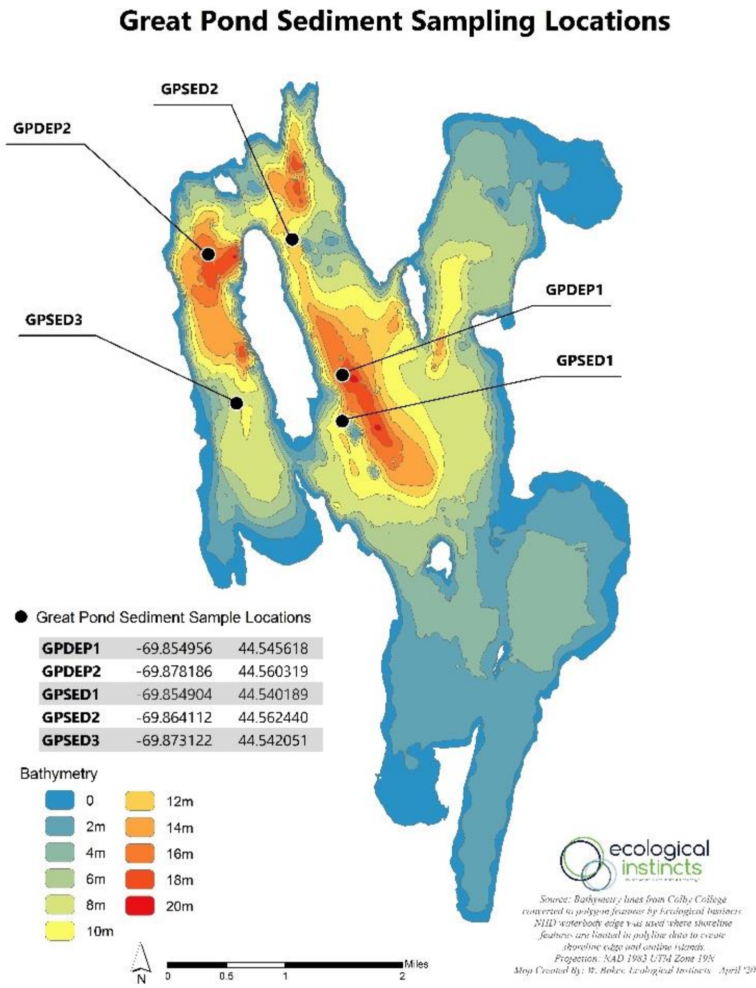


Figure 13. 2019/2020 sediment sampling locations.

[20] Sediment samples were collected in the summer and winter. Analysis of the 2019/2020 samples is not yet complete and results will be available in 2021.

[21] Al:Fe ratios <3 create conditions where reductive dissolution of Fe(III) can release significant amounts of Fe-bound phosphorus into the bottom water of the lake, resulting in internal phosphorus loading that causes algal blooms. Similarly, Al:P ratios <25 are favorable for the release of phosphorus under anoxic conditions.

[22] 2016 results indicate 15 of the 36 samples with Al:Fe ratios less than three, and all 36 samples had Al:P ratios less than 25.

WATER RESOURCES AND WILDLIFE HABITAT

Wildlife habitat is not limited to Great Pond and its shoreline. Fish and wildlife require suitable habitat beyond the lakeshore, with healthy riparian buffers, wetlands, and large undeveloped habitat blocks strategically linked to provide movement of wildlife.

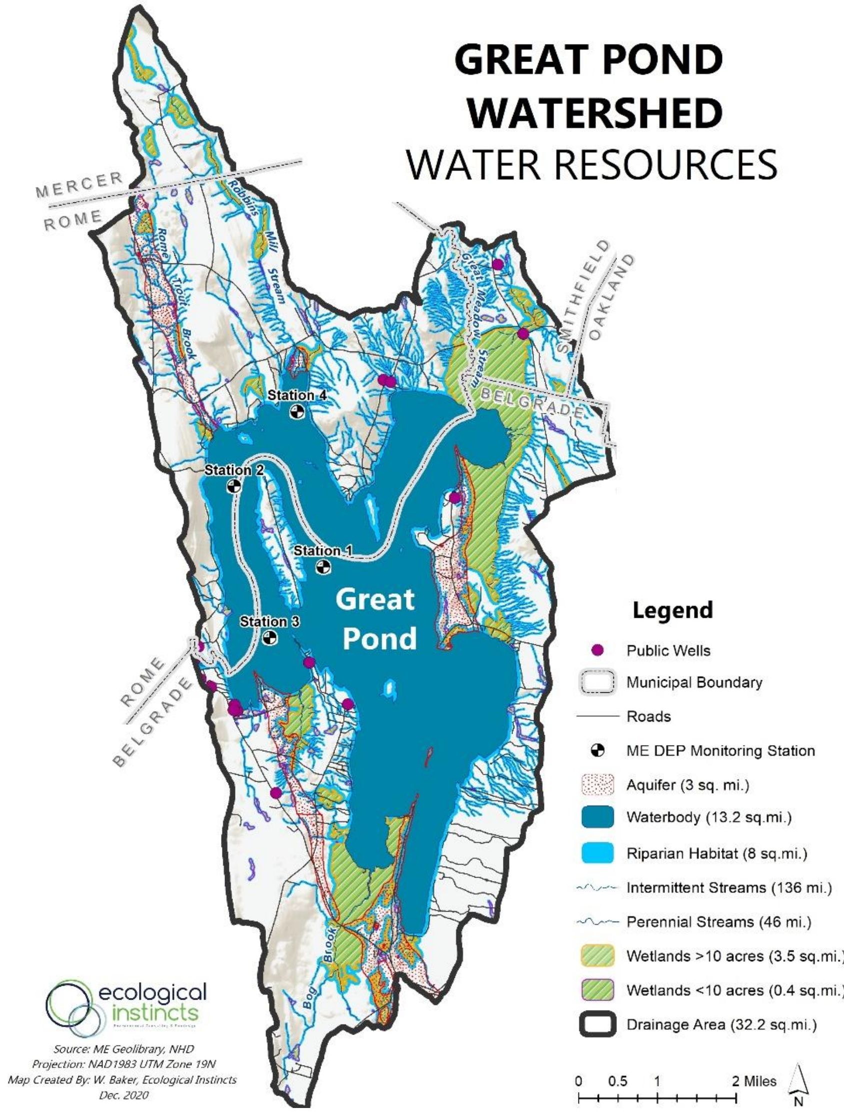


Figure 14. Water resources in the Great Pond watershed.

A habitat assessment was completed for the Great Pond watershed (Figures 14 and 15) using Beginning with Habitat (BwH) Program data. BwH was created in 2000 and is maintained by staff at Maine Inland Fisheries & Wildlife with the purpose of helping landowners and communities in Maine incorporate habitat conservation into their long-term planning efforts. Results of the assessment highlight the wealth of water resources in the watershed, including 46 miles of perennial streams, 136 miles of intermittent streams, 8 square miles of riparian habitat,[23] and 4 square miles of freshwater wetlands. Healthy riparian zones are not only important for water quality but are essential for more than 60 species of Maine wildlife, as more animals live in riparian zones than in any other habitat type in Maine, with hundreds of species depending on riparian zones for survival (ME Audubon, 2006).

Riparian habitat is the transitional area between aquatic habitats and dry, upland areas.

[23] Riparian habitat consists of a 75-ft buffer on all watershed streams, 250-ft buffer around Great Pond, 250-ft buffer around wetlands >10 acres, and a 75-ft buffer on all remaining wetland areas <10 acres.

In the Great Pond watershed, much of the riparian area (8 square miles) is already developed with camps and roads. As development continues, this valuable habitat will diminish - underlining the need for strong protection of the shoreland zone and conservation of undeveloped land within watershed.

Floating artificial nest deployed on Great Pond in 2020. (Photo Credit: Dick Greenan, BLA)

The watershed provides habitat for rare plant and animal species of special concern. The Eastern Ribbon Snake *(Thamnophis sauritus)* has been documented in the Great Meadow Stream wetlands, and Ladd Pond in the northern watershed provides Great Blue Heron (*Ardea herodias*) habitat. Other locally important wildlife species include the American eel (*Anguilla rostrata*) and the common loon (*Gavia immer*).

A symbol of summertime on Maine lakes, loons are common on Great Pond, with 61 adult loons and 2 chicks counted on the lake in 2019 (ME Audubon, 2020). BLA kicked off the Loon Preservation Project in 2019 and hired Loon Conservation Associates (LCA) to conduct a study of loons on Great Pond and Long Pond between 2019 – 2021. 2020 loon monitoring results indicate 12 territorial pairs on Great Pond. Of the 12 pairs identified, four nested, and one nest was successful in hatching a single chick that survived to fledge. As part of this project BLA constructed and installed four floating artificial nests in Long Pond and Great Pond in 2020. Two of the artificial nests were used with a 100% success rate (LCA, 2020).[24]

Wildlife sighting on Great Pond. (Photo Credit: Dick Greenan, BLA)

According to Beginning with Habitat, large undeveloped forest blocks cover over 20 square miles of the watershed (64% of the watershed drainage area total). Deer wintering areas, inland waterfowl and wading bird habitat exists in smaller pockets throughout the watershed. The wetland complex surrounding Great Meadow Stream on North Bay is considered an 'Exemplary Natural Community' as it is an unpatterned fen ecosystem.

[24] Success rate in natural nests in Long Pond and Great Pond in 2020 was 22%.

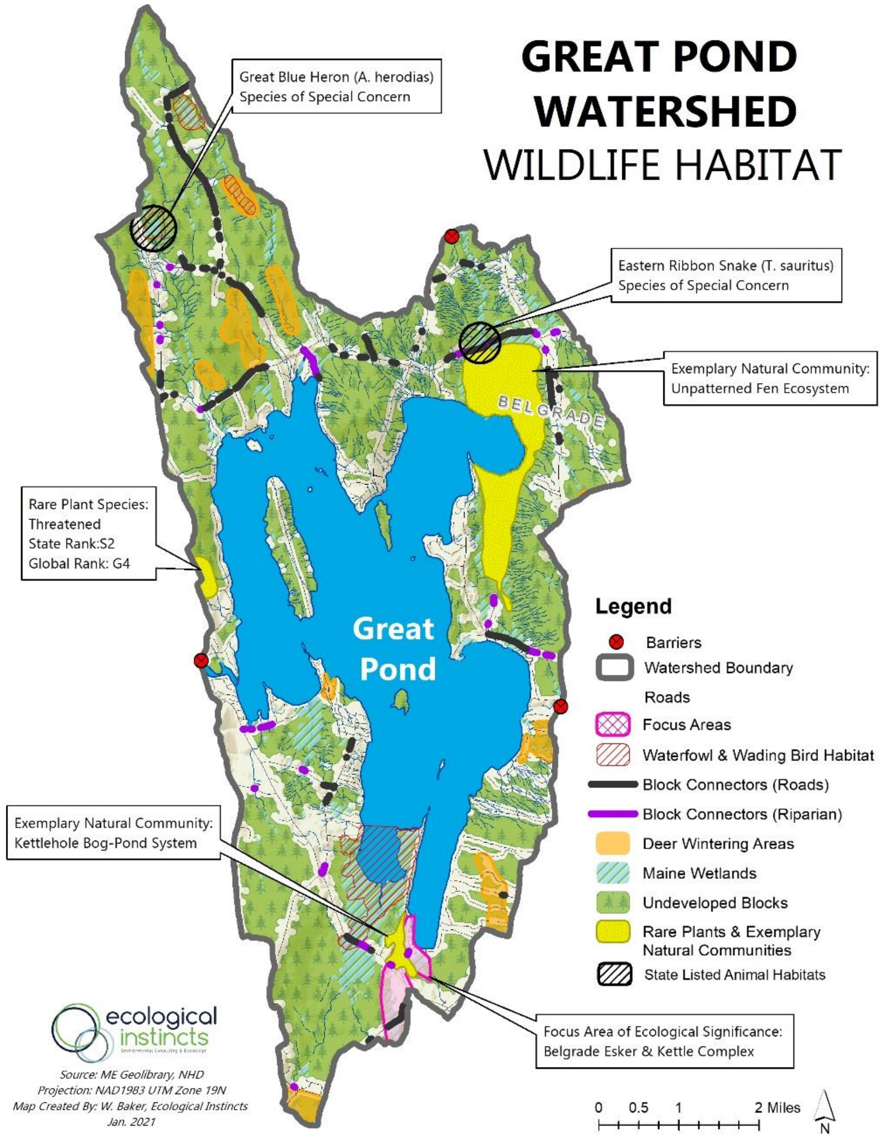


Figure 15. Wildlife habitat in the Great Pond watershed.

A fen is a unique and important type of wetland system. A peatland that relies on groundwater inputs and requires thousands of years to develop, fens are typically hotspots for biodiversity and are also commonly home to rare plants and wildlife. Protection of these ecosystems is vital because they cannot easily be restored once they are damaged.

The Belgrade Esker and Kettle Complex is partially located in the southern watershed and extends from Foster Point on Great Pond south to Tyler Pond in Augusta. Considered by geologists as one of the best esker systems in the State of Maine, it includes the Colby-Marston kettlehole bog, Hamilton Pond and Stuart Pond (kettlehole ponds), and several other small kettles adjacent to Foster Point Road. The Colby-Marston bog contains rare plant community ecosystems that should be protected including: *Leatherleaf Boggy Fen*, *Sedge-Leatherleaf Fen Lawn*, *Mountain Holly-Alder Woodland Fen*, and *Spruce-Larch Wooded Bog* communities. Hamilton Pond, a kettle pond with development of bog vegetation mostly surrounding the southwestern coves, is located on the watershed divide between Great Pond and Messalonskee Lake (BwH, n.d.).

Protecting the land and water in the Great Pond watershed is vital for maintaining the high-value wildlife habitat existing today. While the exact number of buildable lots remaining in the shoreland zone is currently unknown, the shoreline is already heavily developed. However, the habitat map above indicates that forestland within the watershed currently serves as wildlife connectors and large undeveloped habitat blocks covering a large portion of the Great Pond watershed.

Great Pond is home to 18 fish species, including 12 native species, and six introduced non-native species (Maine IF&W, 2000) (Table 3).

Table 3. Native and non-native fish species in Great Pond.

Fish Species *Native*	**Scientific Name**	**Fish Species** *Non-Native/Introduced*	**Scientific Name**
Yellow perch	*Perca flavescens*	White perch	*Morone americana*
Golden shiner	*Notemigonus crysoleucas*	Black crappie	*Pomoxis nigromaculatus*
American eel	*Anguilla rostrata*	Smallmouth bass	*Micropterus dolomieu*
White sucker	*Catostomus commersoni*	Largemouth bass	*Micropterus salmoides*
Chain pickerel	*Esox niger*	Northern pike	*Esox lucius*
Brown bullhead	*Icalurus nebulosus*	Landlocked alewife	*Alosa pseudoharengus*
Landlocked salmon[ϕ]	*Salmo salar*		
Pumpkinseed sunfish	*Lepomis gibbosus*		
Redbreast sunfish	*Lepomis auritus*		
Brown trout[ϕ]	*Salmo trutta*		
Brook trout[ϕ]	*Salvelinus fontinalis*		
Rainbow smelt[ϕ]	*Osmerus mordax*		

[ϕ]Coldwater game fish

Due to its bathymetry, habitat for coldwater game fish is limited in Great Pond despite its large size. The majority of the pond is relatively shallow and favors warmwater species. Brown trout is the only coldwater species currently managed by state biologists, with annual stockings of ~2,500 each fall (Maine IF&W, 2020). The pond also supports a robust smallmouth bass fishery. Northern pike were illegally introduced in Great Pond (via Little North Pond in the 1960s) and are now present in large numbers. Fishing for Northern pike is especially popular in the winter months on Great Pond.

ALEWIVES

Alewives are anadromous fish, meaning they normally spend the majority of their life at sea, but return to freshwater to spawn. Each spring, adult alewives migrate upstream from the ocean to rivers and lakes. After spawning, adults return to the sea while surviving fry remain to feed and grow into juveniles that will later migrate downstream to the ocean where they will grow to adulthood (Maine DMR, 2004). The alewives in Great Pond are not sea-run alewives, but landlocked alewives, which were illegally introduced in the Belgrade Lakes (Maine DEP, 2008).

Juveniles feed primarily on zooplankton (tiny aquatic animals that feed on algae). A large population of alewife in a lake can reduce the zooplankton community and in turn prevent effective grazing on algae during the summer when conditions favor excess algal growth. Lakes with robust alewife populations could have larger stocks of algae because there is reduced grazing pressure from zooplankton. This plan recommends initiating a study of the alewife population in Great Pond including baseline monitoring for zooplankton and phytoplankton, to better understand this complex dynamic (see Action Plan in Table 16).

INVASIVE AQUATIC SPECIES

In addition to invasive fish, other aquatic invaders have been present in Great Pond for decades. Rusty Crayfish (*Orconectes rusticus*) have been documented and studied in Great Pond since 1968 (Matthew Scott et al., 2010). Mudpuppies (*Necturus maculosus*) were accidentally introduced by a Colby College professor in 1939 (Collins, 2003), and have recently been the subject of a new study by biologists at Colby College and Maine IF&W to better understand the spread of this species and its impact on aquatic ecosystems (Sarnacki, 2019). Chinese Mystery Snails were first reported in Great Pond at Pinkham's Cove in 2010 and their full distribution in Great Pond is currently unknown (VLMP, 2013). Invasive aquatic plants are discussed in more detail later in this section.

PLANKTON AND CYANOBACTERIA

Tiny aquatic plants (algae or phytoplankton) and animals (zooplankton) are the primary and secondary source of food and energy in a lake food web and play a key role in lake ecosystems (Figure 16). Because plankton float in the water column, they influence the transparency of the water throughout the season and from year-to-year as these communities undergo both seasonal and annual growth cycles. Secchi disk transparency is often at its lowest in the spring and fall when lakes undergo "turn over". This bi-annual mixing suspends nutrients and sediment in the water column for a period of time, stimulating the growth of certain algae. For example, silica from sediment that is suspended in the water column during spring and fall mixing fuels diatom blooms, often resulting in slight decreases in water clarity during this time. Once the lake becomes thermally stratified in the summer, other types of algae will dominate the water column depending on weather, wind, nutrient availability, and water temperature, among other factors (Figure 17).

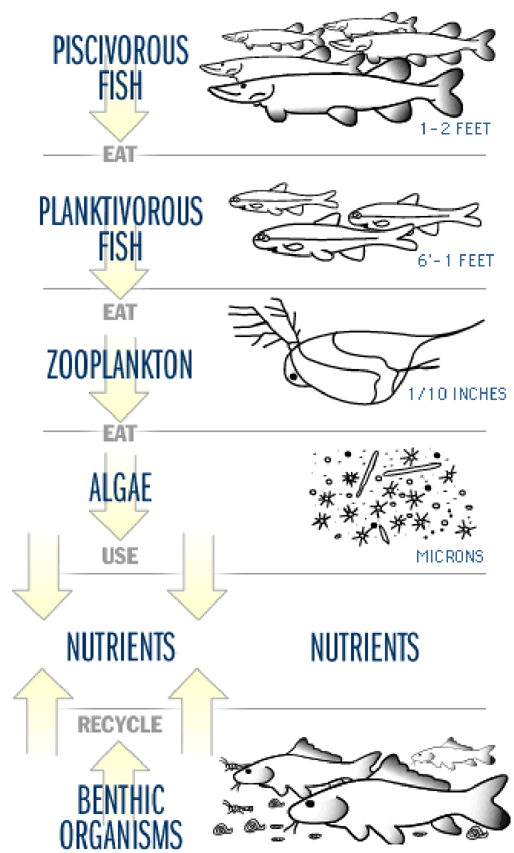


Figure 16. Typical lake food web. (Source: www.waterontheweb.com)

Phytoplankton are microscopic plants, also known as algae, that float in the water column of a lake. Phytoplankton photosynthesize using the sun's energy to turn carbon dioxide, nutrients and water into food for organisms higher in the food web such as zooplankton and small fish. Phytoplankton are sensitive to changes in lake ecosystems. The effects of environmental and watershed impacts can often be detected in changes in the plankton community species composition, abundance, and biomass.

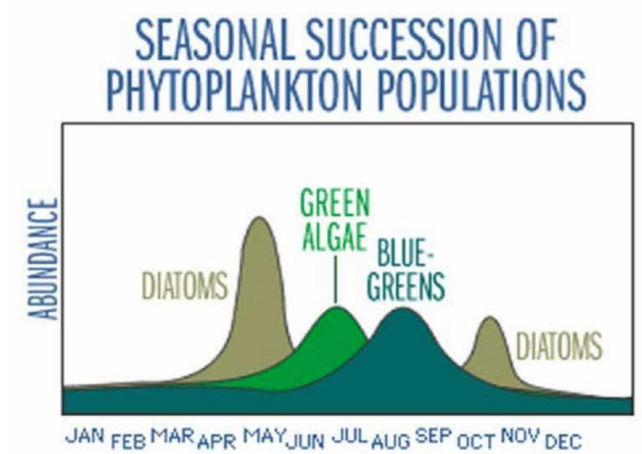


Figure 17. Example of seasonal succession of phytoplankton communities within a lake. (source: www.waterontheweb.com)

GREAT POND PLANKTON COMPOSITION

As part of the 7 Lakes-Colby College Water Quality Initiative, water samples were collected and analyzed by Colby College Interns in 2018 and 2019. The analysis was completed using a FlowCam. The Flowcam records images of plankton in water as they flow through a cell, counts them, and measures their morphological features. Plankton are then classified into broad groupings of dinoflagellates, zooplankton, cyanobacteria, diatoms, green algae, golden algae, and other (when unidentifiable). Figure 18 displays the plankton community composition and seasonal dynamics at Station 1 in June and July 2018. In the course of one month, the relative abundance of cyanobacteria decreases, and diatom abundance increases as also illustrated above in Figure 17.

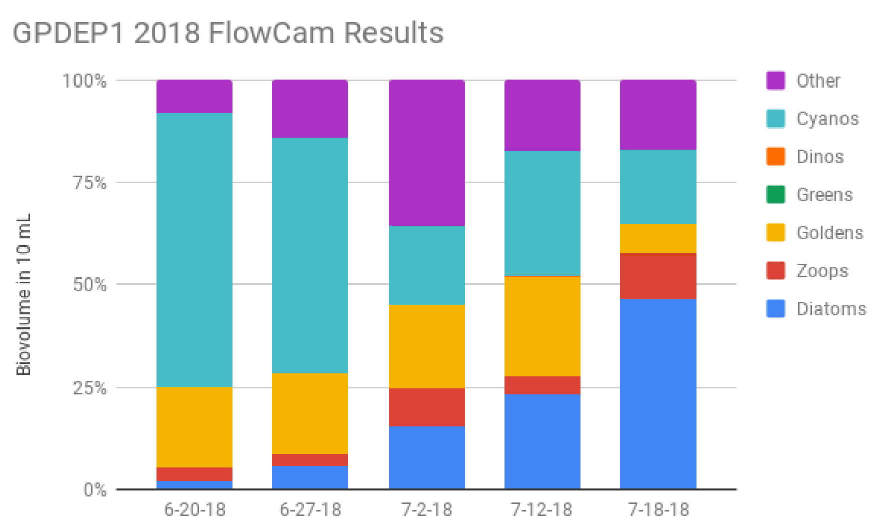
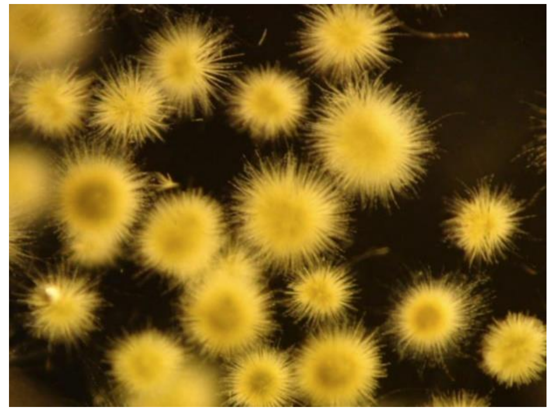


Figure 18. 2018 plankton monitoring results (Source: 7 Lakes)

There is little plankton data available for Great Pond at this time, but 7 Lakes and Colby College plan to collect and analyze more samples in effort to create an adequate baseline for the plankton community in Great Pond, establish successional patterns, and monitor changes over time. Though limited, data indicate a diverse array of plankton types in Great Pond (7 Lakes, 2020b).

<u>CYANOBACTERIA</u>

Cyanobacteria are present in Great Pond and in lakes all around the world. Their presence, species composition, and abundance can be used as an indicator of water quality. Blue-green algae is a term formerly used to describe cyanobacteria, which are not true algae, but photosynthetic bacteria that can form dense growths (blooms) in lakes when nutrients are plentiful, water temperature is warm, and sunlight is abundant. These blooms are an indication that the ecology of the lake is out of balance.



Gloeotrichia echinulata (magnified) in a water sample collected from Great East Lake, ME/NH in 2010. (Source: Jonathan Dufresne, University of New Hampshire)

A type of cyanobacteria common in Great Pond is *Gloeotrichia echinulata* or *"Gloeo*", a cyanobacteria that forms small spheres and can be viewed without the use of a microscope. *Gloeo* grows at the sediment-water interface and then rises through the water column to the surface waters where it completes its life cycle, dies, and sinks back down to the bottom of the lake where it will stay through the winter months until conditions are again suitable for growth (King, 2005). *Gloeo* grows where lake sediments have abundant available phosphorus, and where there is also adequate light for photosynthesis. It has been observed in Maine lakes for many years, but blooms have increased in lakes throughout the northeast in the recent decade ("Gloeotrichia", Lake Stewards of Maine).

Gloeo blooms have been observed in lakes all over the world with a wide range of trophic state and conditions. In recent years, Great Pond has experienced more frequent *Gloeo* blooms of varying intensities. It is entirely plausible that the *Gloeo* blooms over the last few years are a function of intermittent anoxia and associated phosphorus release occurring at shallower depths where sunlight can reach the bottom. The depth of anoxia will be related to weather and may vary among years, leading to less predictable conditions for blooms.

Significant *Gloeo* blooms in Great Pond could also influence the movement of phosphorus within the lake. When *Gloeo* rises to the surface from deep waters, it brings with it an unquantified amount of phosphorus, essentially short-circuiting the traditional nutrient cycle in the lake creating a shift that could have a negative effect on the lake's ecosystem (King, 2005). The phosphorus load associated with *Gloeo* movement into the upper water column from deep water is not accounted for in the internal loading analysis completed as part of this plan.

Since 2015, Great Pond residents have been collecting observational data of *Gloeotrichia* density off their docks using the Bouchard scale (0 – 6) for the duration of the 7 Lakes-Colby Water Quality Initiative (2015-2019) (Table 4).

Table 4. Great Pond Gloeotrichia monitoring sites and years sampled (Source: 7 Lakes)

Site	BM1	ES1	ES2	ES3	G1	GPDEP1	GPDEP2	JS1	MH1	MLRC1	PD1	RS1	WW1	WW2
2015	x	x						x	x			x	x	
2016	x	x	x			x	x	x	x	x		x	x	x
2017	x	x	x	x	x	x	x	x			x	x	x	
2018	x	x	x						x			x		
2019												x		

A coarse analysis of the data is displayed in a box plot (Figure 19), showing the median reported value (red line), the middle two quartiles (the range of the blue box), and the data range without outliers (extent of the whiskers) plus any outliers (red data point outside whiskers).[25]

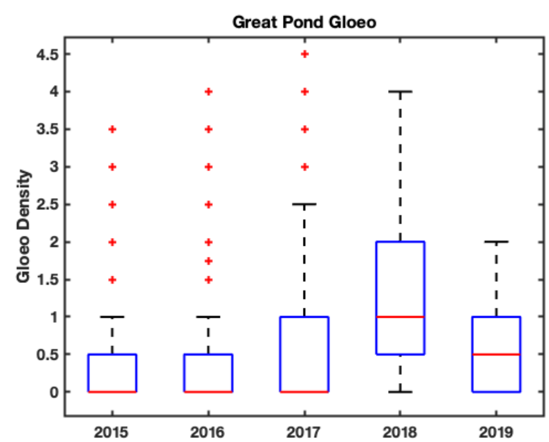


Figure 19. Box plot of Great Pond Gloeotrichia monitoring data using the Bouchard Scale.

Since 2015, the median reported density has increased from 0 to a high of 1 in 2018. 2018 had the largest range of densities, with observations of 3 and 4 not considered outliers as in previous years. In 2019, there were no observations above 2 from the one site in the dataset. In general, a density of 3 begins to have impacts on enjoyment of the lake. While there does appear to have been a small increase in density in the last couple of years, the *Gloeo* densities are still relatively low in Great Pond. A more in-depth analysis of the data should be completed in conjunction

[25] This is a preliminary data analysis as monitoring intensity varies across multiple sites combined into one metric.

with analyses on the various drivers of algae in the pond (weather, anoxia, phosphorus, etc.) and is a recommendation in this plan (7 Lakes, 2020a).

Like *Gloeo*, many other cyanobacteria initiate growth on the bottom, then form gas pockets in their cells and rise to the surface almost synchronously. Those cells tend to carry excess phosphorus, and once in the upper waters, the algae can grow with adequate light. When cells die, some portion of the phosphorus is released into the upper waters that can support other algae growth. Blooms that start on the bottom and move to the surface are therefore not just symptoms of increasing fertility, but vectors of it. Areas of fertile sediment subject to low oxygen that also recieve adequate light can be "nurseries" for cyanobacteria blooms, which is a concern as it relates to internal loading because these potential P inputs are not accounted for in the current loading model. Significant amounts of P from cyanobacteria movement might make the internal load in Great Pond more important than currently estimated, hence the need for more study.

The effects of toxins produced by cyanobacteria (cyanotoxins) to humans, domestic animals and wildlife, is closely associated with the occurrence of Harmful Algal Blooms (HABs) (US EPA, 2019). The effects are well documented, and can affect kidney, brain and liver function. However, not all blue-green algae blooms are toxic. Microcystis is the most common bloom-forming genus[26], and is almost always toxic (US EPA, 2017a). Both the Maine DEP and the US EPA are keeping an eye on HABs in Maine. Data collected on 24 Maine lakes between 2008-2009 documented HAB toxins in 50% of all samples, but only three exceeded World Health Organization (WHO drinking water guidelines, and all the samples were below the WHO guideline for recreational exposure (Maine DEP, 2017a).

Maine DEP is currently working on a statewide advisory for harmful algal blooms. Signage can be used to warn the public about HABs.

Microcystin testing on 2020 samples has not been completed on Great Pond by Maine DEP. Results from 700+ samples taken over the last four years across the state (including chronic bloomers) had microcystin criteria exceedances in algal scums (thick, green paint-like accumulations) along the shoreline. Open water samples that exceeded EPA drinking water standards for infants and non-school-age children, occasionally occurred in lakes that experience chronic annual algal blooms, but never in lakes with water quality as good as Great Pond.[27]

[26] Dolichosperum (also known as Anabaena) is most common in Maine.
[27] Personal Communication, Linda Bacon, Maine DEP. December 9, 2020

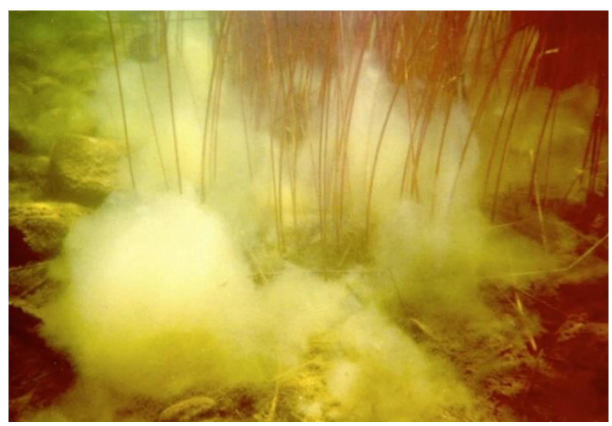
While many states have implemented HAB response guidelines in the event of a significant bloom in recreational waterways (e.g., analyzing water, posting public advisories, beach closures, etc.), these criteria have not yet been finalized in Maine. Maine DEP is working closely with the Maine Center for Disease Control (Maine CDC) and a regional cyanobacteria working group to define these standards. A statewide advisory is expected to be released in the future similar to what was issued for the State's mercury advisory.[28] Final criteria are currently available from US EPA. For more information on cyanobacteria and cyanotoxins and how to avoid exposure, visit the Maine DEP website (links to right).

US EPA criteria for **Drinking Water** are 0.3 µg/L for non-school-age children and 1.6 µg/L for school-age children and adults. US EPA criteria for **Recreation** is 8 µg/L for all ages. These recommendations stem from studies that consider magnitude, duration and frequency of exposure that are considered protective of human health. For more information on how to avoid exposure, visit the following pages at the Maine DEP website:

- https://www.maine.gov/dep/water/lakes/cyanobacteria.html
- https://www.maine.gov/dep/water/lakes/algalbloom.html

Research at the University of New Hampshire has shown that reducing total phosphorus levels in lakes can significantly reduce the risks associated with cyanobacteria blooms. A survey of cyanotoxins in New Hampshire lakes has shown that in-lake phosphorus concentrations above 9-10 ppb result in a dramatic increase in the toxicity of phytoplankton.[29,30]

METAPHYTON



Metaphyton mass. (Photo Source: Lake Stewards of Maine, photo provided by Betsy & Dick Enright.)

Maine DEP and Lake Stewards of Maine have received observational data and reports over the past decade from volunteer lake monitors and watershed associations suggesting a significant increase in metaphyton growth in Maine lakes. Though common throughout the state, implications of an increasing trend are not well understood. There is also limited understanding of the physical, chemical, and biological role these algae play in aquatic ecosystem (Shute &

[28] Personal communication (email), Linda Bacon, Maine DEP Biologist. August 8, 2017.
[29] Personal Communication, Dr. Jim Haney, University of New Hampshire.
[30] In-lake phosphorus concentrations during bloom conditions in East Pond and North Pond were well above 10 ppb, but microcystin testing indicated that toxin levels were not dangerous.

Wilson, 2013). Lake Stewards of Maine has developed a standardized monitoring protocol to help lake associations and volunteer water quality monitors identify and document the location and density of metaphyton growth in their lake.

Metaphyton is filamentous algae typically found in wetlands, floodplains, and the littoral zones of lakes and ponds. It forms loosely aggregated masses or mats that are either attached to benthic substrates or suspended in the water column. Mats can rise to the water surface when oxygen bubbles form within the mass as a result of photosynthesis. Metaphyton begins to form within the littoral zone of a lake or pond shortly after ice-out, persists through the summer months, and begins to degrade in late summer when they sink to the bottom to decompose. The species that make up metaphyton are not cyanobacteria and do not produce toxins.

It is well known that some filamentous algae favor environments with increased nutrients including nitrogen (septic systems, for example, can be a direct input of nitrogen into a lake) and phosphorus.

In addition to phosphorus added to lakes through stormwater runoff, these algae can consume a fair amount of phosphorus from the decomposition of organic matter (i.e., leaves). Because metaphyton, like other freshwater algae, require sunlight and nutrients to survive and thrive, it is likely that watershed management, especially participation in LakeSmart, would help decrease metaphyton growth in the lake. More research is needed to better understand these relationships. This might include volunteer led surveys of the littoral zone to document the extent of metaphyton in shallow areas of the lake, or a drone survey. Changes in the number of occurrences and area covered by metaphyton will provide another indication of changes in water quality over time.

INVASIVE AQUATIC PLANTS

Variable Water-Milfoil (*Myriophyllum heterophyllum*) is an invasive aquatic species first documented in Great Pond (Great Meadow Stream) in 2010. It is extremely well-adapted to a variety of environmental conditions and as such is known to out-compete native aquatic species and quickly forms infestations. From 2010 – 2011, the Belgrade Regional Conservation Alliance (now 7 Lakes Alliance) led a volunteer effort to remove milfoil from Great Meadow Stream, but despite those efforts the milfoil continued to spread downstream into North Bay. It was then that BLA led an initiative to form a task force to address the problem. Within just a few weeks the task force adopted the STOP MILFOIL banner and icon. A fundraising campaign kicked-off in 2012 and continues to this day as the STOP MILFOIL Annual Appeal.

In eight years, $1,273,978 has been raised for milfoil mitigation work in Great Pond and Long Pond. With those funds, 7 Lakes has been able to implement aggressive action plans every summer, employing both seasonal workers and an outside contractor, to remove 190,177 gallons of milfoil from Great Pond.

The infestation has largely been contained and has not spread into downstream Long Pond. The STOP MILFOIL task force also collaborates with volunteer invasive plant surveyors who together support the 'Adopt-A-Shoreline' program recruiting and training volunteers to survey their own shorelines for invasive aquatic species. The team also trains milfoil removal crews that work throughout the summer months to locate and remove plants and contain remaining infestations through the installation of benthic barriers. Milfoil infestations are presently located in Rome Trout Brook, Robbins Mill Stream, and Great Meadow Stream which has the greatest concentration of the three known locations. In 2020, milfoil remediation crews on Great Pond removed over 32,000 gallons of plants from approximately 1.5 acres.[31]

[31] Personal Communication with Lynn Matson, BLA,. January 27, 2021.

3. Water Quality Assessment

Water quality data have been collected by Maine DEP and Lake Stewards of Maine (formerly the Volunteer Lake Monitoring Program) in cooperation with the Belgrade Lakes Association since 1970 at the deep holes (Stations 1 through 4, Figure 20). This includes 49 years of data[32] collection over the 49-year monitoring period. More recent, and more intensive monitoring has been completed by Colby including deployment of "Goldie" in 2014 - a research buoy that collects information about the physical and biological conditions in the lake. Great Pond's buoy is a node in an international observation network (GLEON) to assess lakes across the world. In addition, a three-year intensive water quality study (2015-2017) was conducted by Colby researchers which included weekly collection of dissolved oxygen/temperature/pH profiles, water clarity, nutrients, metals and phytoplankton, as well as sediment sampling. This intensive monitoring effort has continued through 2020, led by staff at 7 Lakes and Maine Lakes Resource Center in collaboration with Colby College interns.

A water quality analysis was conducted for Great Pond as part of the development of the WBMP. The analysis includes data collected between 1970 and 2018 by Maine DEP[33] and volunteer lake monitors as well as 7 Lakes and Colby College data collected from 2015-2020. Data collected in the last five years was primarily collected at Stations 1 and 2 between June and September each year. A statistical analysis was conducted by 7 Lakes in 2020 to determine whether water quality trends for specific parameters in Great Pond have changed over time. Results of the full statistical analysis are included in Appendix F.

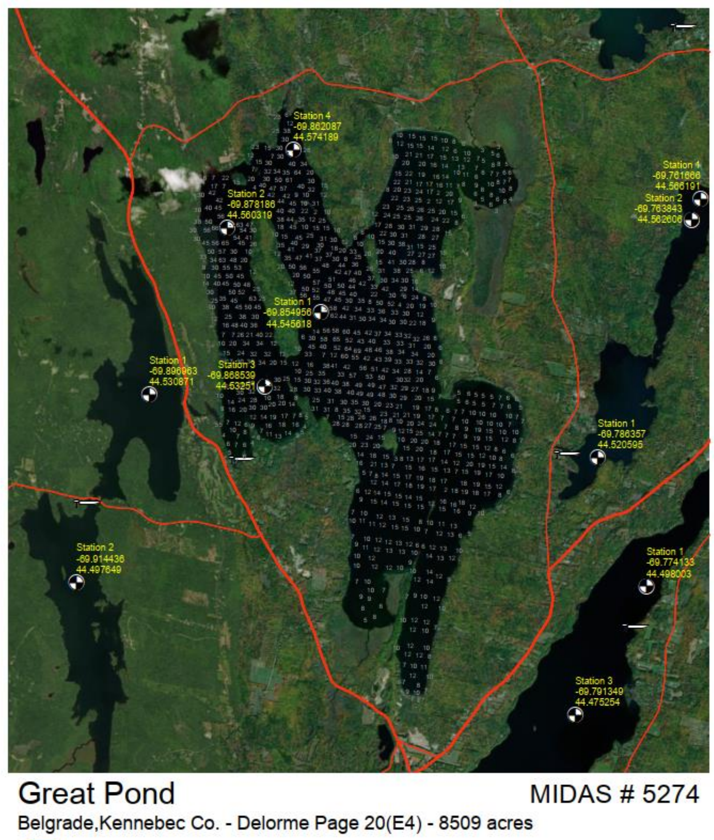


Figure 20. Water quality monitoring stations in Great Pond (Source: LakesofMaine.org)

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[32] DEP data collected 1970-2018, Colby 3-year intensive study 2015-2017, and continued intensive monitoring by 7 Lakes 2018-2020.

[33] 2019 and 2020 Maine DEP and LSM volunteer data were not available in the state data base at the time the analysis was conducted.

TROPHIC STATE INDICATORS

Trophic state indicators are key parameters for measuring lake productivity that can be used to calculate a Trophic State Index (TSI) which can be compared to other lakes across the state. In 568 Maine lakes monitored by Lake Stewards of Maine, TSI ranges from 8-163 with a mean of 48 (Lake Stewards of Maine, 2020). Less productive lakes are typically clearer, colder, and have fewer algae than productive lakes and have lower TSIs. The primary trophic state indicators are Secchi disk transparency, total phosphorus and chlorophyll-a. Monitoring results from these key parameters are described below. TSI has been calculated for Great Pond by Maine DEP. The average TSI calculated using water clarity data ranges between 35 (Station 1) and 38 (Station 2). TSI has also been calculated using total phosphorus results and ranges between 39 (Station 1) and 42 (Station 2).

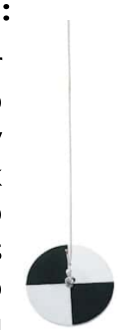
WATER CLARITY

Measuring water clarity (a.k.a. transparency) is one of the most useful ways to determine whether a lake is changing from year to year. Changes in transparency may be due to increased or decreased algal growth, or the amount of dissolved or particulate materials in a lake. Factors that affect transparency include algae, water color, and suspended sediment. Since algal density is usually the most common factor affecting transparency in Maine lakes, transparency is an indirect measure of algae abundance. Water clarity is measured using a Secchi disk and is obtained by lowering the black and white disk into the water until it is no longer visible.

Annual average Secchi disk transparency (SDT) from data collected between June and September, ranged from 5.0 to 8.6 m at Station 1 with a long-term average of 6.4 m. Results of this analysis for SDT indicate a significant decreasing trend in average SDT (lower water clarity over time) in both the long-term and short-term time series at Station 1, and in the short-term time series at Station 2. At Station 2, the trend in SDT over the past 50 years is not significant, likely due to gaps in the time series that are not present at Station 1.

Secchi Disk Transparency (SDT):

A vertical measure of water transparency (ability of light to penetrate water) obtained by lowering a black and white disk into the water until it is no longer visible. Measuring SDT is one of the most useful ways to show whether a lake is changing from year to year.



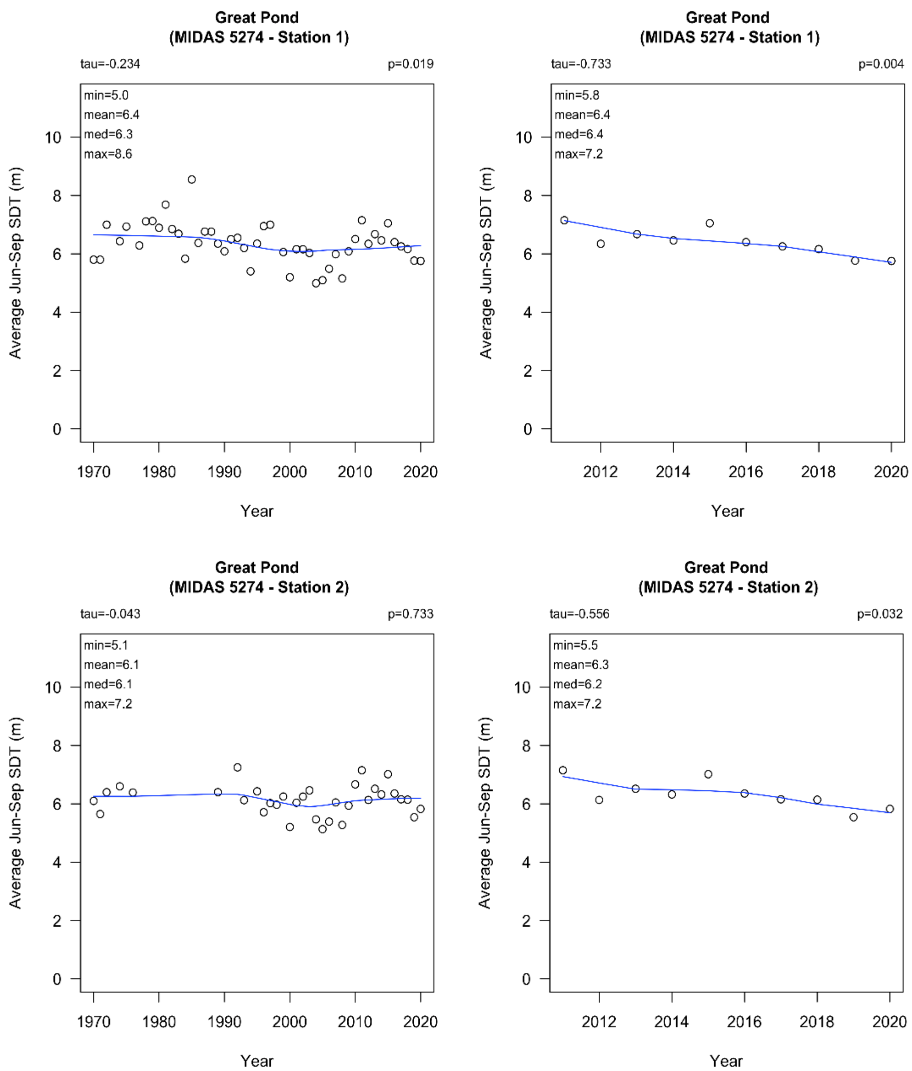


Figure 21. Trend plots of long-term (left) and short-term (right) SDT for Great Pond, Stations 1 and 2, results of Mann-Kendall Trend test (Source: 7 Lakes). Note that the y-axis is reversed.

The statistical analysis conducted by 7 Lakes included SDT data collected between June – September by Maine DEP, volunteers, and the recent data collected by 7 Lakes and Colby College. Long-term (1970-2020) and short term (2010-2020) SDT trends were examined. Results of the Mann-Kendall trend test indicate a significant decreasing trend in average SDT (lower water clarity over time) in both the long-term and short-term time series at Station 1, and in the short-term time series at Station 2 (Figure 12). At Station 2, the trend in SDT over the past 50 years is not significant, likely due to gaps in the time series that are not present at Station 1. The blue line is a LOWESS (locally weighted scatter plot smoothing) curve. Significance of the SDT results may be influenced by increased monitoring intensities over a number of years, timing of sampling, and density of samples within a given year. SDT data becomes more variable over time (Figure 21; 7 Lakes, 2020c).

TOTAL PHOSPHORUS

Total phosphorus (TP) is the concentration of phosphorus found in the water, including organic and inorganic forms. It is one of the major nutrients needed for plant growth, and generally present in small amounts, which limits plant growth in freshwater ecosystems. As phosphorus increases, the amount of algae generally increases. Humans add phosphorus to a lake through stormwater runoff, lawn or garden fertilizers, agricultural runoff and leaky or poorly maintained septic systems. Phosphorus can also be released from the lake's bottom sediments through a chemical release when there is no oxygen at the sediment water interface (internal loading); it eventually reaches the epilimnion where it fuels algal growth.

***Epilimnion* –** the upper layer of a thermally stratified lake. The epilimnion is typically warmer as a result of the sun penetrating the water's surface and higher in oxygen due to mixing from wind.

A combination of watershed loading and internal loading can result in an overabundance of phosphorus that throws the lake ecosystem out of equilibrium, resulting in nuisance algal blooms similar to blooms documented in neighboring ponds in the Belgrades. Total phosphorus is most often measured by collecting an "integrated core sample" from the epilimnion of the lake (representing the water column from the surface of the lake to the bottom of the epilimnion) and is reported in parts per billion (ppb). Other methods for measuring TP include collection of water from the surface (surface grab), approximately 1m off the bottom of the lake (bottom grab), and at selected depths through the water profile (profile grabs).

Total phosphorus (TP) samples collected between 1977 – 2018 in Great Pond range from 5 ppb to 15 ppb with a mean of 9 ppb at Station 1 and 10 ppb at Station 2. The statistical analysis for TP indicates no significant trends in total phosphorus at either monitoring station.

Results from the statistical analysis conducted by 7 Lakes included TP measurements collected from the epilimnion of Great Pond by Maine DEP and certified volunteer monitors from Lake Stewards of Maine between 1980 and 2018. Results indicate no significant trends in total phosphorus at either monitoring station for both long-term (1980-2018) or the short-term (2011-2018) time series (Appendix F) (7 Lakes, 2020c).

CHLOROPHYLL-A

Chlorophyll-a (Chl-a) is the third trophic state indicator, measuring the green pigment found in all plants, including microscopic plants such as algae. Chl-a is used as an estimate of algal biomass; higher Chl-a equates to greater amounts of algae in the lake. Like TP, Chl-a is typically collected as an integrated core from the epilimnion as this is typically where temperatures are warmest, light penetration strongest, and where plants, including algae, grow.

Chlorophyll-a (Chl-a) measurements collected between 1976 and 2018 range from 2.4 ppb to 9.5 ppb with an annual average of 4.8 ppb at Station 1 and 4.6 ppb at Station 2. Chl-a, being directly correlated to algal production, has been variable yet remains relatively low in Great Pond. Results of the statistical analysis for Chl-a indicate a lack of a statistically significant increase in Chl-a (increasing algal density) over the historical sampling period at either station.

Chl-a has been variable with a direct correlation to algae production and remains relatively low in Great Pond. Results of the Mann-Kendall trend test by 7 Lakes indicate a no statistically significant increase in Chl-a (increasing algal density) over the historical sampling period at either station for either time series (Appendix F; 7 Lakes, 2020c). Algae, and cyanobacteria, float to the surface waters and can be blown by the wind concentrating along the shoreline or in coves. This accumulation is usually missed by standard site monitoring but is highly visible to residents. Higher chl-a concentrations are likely confined to various areas of the pond during the summer months and therefore may not show up in this analysis.

DISSOLVED OXYGEN & TEMPERATURE

Dissolved oxygen (DO) is the concentration of oxygen dissolved in the water, and is vital to fish, zooplankton, vertebrates, and chemical reactions that support lake functioning. DO levels below 5 ppm can stress some species of cold-water fish, and over time reduce habitat for sensitive cold-water species. DO concentrations in lake water are influenced by several factors, including water temperature, concentration of algae and other plants in the water, decomposition in bottom waters, and, the amount of nutrients and organic matter flowing into the lake as runoff from the watershed. DO is measured using a dissolved oxygen meter that is lowered through the water column at one-meter increments and reported in parts per million (ppm).

Hypolimnion **–** the bottom layer of a thermally stratified lake. The hypolimnion is typically cooler and may be lower in oxygen than the warmer, oxygenated epilimnion above.

Summer DO concentrations can change dramatically with lake depth, as oxygen is produced in the top portion of the lake (where sunlight drives photosynthesis), and oxygen is consumed near the bottom of the lake (where organic matter accumulates and decomposes). In stratified lakes, such as Great Pond, the DO concentrations from top to bottom can be very different, with high levels of oxygen near the surface and little to no oxygen near the bottom, especially during the summer and early fall when water temperature and decomposition are at their highest. Stratification prevents atmospheric oxygen (wind, wave mixing) from reaching the deep areas, cutting off the supply. In addition, microbial respiration (microbes breaking down decaying plant and animal matter) at the bottom of the lake consumes oxygen, the combination of which results in loss of DO in deep areas of the lake (anoxia). Excess phosphorus in the bottom sediments, thermal stratification, anoxia, and sediment chemistry results in the release of phosphorus from the sediments (internal loading) which can fuel algal growth and lead to persistent, recurring nuisance algal blooms..

DO and temperature data were collected by Maine DEP and volunteers in 38 years between 1970 and 2018. This includes 121 DO and temperature profiles collected at Station 1 and 156 profiles collected at Station 2. In addition, Colby and 7 Lakes have collected profile data over the course of six summers (2015-2020). Generally, DO at the bottom of the lake ranges from 0 – 5 ppb with a decrease evident in July and the lowest values occurring at the end of August. Anoxic depth (depth with DO less than 2 ppm) ranges between 10 and 14 m and increasing in area as the summer progresses.

WATER QUALITY INITIATIVE DATA 2015-2020

Water quality profiles are documented in Great Pond by the 7 Lakes Alliance-Colby College Water Quality Initiative. During a typical summer, when Colby interns are available, SDT and profiles of temperature and oxygen are taken every week at the two stations using an *In Situ* multiparameter water quality sonde. Every two weeks, water samples are collected every 2 m with a Van Dorn sampler for total phosphorus and analyzed at Colby.[34] When interns are not available, SDT and profiles are taken every two weeks and water samples are collected once per month at 4 m intervals (7 Lakes, 2020c).

Figure 22 (below) shows the patterns from 2019 and 2020, although data from all six summers of the Water Quality Initiative show similar results. The following patterns were observed in Great Pond over the course of the summer (June – September) between 2015 and 2020:

- **SDT** typically varies at both stations between 6 and 7 m, with the lowest values occurring in September and the highest values in July.
- **Surface temperature** at both stations typically ranges between 21 and 24 C, reaching its peak in July.
- **Bottom temperature** ranges between 13-14 C at Station 1 and 9-11 C at Station 2, both warming as the summer progresses.
- The **top of the thermocline** varies between 6-9 m at Station 1 and 5-7 m at Station 2, both getting deeper through the summer.
- **Dissolved oxygen** (DO) at the bottom of the lake at both stations ranges between 0 and 5 mg/L, with the lowest values occurring at the end of August.

[34] Lab splits are taken from the Colby TP samples and sent to the Health and Environmental Testing Laboratory (HETL) in Augusta for analysis. Colby College is not certified by the State for phosphorus analysis. Maine state law requires that any samples on which environmental decisions are made must be analyzed at a lab certified by the State of Maine.

- **Onset of hypoxia** (when the DO first drops below 5 mg/L at any depth) typically occurs in July.
- **Hypoxic depth** (for this analysis defined as the depth below which the DO is <5 mg/L) ranges between 9-11 m at Station 1 and 8-13 m at Station 2; much of the water below the thermocline is hypoxic, so the hypoxic depth gets deeper through the summer along with the thermocline.
- **Anoxic depth** (for this analysis defined as the depth below which the DO <2 mg/L) at both sites typically ranges between 10 and 14 m, increasing in area with the thermocline as the summer progresses.
- **Onset of anoxia** (when the DO first drops below 2 mg/L at any depth) is typically in late August. **Phosphorus in the surface water** at both sites typically ranges between 6 and 12 ppb and is quite variable with no particular seasonal trend. One possible explanation for this variation is that one *Gloeo* colony can contribute a lot of P to a sample. The same applies to variations observed in Chl-a.
- **Phosphorus near the bottom** typically ranges between 8-18 ppb at Station 1 and 11-26 ppb at Station 2, with values increasing through the summer with a maximum near the end of September.

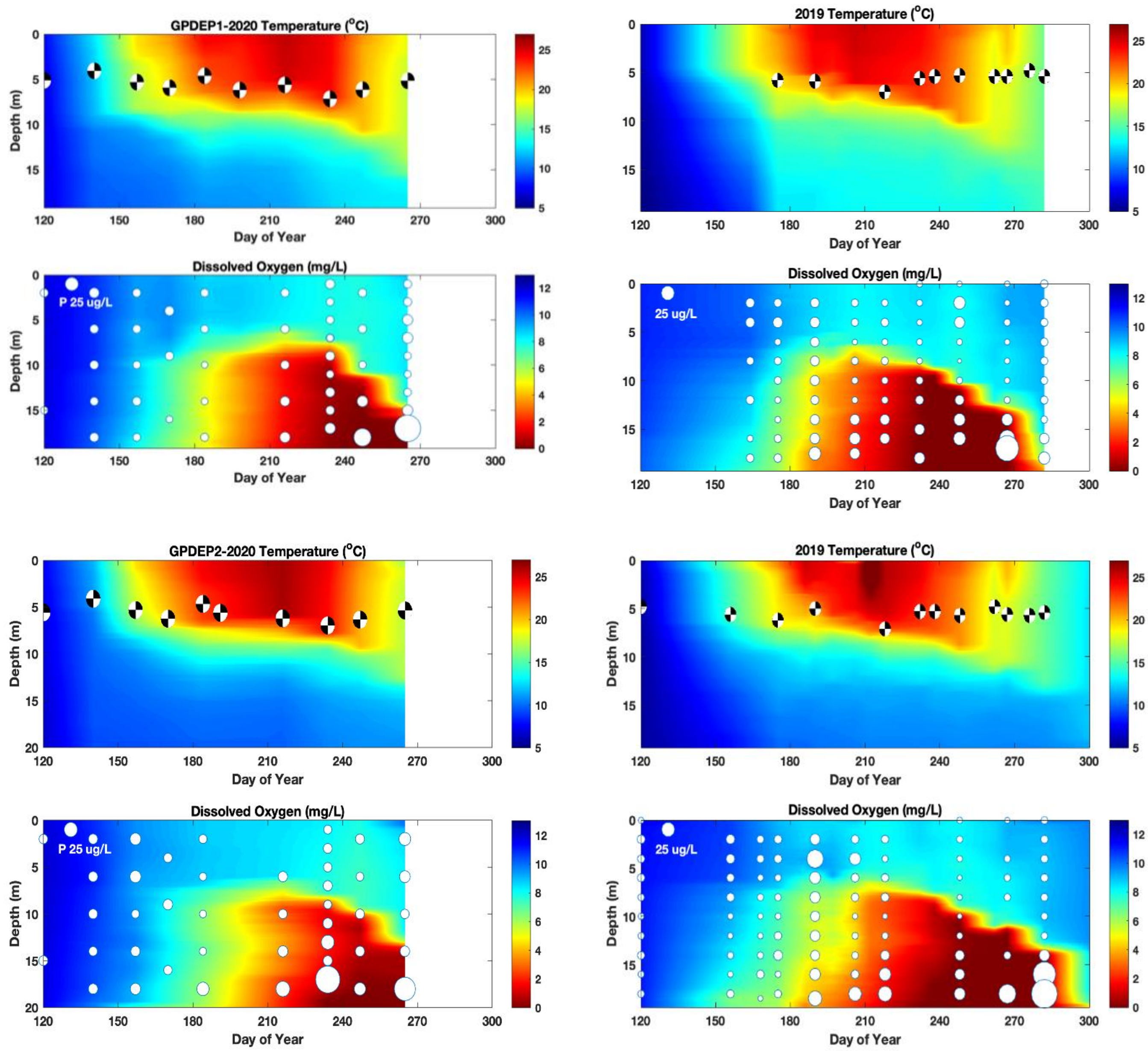


Figure 22. DO, Temperature, TP profile samples, and SDT in 2019 and 2020 at Station 1 (GPDEP1) and 2 (GPDE2) in Great Pond (Source: 7 Lakes). SDT results are indicated by the Secchi disk symbols and presented in depth (m) below the water surface. Phosphorus results collected at various depths (m) are displayed as white circles, with larger circles indicating higher P concentrations. Red coloring indicates higher temperatures (temperature graphic) or low oxygen concentrations (Dissolved oxygen graphic).

CONDITION ANALYSIS

Maine DEP recently published a classification and condition analysis for Maine lakes (Deeds, 2020). Based on this analysis, Great Pond is classified as a "coastal deep lake", and its watershed is in the "intermediate" category due to the level of human activity it contains. Table 5 (below) presents the ranges of water quality parameters observed in coastal ponds for each condition class.

Table 5. Coastal pond lake type: water quality parameter ranges (Maine DEP).

	Condition Classes			Great Pond
Parameter	Reference	Intermediate	Altered	
Total Phosphorus - Epilimnion Core (ppb)	<8.3 ± 0.7	8.3-13.4	>13.4 ± 4	**9**
Specific Conductivity (µS/cm)	< 34.2 ± 3.2	34.2-66.3	≥ 66.3 ± 4	**50**

According to this analysis, Great Pond falls within the range for 'Intermediate' coastal lakes in both Specific conductivity and Total Phosphorus. Total Phosphorus can be indicative of watershed development, while specific conductivity is directly related to the level of dissolved ions in the water. Higher levels of conductivity can indicate a greater concentration of contaminants such as road salt that suggest human activity in the watershed.

4. Watershed Modeling

The Lake Loading Response Model (LLRM) is an Excel-based model that uses environmental data to develop a water and phosphorus loading budget for lakes. Water and phosphorus loads (in the form of mass and concentration) are traced from various sources in the watershed to the lake. The model requires detailed and accurate information about the waterbody, including the type and area of land cover, water quality data for the deep spot, lake volume, septic systems, internal loading estimates, and a few other factors.

The following describes the process by which these critical inputs were determined and utilized for the Great Pond LLRM using available resources, and presents predicted outputs including how much and where total phosphorus is coming from in the watershed, as well as in-lake annual average predictions of total phosphorus, chlorophyll-a, and Secchi disk transparency. The outcome of this model can be used to identify current and future pollution sources, estimate pollution limits and set water quality goals, provide insight on where future monitoring is needed, and guide prioritization of on-the-ground watershed improvement projects.

WATERSHED AND SUB-BASIN DELINEATIONS

Great Pond (13 sq. mi.; 3,453 hectares) has a large surface area and a moderately-sized direct watershed (32 sq. mi.; 8,260 hectares), which is drained by perennial tributaries, numerous intermittent streams, and direct shoreline drainage areas. Great Pond is part of the current HUC12 (010300032202) watershed which includes the contributing watersheds of McGrath Pond and Salmon Lake. For the purposes of this model, the Salmon Lake and McGrath Pond watershed was delineated as an indirect drainage to Great Pond. The current HUC12 (010300032201) East Pond-North Pond watershed was also included as an indirect drainage basin within the model.

LLRM is most commonly set up to estimate the loading from up to ten contributing subwatersheds. However, due to its large watershed size, many tributaries and intermittent drainages, and multiple indirect watersheds, the Great Pond LLRM utilized a "nested" watershed approach. The nested model can be set up within the LLRM for more complex watersheds in which up to ten larger contributing basins (major basins A through J) are divided into up to ten additional smaller basins within each major basin (minor basins 1 through 10)(Figure 23).

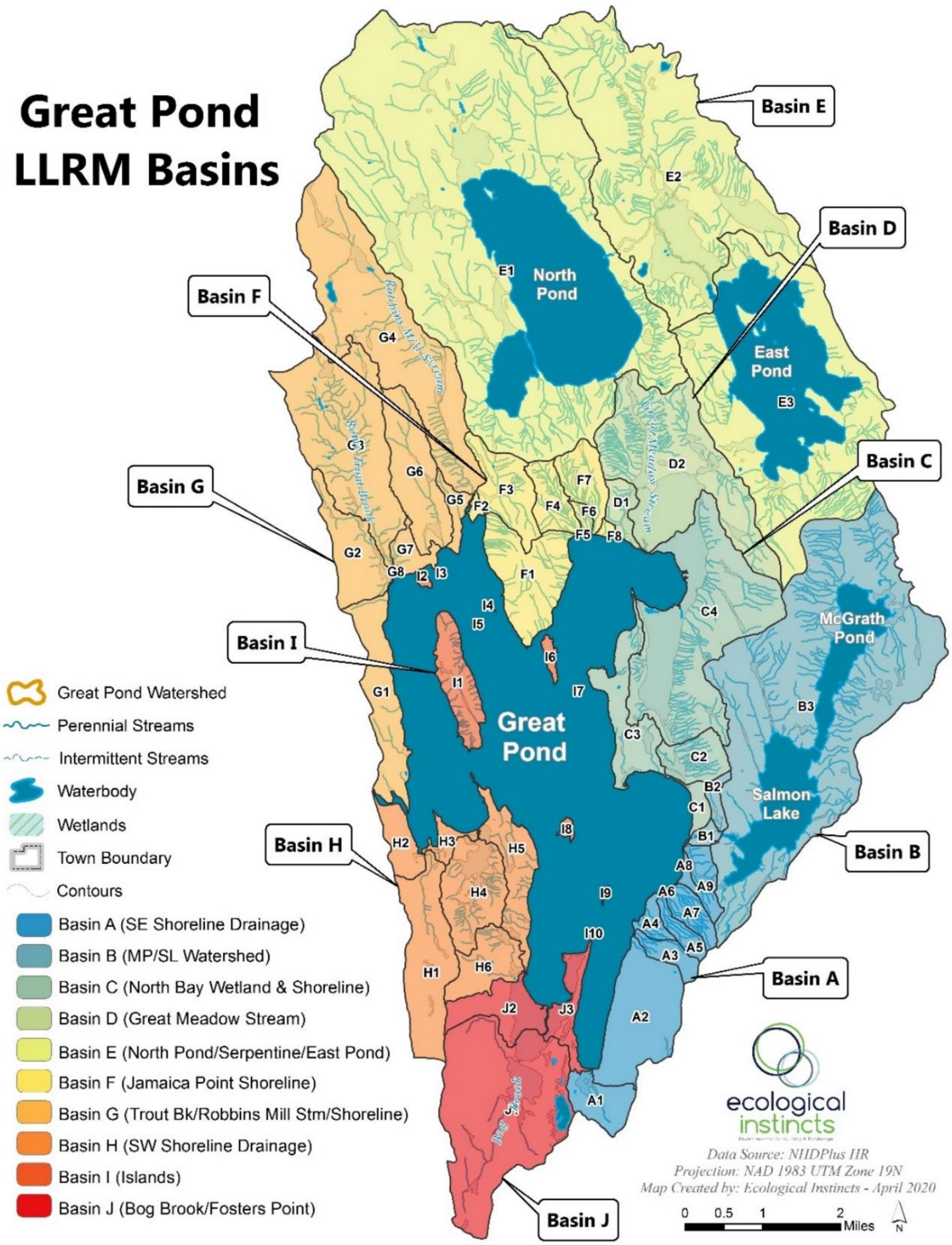


Figure 23. Great Pond drainage basins used in the 2020 LLRM.

Sub-basin delineations were completed in ArcMap using NHDPlusHR "Catchments" data downloaded for this region of the USGS National Map in NHD view[35], ME Drainage divides layer from Maine GeoLibrary[36], and Maine State 2' Elevation Contour layer from MaineGeoLibrary[37] as guides to determine topography breaks between each sub-basin.

The result was 10 major basins (Basins A through J, Figure 23 above). The direct watershed (major basins A, C, D, F, G, H, I, J) was further divided into 56 minor basins. Basin E (indirect watershed) includes the separate watersheds of East Pond, Serpentine wetland, and North Pond. Major Basin B (indirect watershed) includes the drainage of McGrath Pond and Salmon Lake delineated to the dam at Great Pond.

LAND COVER

The delineated basins layer was combined with the updated land cover layer (detailed on Page 18) to create a land cover breakdown for each major and minor basin for use in the watershed model. Table 6 displays the combined land cover types and the associated phosphorus export coefficients selected for the Great Pond model.

Figure 24 presents an overview of general land-cover types for the Great Pond watershed (left), and the corresponding total phosphorus load (right). Developed land accounts for approximately 14% of the watershed area and contributes approximately 49% of the watershed phosphorus load to Great Pond.

View south of Foster Point in Belgrade. Photo Credit: Alexander Wall, BLA.

35 https://viewer.nationalmap.gov/basic/?basemap=b1&category=nhd&title=NHD%20View
36 https://geolibrary-maine.opendata.arcgis.com/datasets/maine-drainage-divides
37 https://geolibrarymaine.opendata.arcgis.com/datasets/maine-elevation-contours-2-feet-layer

Table 6. Land cover phosphorus coefficients and land cover areas for Great Pond.

LAND COVER TYPE	Runoff P export coefficient	Baseflow P export coefficient	Area (hectares) Great Pond Watershed (Direct)
Urban 1 (Low Density Residential)	0.55	0.010	318
Urban 2 (Med Density Residential/ Commercial)	0.75	0.010	56
Urban 3 (Paved Roads)	1.00	0.010	105
Other 3 (Unpaved Roads)	1.50	0.010	132
Urban 5 (Mowed Fields)	0.80	0.010	138
Agric 1 (Cover Crop)	0.80	0.010	0
Agric 2 (Row Crop)	1.00	0.010	0
Agric 3 (Grazing/Hayfield)	0.60	0.010	301
Agric 4 (Feedlot)	224.00	0.010	0
Forest 1 (Upland Forest)	0.08	0.005	5,174
Forest 4 (Forested Wetland)	0.10	0.005	1,130
Open 1 (Water) – *not including East Pond*	0.10	0.005	134
Forest 5 (Scrub-Shrub)	0.10	0.005	33
Open 3 (Excavation)	0.80	0.005	86
Other 1 (Freshwater Emergent Wetland)	0.20	0.005	97
Other 2 (Forestry/Logging)	0.55	0.050	556
TOTAL			**8,260**

OTHER MAJOR LLRM INPUTS

Other variable sources and assumptions used in the Great Pond LLRM include:

Annual precipitation data were obtained from NOAA National Climatic Data Center (NCDC) from 2010-2019 for Waterville, ME, US, and New Sharon, ME, US. (average of both stations' annual average rainfall totals).

Lake area was based on data provided by Colby College collected during a bathymetric study of Great Pond in 2011 and 2012.

Lake volume was obtained from Colby College based on the 2011/2012 bathymetric study.

Atmospheric Deposition coefficient was lowered to 1.0 kg/ha/yr following discussion with Maine DEP in November 2020.

Septic system data were estimated based on watershed residence counts reported in the 1999 study by the Colby Environmental Assessment Team (CEAT) titled 'Land Use Patterns In Relation To Lake Water Quality In The Great Pond Watershed', and results of inquiries with project partners (BLA and 7 Lakes). Model input assumes that 1/3 of all watershed homes are within 100 feet of a waterbody (i.e., streams, ponds, lakes, wetlands), and 75% of homes only seasonally occupied.

Water quality data were obtained from Maine DEP and 7 Lakes. Data was sorted by station (Station 1) and parameter (SDT, TP, Chl-a).

Waterfowl counts assumed roughly 500 waterfowl units are contributing to the phosphorus load for half the year. Waterfowl can be a direct source of nutrients to lakes, however, if they are eating from the lake, and their waste returns to the lake, the net change may be less than might otherwise be assumed; however, the phosphorus excreted may be in a form that can readily be used by algae.

Internal phosphorus loading was calculated by Water Resource Services, Inc. utilizing available water quality data for Great Pond, 2020 monitoring results, sediment chemistry data, and verified using the LLRM results.

MODEL CALIBRATION

Calibration is the process by which model results are brought into agreement with observed data and is an essential part of environmental modeling. Usually, calibration focuses on the input data with the greatest uncertainty. Changes are made within a plausible range of values, and an effort is made to find a realistic explanation among environmental conditions for these changes. In the case of the Great Pond LLRM model, the in-lake phosphorus concentration was used as a guide for reviewing and/or adjusting land-cover export coefficients and attenuation factors. A review of the draft model was completed by Ken Wagner of Water Resource Services, Inc and by the Great Pond Technical Advisory Committee. Recommendations were incorporated into the final model.

MODEL LIMITATIONS & ASSUMPTIONS

LLRM generates load estimates for water and phosphorus using various assumptions with regard to export coefficients, basin attenuation factors, and specific loading details (for example, the numbr of people per household to calculate wastewater loading) that, if changed, result in changes to each loading component and ultimately the total load estimate to Great Pond. LLRM is a "steady state" model that uses the annual averages for the selected or assumed input values. Major model assumptions include:

Land cover was not ground-truthed. Land cover was updated using recent aerial imagery without field verification of any questionable areas. However, the updated land-cover layer received a thorough review by Charlie Baeder of 7 Lakes whose comments were incorporated into the final land-cover file prior to use in the model.

Land-cover export coefficients are estimates. Literature values and best professional judgement were used in evaluating and selecting appropriate land-cover export coefficients for Great Pond. While these coefficients may be accurate on a larger scale, they are likely not representative on a site-by-site basis. Land-cover export coefficients and other model assumptions were reviewed by a sub-group of the Great Pond WBMP Technical Advisory Committee (TAC), including representatives of the Belgrade Lakes Association, 7 Lakes, Colby College, and Maine DEP.

Septic system loading is a rough estimate. Minimal data were available to assess the number of buildings with septic systems within 250 feet of Great Pond and tributaries, the age of septic systems, the number of people on each septic system, and the average use of septic systems (whether seasonal or year-round).

Waterfowl counts are based on estimates. In the future, a more precise bird census would help improve the model, but the method used here fell within the plausible range estimated by Water Resource Services, Inc (2016).

Tributary data were not available to aid overall model calibration. Real measurements of phosphorus concentrations were not available for any tributaries that outlet into Great Pond. Comparing measured values to modelled phosphorus concentration and flow outputs would benefit attenuation value selection and overall model calibration. Additional reality checks in the model can be completed when real data becomes available (i.e., tributary monitoring).

P attenuation factors are assumed unless data becomes available to calibrate model. Attenuation factors for each sub-basin range from 0.4 (60% loss) to 0.75 (25% loss) and were estimated based on individual basin characteristics which were reviewed by members of the TAC.

Water Attenuation is estimated. The final model opted for a standardized approach to estimating water attenuation within each sub-basin. It was assumed that 85% of the water landing on the land makes it to the lake as runoff, baseflow, or groundwater from direct drainages. Indirect drainage values were set at 80% to allow for more evaporation in the upstream lake watersheds.

The model has not been validated, a process whereby data not involved in calibration are used to check the accuracy of the model for a separate time period. This is a helpful step that improves reliability but requires data not currently available. Splitting the available data into part to be used in calibration and part for verification was an option but the quantity of data is not so large as to make such an exercise worthwhile. As such, there may be unquantified error in the model and sensitivity analyses can be applied to determine just how influential such error may be. For example, if the actual area in given land uses are off by 10%, what that may do to the model can be assessed by making changes to land use and observing the change in final values like the predicted in-lake phosphorus concentration. Ideally, data would be collected for selected tributaries, a weak point in the data set, allowing comparison of model predictions with actual data not available at the time of model construction. As it is, we believe the model represents reality for Great Pond, but should not be considered an extremely accurate representation.

Sub-basin conditions are not considered within the model. Work that has been completed by watershed partners to address NPS pollution (319 projects, LakeSmart, and YCC efforts) is not considered within the model. Alternatively, major problem spots that are unknown to the modeling team may be overlooked. The model could be improved with more detailed knowledge of each individual sub-basin.

BACKGROUND CONDITIONS

Once the Great Pond LLRM was finalized, land cover and various other model factors were adjusted to estimate pre-development loading conditions to provide an approximation of the in-lake phosphorus concentration prior human development in the watershed. Methodology for the background conditions scenario include:

1. Converted all human land cover (Urban, Agric, Open 3 (excavation), & Other 2 (logging) land cover categories) to upland forest (Forest 1) for all sub-basins A through J.
2. Removed all septic inputs (set # of dwellings to zero).
3. Reduced internal loading to about 10% of the current modelled internal load.
4. Reduced atmospheric loading coefficient to 0.05 kg/ha/yr
5. Matched outflow TP to predicted in-lake TP.

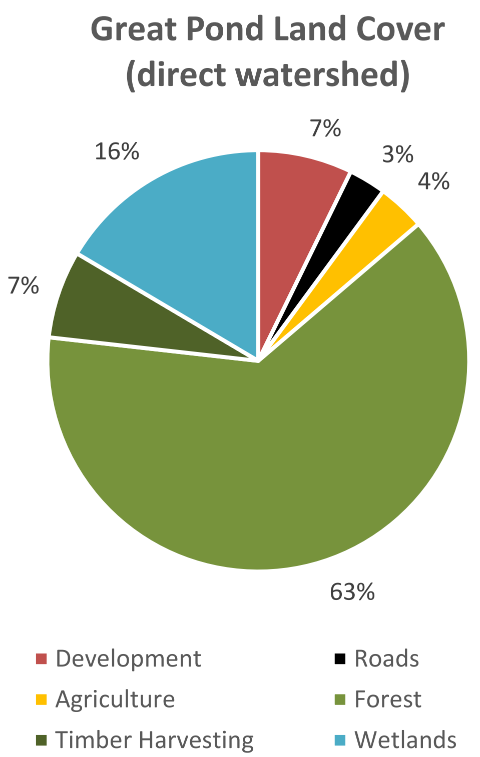
RESULTS

The watershed load in phosphorus mass by area (kg/ha/year) to Great Pond is relatively low[38] (Table 7). Currently, the watershed load is the largest contributor of phosphorus to Great Pond (72%), followed by atmospheric deposition (12%) (Table 8 & Figure 25). Watershed loading is usually the

[38] Normalizing the P load by unit area suggests the average contribution from the total watershed area is low, but certain land uses (e.g., development) yield a disproportionally large fraction of the total load, so a small pocket of development can export a large amount of P to the lake. Under current conditions, the watershed is the largest contributor of P to Great Pond in the current model.

largest phosphorus load to waterbodies as a result of urban development. Atmospheric deposition represents the second largest phosphorus load to the pond, reflecting Great Pond's large surface area. The internal load makes up 10% of the total phosphorus load with waterfowl and septic systems each accounting for 3% of the remaining load.

The background watershed phosphorus load to Great Pond is estimated at 908 kg/yr (3.8 ppb in-lake concentration), representing just under half of the current load of 2,053 kg/yr (9.0 ppb in-lake concentration) (Table 7, 8, 9; Figure 26). This represents a significant increase in the watershed phosphorus load to Great Pond from pre-development to present, suggesting the phosphorus load to Great Pond has almost doubled as a result of human development within the watershed.



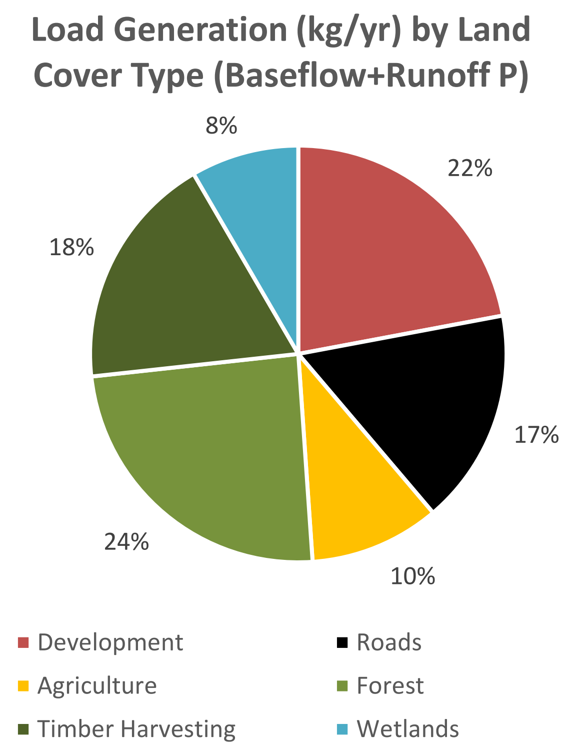


Figure 24. Direct watershed land-cover area by general category and total phosphorus (TP) load by general land-cover type. This shows that although developed areas cover 14% of the watershed, these areas are contributing 49% of the TP watershed load to Great Pond.

Table 7. Summary of total phosphorus (TP) loading for Great Pond from watershed sources.

WATERSHED LOAD COMPARISON	Land Area (ha)	Water Flow (m^3/yr)	Calculated P Concentration (ppb)	P mass (kg/yr)	P mass by area (kg/ha/yr)
Background	18,147	81,431,659	3.8	908	0.05
Current	18,147	81,889,369	9.0	2,053	0.11

Table 8. Total phosphorus (TP) and water loading summary from internal and external watershed sources for Great Pond.

LLRM LOAD SUMMARY COMPARISON	*BACKGROUND* P (kg/yr)	*BACKGROUND* %	*BACKGROUND* Water (m^3/yr)	*CURRENT* P (kg/yr)	*CURRENT* %	*CURRENT* Water (m^3/yr)
ATMOSPHERIC	169	14%	39,919,400	338	12%	39,919,400
INTERNAL	28	2%	0	275	10%	0
WATERFOWL	100	8%	0	100	3%	0
SEPTIC SYSTEM	0.0	0%	0	97	3%	121,556
WATERSHED LOAD	908	75%	81,431,659	2,053	72%	81,889,369
TOTAL LOAD TO LAKE	1,205	100%	121,351,059	2,864	100%	121,930,325

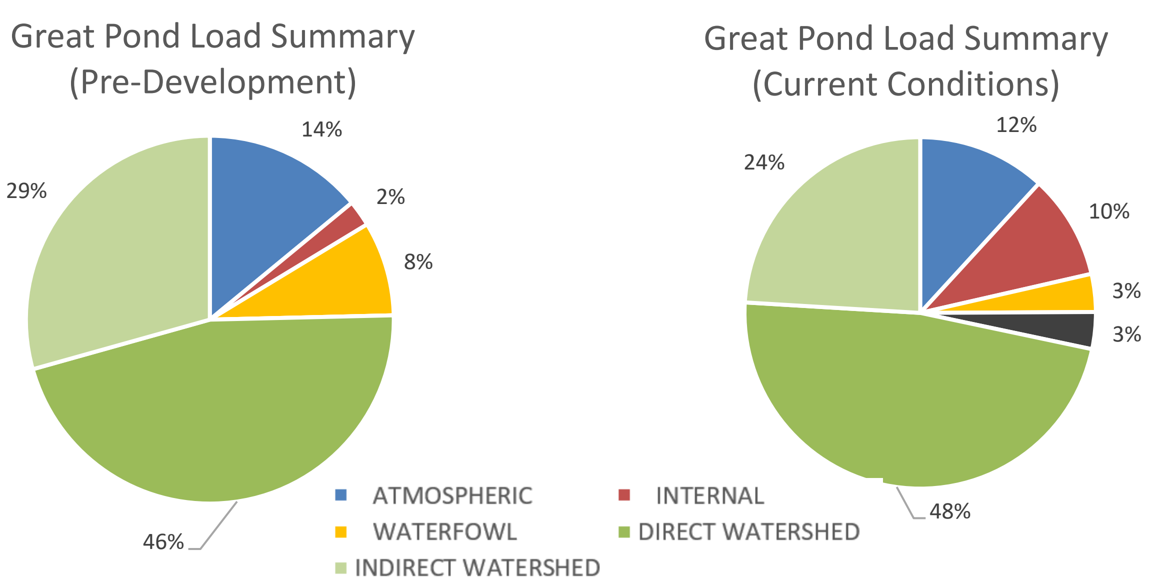


Figure 25. Percentage of total phosphorus loading (kg/yr) by source (atmospheric, internal loading, waterfowl, septic systems, watershed load) to Great Pond.

MODEL PREDICTIONS

For current conditions, the model predicted worse-than-observed mean transparency despite predicting better-than-observed chlorophyll-a. This suggests that other factors aside from phosphorus may be controlling observed water quality (i.e., the general empirical equations used in the LLRM do not fully account for all biogeochemical processes occurring within Great Pond that contribute to the overall water quality condition). In particular, processing of nutrients within the lake may vary substantially depending on biological components such as zooplankton and the fish community, neither of which are addressed in the model. Additionally, storm-induced turbidity from soils rather than algae can depress clarity and large particles like the cyanobacterium *Gloeotrichia* have less impact on clarity than a similar mass of smaller particles. Production of algae at the sediment-water interface from P release from sediment that does not enter the water column could allow greater Chl-a than average upper water column P concentrations would suggest through the model. Empirical equations can be developed for more narrow geographic areas than those applied here but have not been developed for this area. A fair amount of the watershed P load could be entering Great Pond as particulates and therefore would not immediately figure into algae production. This could explain the higher-than-predicted water clarity and chlorophyll-a concentrations measured in Great Pond.

For background conditions, the model predicted substantially lower phosphorus (3.8 ppb) and mean chlorophyll-a concentrations (0.6 ppb), and deeper mean Secchi disk transparency (8.3 m) compared to current conditions (Table 9, Figure 26). This analysis is focusing on phosphorus concentrations as this is the primary metric to be assessed in evaluating management actions.

Table 9. In-lake water quality predictions for Great Pond.

Model Water Quality Predictions	*Observed Median TP (ppb)*	*Predicted Median TP (ppb)*	*Observed Mean Chl-a (ppb)*	*Predicted Mean Chl-a (ppb)*	*Observed Mean SDT (m)*	*Predicted Mean SDT (m)*
Background	--	3.8	--	0.6	--	8.3
Current	9.0	9.0	4.8	2.6	6.4	4.3

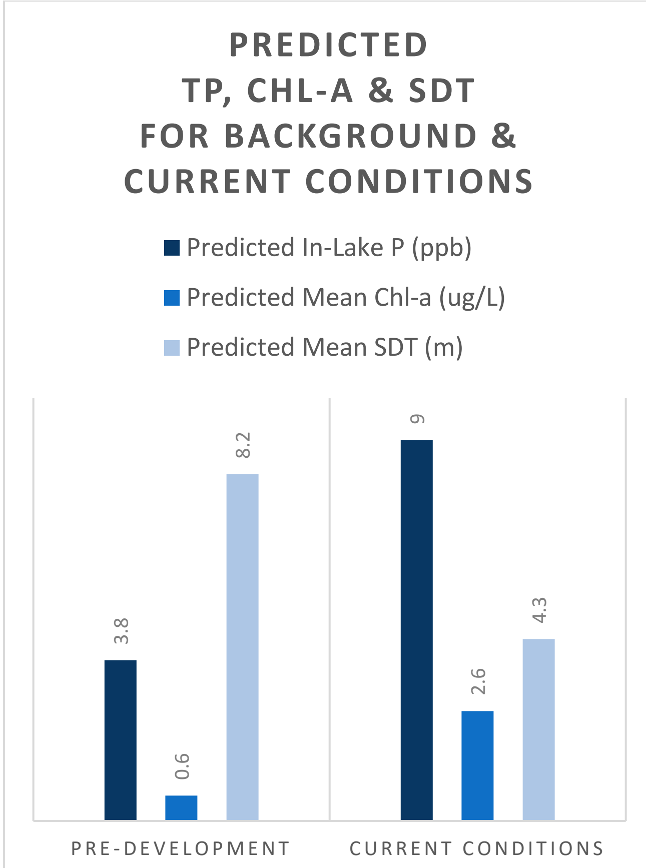


Figure 26. Predicted phosphorus (TP), chlorophyll-a (Chl-a), and Secchi disk transparency (SDT) for background and current conditions.

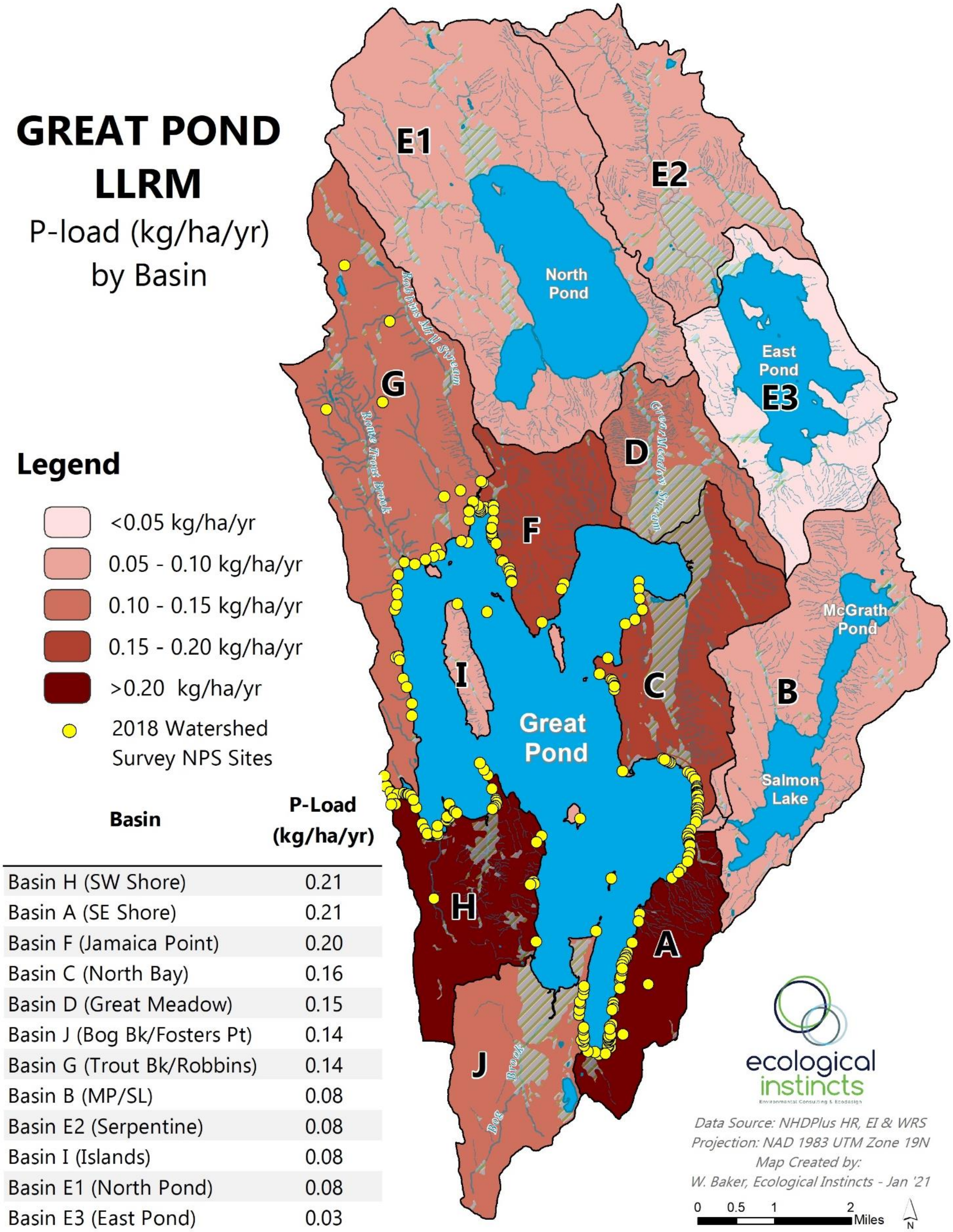
SUB-BASIN PHOSPHORUS LOADING RESULTS

Utilizing a "nested" watershed modeling approach within the Great Pond LLRM allowed for a geographical assessment of the subwatersheds with the greatest potential for phosphorus loading within the direct and indirect watersheds. Ten major basins (A through J) and 56 minor sub-basins were included in the model to estimate phosphorus loading at different scales (Table 10, Figures 27 & 28) so that watershed managers in the Great Pond watershed can provide more targeted outreach and on-the-ground conservation planning in the sub-basins that contribute the highest amounts of phosphorus. Tributary monitoring and tracking phosphorus reductions within these sub-basins will allow for a more robust model over time.

After normalizing by area, at the major basin level (Basins A through J), Basin H (southwest shoreline), Basin A (southeast shoreline), and Basin F (Jamaica Point) export the highest phosphorus mass per hectare delivering between 0.20 and 0.21 kg/ha/yr to Great Pond (Figure 27). By total mass (kg/yr), Basin E1 (North Pond) and Basin H (SW Shore) have the highest phosphorus inputs to Great Pond contributing 309 and 217 kg/year, respectively (Table 10). Overlapping the locations of the 2018 Great Pond Watershed Survey results with the phosphorus export estimates reinforces the fact that developed land contributes to increased export of total phosphorus to lakes. Addressing erosion at these sites and adding natural buffers to disturbed shorelines will help reduce the amount of sediment and attached phosphorus entering the lake.

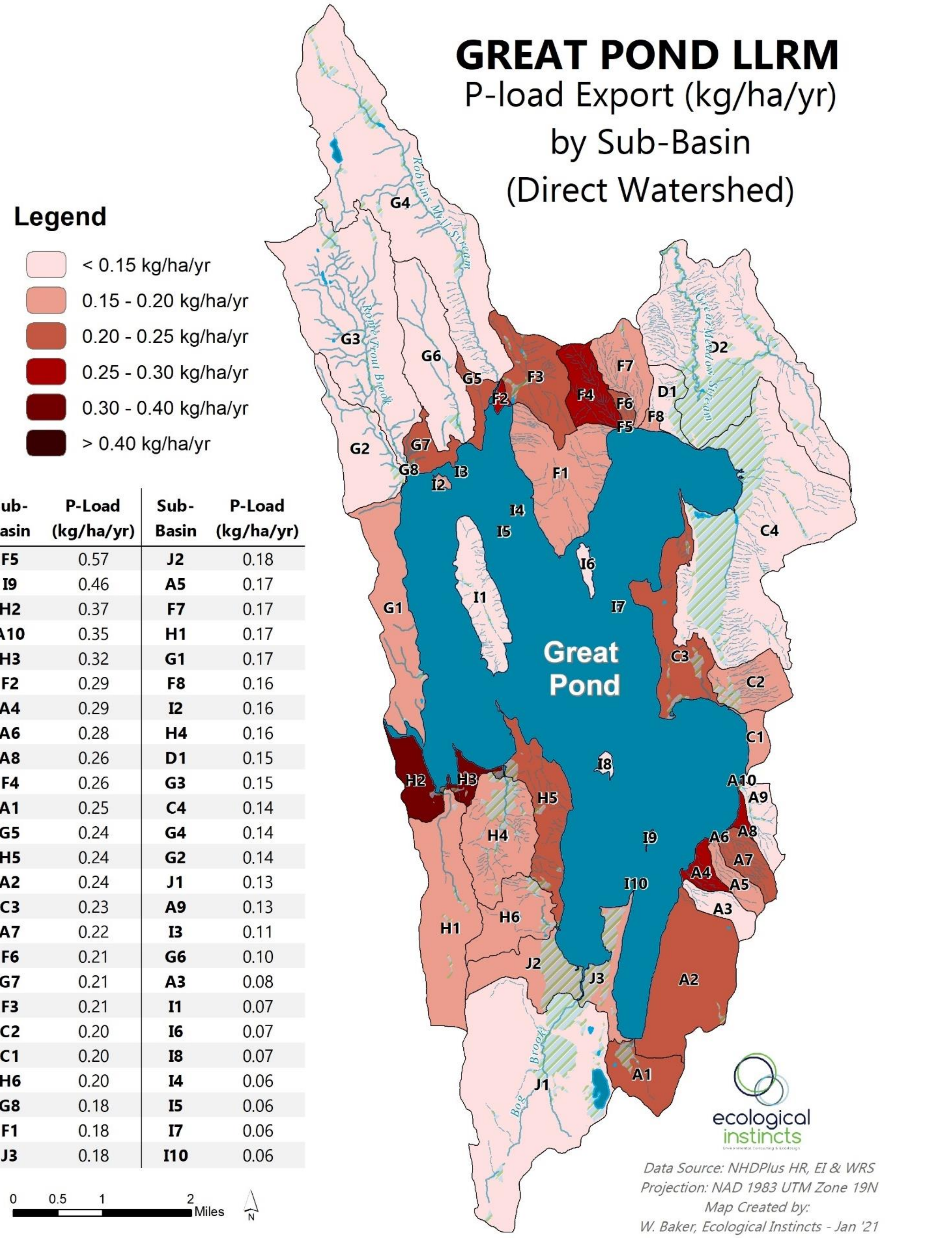
At the sub-basin level (direct watershed only), sub-basin I9 (Pine Island), H2 (Belgrade Lakes Village), and H3 (Hersom Point) export the highest phosphorus mass per hectare delivering 0.46, 0.37, and 0.32 kg/ha/yr to Great Pond. Sub-basins F5 and A10 also contribute a high P load per hectare due to their small size. These areas of direct shoreline drainage remain after delineating intermittent stream basins on either side and should be prioritized with adjacent sub-basins. (Figure 28). Sub-basin G4 had the highest phosphorus export by total mass contributing 125 kg/yr P to Great Pond. Sub-basins D1 (Great Meadow Stream), C4 (North Bay Wetland), J1 (Bog Brook), and G3 (Rome Trout Brook), are also large contributors by mass at 121, 119, 111, and 93 kg P/year, respectively (Table 10).

It is important to note that drainage areas directly adjacent to waterbodies do not have adequate treatment time and are often most desired for development in a lake watershed which may increase the possibility for greater phosphorus export in these areas. The sub-basins of Robbins Mill Stream (G4) and Rome Trout Brook (G3) in the northern watershed are the first and fifth largest contributors of phosphorus by mass. This is expected due to the large, developed drainage areas surrounding major tributary streams with limited wetlands (places to attenuate phosphorus) bringing phosphorus directly into Great Pond with little treatment. Sub-basins with moderately high phosphorus mass exported generally had more developed land area (e.g., F1, A2, J1). Verification of these relationships with actual data from these drainage systems is recommended.



Basin	P-Load (kg/ha/yr)
Basin H (SW Shore)	0.21
Basin A (SE Shore)	0.21
Basin F (Jamaica Point)	0.20
Basin C (North Bay)	0.16
Basin D (Great Meadow)	0.15
Basin J (Bog Bk/Fosters Pt)	0.14
Basin G (Trout Bk/Robbins)	0.14
Basin B (MP/SL)	0.08
Basin E2 (Serpentine)	0.08
Basin I (Islands)	0.08
Basin E1 (North Pond)	0.08
Basin E3 (East Pond)	0.03

Figure 27. P load (kg/ha/yr) by major basins (A through J) in the Great Pond watershed (direct and indirect drainages).



Sub-Basin	P-Load (kg/ha/yr)	Sub-Basin	P-Load (kg/ha/yr)
F5	0.57	J2	0.18
I9	0.46	A5	0.17
H2	0.37	F7	0.17
A10	0.35	H1	0.17
H3	0.32	G1	0.17
F2	0.29	F8	0.16
A4	0.29	I2	0.16
A6	0.28	H4	0.16
A8	0.26	D1	0.15
F4	0.26	G3	0.15
A1	0.25	C4	0.14
G5	0.24	G4	0.14
H5	0.24	G2	0.14
A2	0.24	J1	0.13
C3	0.23	A9	0.13
A7	0.22	I3	0.11
F6	0.21	G6	0.10
G7	0.21	A3	0.08
F3	0.21	I1	0.07
C2	0.20	I6	0.07
C1	0.20	I8	0.07
H6	0.20	I4	0.06
G8	0.18	I5	0.06
F1	0.18	I7	0.06
J3	0.18	I10	0.06

Figure 28. Phosphorus load (kg/ha/yr) by sub-basin in the Great Pond watershed (direct drainage only).

Table 10. Great Pond LLRM total phosphorus mass export (kg/yr) by sub-basin.

BASIN A		BASIN B		BASIN C		BASIN D		BASIN E		BASIN F		BASIN G		BASIN H		BASIN I		BASIN J	
#	kg/yr	#	kg/yr	#	kg/yr	#	kg/yr	#	kg/yr	#	kg/yr	#	kg/yr	#	kg/yr	#	kg/yr	#	kg/yr
A1	29	**B1**	192	**C1**	8	**D1**	121	**E1**	309	**F1**	54	**G1**	44	**H1**	57	**I1**	12	**J1**	111
A2	84			**C2**	23			**E2**	134	**F2**	3	**G2**	27	**H2**	33	**I2**	1	**J2**	28
A3	5			**C3**	49			**E3**	54	**F3**	37	**G3**	93	**H3**	13	**I3**	0.03	**J3**	18
A4	11			**C4**	119					**F4**	28	**G4**	125	**H4**	38	**I4**	0.1		
A5	9									**F5**	0.4	**G5**	11	**H5**	45	**I5**	0.04		
A6	0.3									**F6**	4	**G6**	28	**H6**	30	**I6**	1		
A7	15									**F7**	21	**G7**	12			**I7**	0.02		
A8	4									**F8**	2	**G8**	0.3			**I8**	1		
A9	9															**I9**	1		
A10	0.2															**I10**	0.01		
166		**192**		**199**		**121**		**497**		**149**		**341**		**217**		**15**		**157**	

Total # of sub-basins equals 56

Total Watershed Load: 2,053 kg/yr

WATER QUALITY TARGET SELECTION

The LLRM can be used to evaluate possible water quality targets for any restoration project. There are several alternative ways to proceed, including setting a phosphorus target based on desired average chlorophyll-a or water clarity levels, picking a target level based on achieving a desired chlorophyll-a or water clarity value at some high level of probability (e.g., 90% of the time), setting percentage reductions for each known loading component that are practical and lead to meaningful improvement, or simply holding the line on further increases in loading. The approach depends on use goals and the regulatory structure under which management of the lake must operate.

For Great Pond, with an estimated pre-settlement phosphorus average concentration of just under 4 ppb and a current average concentration of 9 ppb, the difference is not all that large; many problem lakes in New England have phosphorus averaging in excess of 20 ppb. While discussion by interested parties is warranted, moving the lake substantially toward pre-development conditions will be very difficult with the present level of development and continuing pressure for more development. However, current year-to-year variation in phosphorus concentrations is high enough to suggest that there is room to “cut the tail” off the high end of the distribution, lowering the average slightly while minimizing the number of years in which undesirable conditions occur.

If we were to achieve this by attacking the phosphorus sources that vary the most over time, we could effectively cut the tail off the distribution and improve conditions in a way that minimizes blooms. Reducing average epilimnetic TP concentration to this lower level should be viewed as a practical minimum. The final in-lake target is likely to fall somewhere between 7.5 ppb and the current concentration of 9 ppb.

The obvious phosphorus sources with the greatest variability are stormwater runoff and internal loading, although the conditions that maximize each are not congruent. By managing land in the watershed to minimize runoff and improve its quality we can reduce loading to Great Pond that may lead to problem blooms, which certainly contributes the most to the sediment reserves that provide the internal load.

FUTURE DEVELOPMENT AND CLIMATE CHANGE SCENARIOS

While LLRM is used to present “steady state” conditions, various scenarios can be examined to estimate the range of influence from impacts such as future development and climate change.

Model predictions (Table 11, Figure 29) were based on the following future development and climate change scenarios:

- Future Development – Estimated increase of 0.2 – 0.5 ppb in-lake P concentration (FBE, 2009a). 0.2 ppb increase is associated with future development if municipal ordinances were updated to require P controls for all new development, and an increase of 0.5 ppb reflects increased P loading from future development in the watershed without additional controls for P export from new development.
- Climate Scenario 1 – Summertime anoxia reaching 9 m with an increased release period and rate; 10% increase in total watershed load as a result of increased precipitation and decreased attenuation.
- Climate Scenario 2 – Summertime anoxia reaching 8 m with an increased release period and rate; 20% increase in total watershed load as a result of increased precipitation and decreased attenuation.

The phosphorus reduction goal (8.5 ppb) set within the timeline of the 10-year WBMP does not fully address anticipated P load increases from climate change scenarios, but should assimilate loading from the future development scenario. Management strategies including installation of Best Management Practices in the watershed that infiltrate and/or treat stormwater runoff for existing development is a necessity based on anticipated increases in precipitation over the next few decades and longer in order to offset the loading increases expected over time.

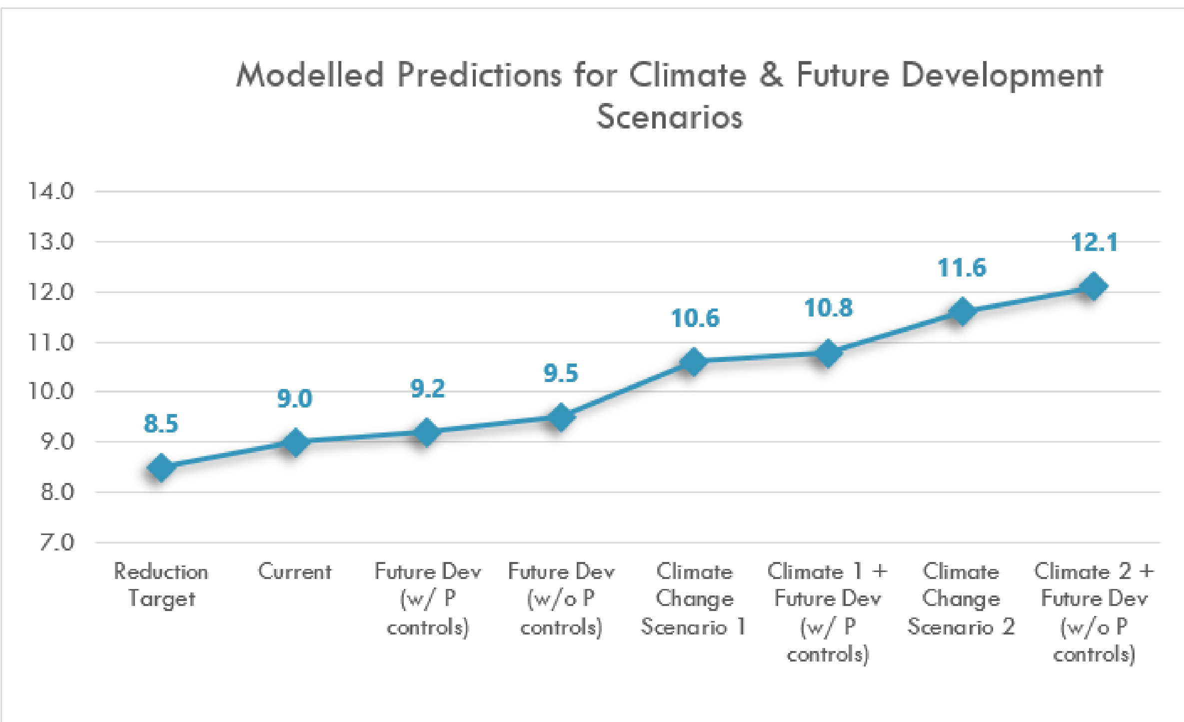


Figure 29. Modelled predictions for climate change & future developments scenarios.

Table 11. Model P loading results and water quality predictions based on various scenarios for future development and climate change.

	2021-2031 Load Reduction Target	CURRENT	Future Development*	Climate Change Scenario 1 & 2	Future Development + Climate Change
In-Lake P Conc.	- 0.5 ppb	9.0 ppb	+ 0.2 to 0.5 ppb	+ 1.6 to 2.6 ppb	+ 1.8 to 3.1 ppb
DIRECT LOADS TO LAKE	P (KG/YR)	P (KG/YR)	P (KG/YR)	P (KG/YR)	P (KG/YR)
ATMOSPHERIC	338	338	338	338	338
INTERNAL	275	275	275	564 - 696	564 - 696
WATERFOWL	100	100	100	100	100
SEPTIC SYSTEM	97	97	97	97	97
WATERSHED LOAD	1,923	2,053	2,118 - 2,183	2,258 - 2,464	2,324 - 2,594
TOTAL LOAD TO LAKE	2,733	2,864	2,928 - 2,993	3,357 - 3,695	3,423 - 3,825
PREDICTIONS					
Mean SDT (m)	4.4	4.3	4.1 - 4.2	3.5 - 3.8	3.4 - 3.7
Peak SDT (m)	5.4	5.3	5.2	4.9 - 5.1	4.9 - 5.0
Mean Chl-a (ug/L)	2.4	2.6	2.7	3.2 - 3.6	3.3 - 3.8
Peak Chl-a (ug/L)	9.0	9.6	9.9 - 10.2	11.7 - 13.2	12.0 - 13.8
% of time Chl-a >8 ug/L	0.4%	0.6%	0.7%	1.8% - 3.4%	2.1% - 4.2%

**Based on Long Pond-Great Pond Buildout Analysis, FB Environmental, 2009.*
0.2 ppb P increase from future development w/ P controls; 0.5 ppb increase w/o P controls.

Climate Scenario 1

Overall watershed load increase by 10% to reflect increase precip and runoff, decreased attenuation

Affected area of internal load reaches 9 m depth; increased period of release; increased release rate

Climate Scenario 2

Overall watershed load increase by 20% to reflect increase precip and runoff, decreased attenuation

Affected area of internal load reaches 8 m depth; increased period of release; increased release rate

5. Climate Change Adaptation

Current Maine DEP guidance calls for developing watershed management plans that incorporate climate change considerations. This guidance would be addressed to a large extent by any plan that focuses on stormwater inputs and minimzing the internal load. The primary climate change impacts on lakes are variation in precipitation and temperature. Higher precipitation periods, usually involving more intense storms, lead to more runoff and greater nutrient loading. Higher temperatures lead to increased algal growth, greater oxygen demand, lower oxygen near the lake bottom, and increased phosphorus release from surficial sediments where iron is a major phosphorus binder. The factors that appear to be of greatest importance to conditions in Great Pond are also those most influenced by climate change. The approximate influence can be evaluated in LLRM by varying the annual precipitation in accordance with projected climate change effects, generally set at a 10-20% increase. Climate change influence on internal loading can be similarly evaluated by increasing the internal load in accordance with expected temperature changes and oxygen depletion rates, which appear to lead to internal loading increases as high as 100%. In addition to precipitation, earlier ice out and longer periods of stratification have a significant role to play in the changes that will occur in the lake as a result of climate change. From preliminary evaluation, the range of conditions in Great Pond may be completely explained by major increases in stormwater runoff, and to a lesser extent, internal loading.

Over the last several decades, air and surface water tempatures have been increasing. Surface water temperatures in northern New England increased 1.4°F per decade from 1984-2014, which is faster than the world-wide average, with Maine lakes warming on average by nearly 5.5°F during this time period. Data also show that smaller lakes and ponds are warming more rapidly than larger lakes. Increased precipaition, and bigger and more frequent storms has resulted in many effects observed in Maine Lakes including an increase in dissolved organic carbon (DOC) and increased stormwater runoff volumes from surrounding watersheds. Increasing temperature and DOC in lakes has a direct effect on thermal and biological dynamics, ultimately favoring nutrient-loving species (like toxin-producing cyanobacteria) over species adapted to cooler water temperatures. Though water quality in many Maine lakes has improved as a result of laws and regulations that protect water quality by mitigating the effects of human development, the effects of climate change threaten the effectiveness of these dated laws that may need adjusting to adequately protect natural resources in the future (MCC, 2020).

Internal loading, not currently a priority restorative action in Great Pond, is largely a function of water temperature. Increases in temperature result in increases in oxygen demand through decomposition, which will lead to lower DO over a larger area of the pond for longer durations of time. Increasing temperatures mean increased internal loading in Maine lakes. Though internal loading has remained confined to the deepest areas of Great Pond, the effects of climate change could easily push this over the threshold if not closely monitored and managed.

Warmer water temperatures and P release from internal loading also favors invasive species, cyanobacteria, and harmful algal blooms (HABs) that produce toxins harmful to humans and wildlife. Movement toward bigger and more frequent storms presents a challenge for watershed management and exacerbates the internal loading problem as more intense rainfall will increase the amount of nutrient transport to the lake from the watershed via stormwater runoff that will be available for algal growth. Phosphorus loading is very strongly connected to precipitation, and disrupting that relationship is not an easy task. Climate change will surely make this task more complex, and it will require immediate and determined action by watershed partners and residents. Everyone will need to do their part.

Watershed modeling estimates **an additional 205-411 kg/yr of phosphorus from the watershed alone could be delivered to Great Pond with an increase in precipitation of 10-20%.** It is important to remember that the watershed is not a static system, and the phosphorus load will continue increasing over time without taking actions to address these changes. The estimated increase above could be exceeded with just a few unforeseen large-scale climatic events that deliver a lot of sediment to the lake in a single pulse. These inputs could have consequences for water quality resulting in costly remediation measures to address internal loading that are not currently needed. Climate change adaptation planning, such as upgrading infrastructure on roads (i.e., undersized culverts), infiltrating stormwater runoff on commercial and residential properties, planting buffers, and conserving undeveloped land are a few ways to counteract the effects of the anticipated increase in precipitation.

The following climate change activities should be factored into the future watershed planning activities:

1. **Develop a watershed climate model** that can be used to anticipate effects of extreme events in the watershed.
2. **Develop a Climate Change Action Plan** for Great Pond that incorporates a model to anticipate the effects of extreme events in the watershed and can be used in other watersheds in the region.
3. **Host climate change workshops** or webinars to provide information about ways landowners can adapt to climate change and help protect water quality.
4. **Create an online video** about potential effects of climate change on the lake.
5. **Set up a precipitation monitoring program** (e.g., automated rain gauge) to document occurrence and intensity of rainfall.

6. **Conduct a stream-crossing survey** to assess whether culverts at road/stream crossings require upgrades.
7. **Work with municipal officials** to identify areas of the watershed with the greatest threat to infrastructure.

6. Establishment of Water Quality Goals

Results of the watershed loading model indicate that taking immediate actions to increase efforts to reduce the external (watershed) load should be given high priority for this watershed management plan. However, managing the internal (sediment) load is no less important. While management actions to reduce the external load will help to keep excess phosphorus from building up in the sediment, ongoing monitoring is needed to ensure that the area of anoxia at the bottom of the lake and consequently the internal load is not increasing.

WATER QUALITY GOAL

Great Pond has a stable or improving water quality trend.

In-Lake Phosphorus = 8.5 ppb

"P" REDUCTIONS NEEDED

Direct Watershed: 101 kg/year

Upstream Watersheds: 29 kg/year

Projects: 319, YCC, LakeSmart, Septic System Program, Buffer Campaign

Timeframe: 2021- 2031

The Great Pond TAC reviewed and discussed the results of relevant documents developed over the two-year planning period in order to develop a water quality goal. Specifically, the committee reviewed the results of water quality monitoring conducted by 7 Lakes, Colby, and Maine DEP, water quality analyses conducted by 7 Lakes, watershed modeling and internal loading analysis conducted by Ecological Instincts and WRS, and the preliminary sediment analysis conducted by Colby. Previous watershed assessment work, including a watershed survey, previous 319 implementation projects, and active YCC and LakeSmart programs was also considered to increase the probability that water quality goals could be met based on estimated load reductions.

Reducing the watershed load by 5% (130 kg/yr) is expected to result in a reduction of the average in-lake total phosphorus concentration from 9.0 to 8.5 ppb, increase summer water clarity readings by 0.1 m and minimize probability of algal blooms to 0.2% (Appendix G).[39]

ASSESSMENT OF THE INTERNAL LOAD

The internal loading analysis conducted by WRS, Inc. in 2020, provides new estimates of internal loading based on monitoring completed between 2015-2020 to allow for a more accurate calculation. Past estimates for internal loading in Great Pond were solely based on modeled projections using assumed phosphorus release rates and areas of the pond bottom exposed to anoxia for various durations of time.

New analysis looks at phosphorus mass accumulation in the hypolimnion over the course of the summer to determine the change in hypolimnetic phosphorus mass as an estimate of P release from bottom sediments. Based on this analysis, the internal load in Great Pond averages <300 kg/yr, increasing in years with early onset of anoxia (DO <2 mg/L) resulting in more widespread exposure of sediment to low oxygen conditions for longer periods of time. However, internal load estimates for the past six years do not exceed 400 kg/yr.

The area of pond bottom affected by low DO varies throughout the year and between years with the shallowest depths having DO <2 mg/L occurring between 9 m – 11.5 m (Table 12), and the duration of low oxygen over any part of sediment is roughly two months which is shorter than previously assumed in past estimates. The date when low DO starts in the deepest area of the pond is sometime in July and has varied by only 2 weeks since 2015. The date of shallowest anoxia depth falls between early August and early September; low DO conditions end at turnover in mid to late September.

Table 12. Characterization of low oxygen features in Great Pond.

	1st day DO<2 (Julian)	Shallowest depth DO<2 (m)	Day of shallowest DO<2 (Julian)	Last day with DO<2
2015	204	9.5	251	267
2016	215	11.5	231	272
2017	214	10	243	276
2018	212	9.5	221	277
2019	206	9	232	267
2020	216	9	234	265

The mass of phosphorus in the volume of water in each depth increment is the product of the phosphorus concentration at a given depth and the volume of the pond associated with that depth interval. The hypolimnetic phosphorus mass is then summed for a single date for the depth intervals in that layer. The largest difference in

[39] Defined here as Chl-a concentrations >10 ppb.

hypolimnetic phosphorus mass (550.1 – 211.2) is assumed to be the amount of P released from sediment over that period (Table 13 displays this exercise using 2020 as an example). Using data collected between 2015-2020, the mass of phosphorus released from sediment in Great Pond ranges between 132-368 kg with an average of 262 kg (Table 13).

Table 13. 2020 P mass accumulation in Great Pond.

		2020	P mass (kg)				
Depth range (m)	Layer volume (m3)	6/18/20	7/2/20	8/3/20	8/21/20	9/3/20	9/21/20
0 to 3	88528910	1103.1	840.1	823.3	982.7	832.2	916.0
3 to 6	56610016	705.4	520.8	583.1	515.2	571.8	724.6
6 to 9	36504529	403.0	322.6	385.3	306.6	364.1	591.4
9 to 12	18783377	207.4	115.0	199.9	191.6	249.8	140.9
12 to 15	9180235	63.3	63.9	118.3	106.5	152.7	79.9
>15	3440113	23.7	32.3	52.6	55.0	147.6	30.1
	0 to 9	2211.5	1683.5	1791.7	1804.5	1768.1	2231.9
	>9	294.4	211.2	370.7	353.1	550.1	250.8
	Hypo P accum					338.9	

The average daily phosphorus release rate (mg/m2/day) is then calculated by dividing the estimated hypolimnion phosphorus mass by the area of the pond associated with low oxygen and the number of days low oxygen was recorded in the pond. Since 2015, the estimated average phosphorus release rate from sediment has ranged between 0.36 – 1.40 mg/m2/day with an average of 1.02 mg/m2/day (Table 14).

Table 14. P mass accumulation and sediment release rate estimates

Year/Source	Est. Hypo P Accum (kg)	Avg area with DO<2	Days with DO<2	Avg release rate (mg/m2/d)
2015 GP1	368.4	5425077	63	1.08
2016 GP1	271.3	3402022	57	1.40
2017 GP1	364.6	4892753	62	1.20
2018 GP1	234.9	5425077	65	0.67
2019 GP1	132.4	5957400	61	0.36
2020 GP1	338.9	5957400	49	1.16
2016 HETL	209.0	3402022	57	1.08
2015 GP2	167.9	3402022	57	0.87
2016 GP2	268.9	3402022	57	1.39
Avg	261.8	4585088	59	1.02

Entering the average release rate and area associated with low DO into the LLRM for Great Pond results in an estimated internal load of 275 kg/yr. It is likely that higher and lower internal load values could be measured over any given year with variable conditions directly affecting thermal stratification and DO concentrations. However, it is unlikely that the internal load in Great Pond will significantly exceed 400 kg/yr (WRS, 2020).

ADDRESSING THE EXTERNAL LOAD

Addressing NPS pollution from watershed sources is the most important planning goal but is still only one part of a multi-step process to improve the water quality in Great Pond. Addressing the external load will require ongoing work annually over the ten-year planning period and beyond. Cooperation from private landowners will be needed to successfully reduce the watershed phosphorus load by 130 kg/yr. This goal will be met by addressing high, medium, and low priority sites identified through the 2018 watershed survey, effective LakeSmart programming, implementation of a robust new buffer initiative, upgrading septic systems, addressing loading from upstream indirect watersheds (North Pond and McGrath Pond/Salmon Lake), and preventing new sources of phosphorus from getting into the lake.

WATERSHED NPS SITES

In 2018, volunteers and technical staff identified 237 sites across the watershed that are currently or have the potential to negatively affect the water quality of Great Pond (Appendix A). The greatest number of sites are located on the east shore of the lake (48%). Sites were documented across 11 different land-use types (Figure 30 & Table 15). The number of residential properties far outweighed the other land-use types. Similarly, many other sites associated with trails/paths, boat/beach access and construction are also located on residential properties. The watershed action plan (Table 16) outlines the strategies and costs for reducing the watershed load from NPS sites in the Great Pond watershed, including the following actions:

1. Prepare a list of NPS sites on **Town property** that includes documented issues, proposed solutions, and estimates of cost, and send to each town for consideration in annual budget planning meetings.
2. Revisit NPS sites on **private gravel roads** in the spring and include roads with known issues, that did not make the NPS site list, to document NPS problems.
3. Set up a meeting with **gravel pit** owners/operators to discuss NPS problems, solutions, and potential funding opportunities.
4. Meet with **summer camp** owners/managers to review NPS survey results and discuss next steps including a meeting with Camp Runoia to walk the site and start the process of developing a road management plan for Camp Bomazeen.
5. Host a meeting with **businesses in the Village District** to discuss NPS survey results and possible funding opportunities.

6. Target **residential neighborhoods** where multiple NPS sites have been identified for greater reach and impact (for example, Crystal Springs Association, Horsepoint Rd., and Pine Beach Rd.) and target high-impact residential sites in Phase I 319 restoration efforts.
7. **Look more closely at the impact of agriculture and logging** in the watershed by hosting meetings with USDA/NRCS to create an inventory, better understand extent of impact, and offer technical assistance to address NPS problems.

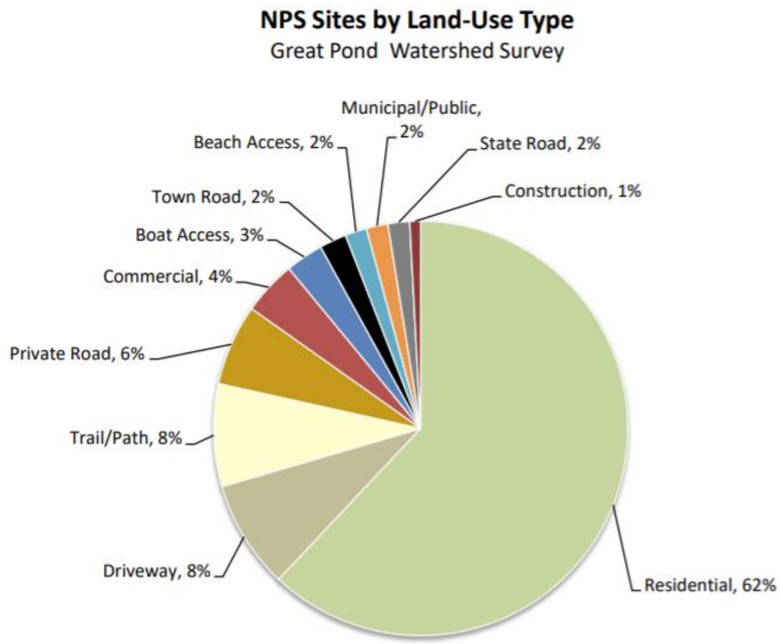


Figure 30. Percentage of NPS sites identified in the Great Pond watershed by land use.

Table 15. Summary of NPS sites in the Great Pond watershed by land use and impact rating.

Land Use	High Impact	Medium Impact	Low Impact	Unknown	Total	% of Total
Residential	11	57	79	0	147	62%
Driveway	5	10	5	0	20	8%
Trail/Path	1	5	13	0	19	8%
Private Road	3	7	5	0	15	6%
Commercial	2	5	3	0	10	4%
Boat Access	0	3	3	1	7	3%
Town Road	2	2	1	0	5	2%
Beach Access	0	0	4	0	4	2%
Municipal/Public	0	3	1	0	4	2%
State Road	1	2	1	0	4	2%
Construction	0	1	1	0	2	1%
TOTAL	**25**	**95**	**116**	**1**	**237**	**100%**

The impact that documented NPS sites may have on the water quality of Great Pond was determined during the survey based on the proximity to a waterbody and the magnitude of the problem. Factors such as slope, soil type, amount of eroding soil, and buffer size were also considered. A closer look at the estimated impact of these sites shows that while there are a total of 237 sites documented, only 25 rank high-impact compared to 95 medium, and 116 low-impact sites (Table 15). Residential NPS sites make up the greatest number of high, medium, and low-impact sites, accounting for 62% of all sites, and 68% of the low-impact sites.

Preliminary prioritization of the 237 survey sites was completed with the help of the technical leaders and steering committee members using the following criteria: sites with the greatest impact for the least cost, sites with a high likelihood of being completed, and sites with good educational value. High-priority sites by sector include:

Sector 1 1-03 (private road drains to stream), 1-01 (address unstable slopes, commercial site), 1-02 (spring site visit on Wooster Hill Rd.)

Sector 4 Sites 4-04 and 4-05 (Hathaway Ln.) are linked. Camp road is causing erosion in the driveway; 4-10 (eroded driveway and willing landowner on Golden Pond)

Sector 5 North and South Crane Ln. (private roads need ditching, culvert improvements and resurfacing)

Sector 9 9-14 (boat ramp on Snug Harbor Rd.)

Sector 11 11-03 (residential, construction, boat access on Cyr Ln.), 11-11 (Residential site on Wanser Ln.), 11-08 (Residential site on Wanser Ln.)

Sector 12 12-07 (stream); 12-05 (driveway affecting 12-06), 12-21 (significant erosion)

Sector 13 Site 13-5 (Pickerel Ln. driveway, high-impact)

Sector 20 Review original design plans for existing BMPs at Taconnet Parking Lot and develop new plans to address runoff

Sector 21 Steep eroding bank and multiple NPS issues stemming from walkways, roofs and tent platforms on Pine Island. Good YCC project.

Improvements are needed at a commercial parking lot in Sector 20 to prevent sediment from getting into the lake.

BUFFERS

Shoreline survey photo on Great Pond (Zone F) taken in 2011 as part of the of the Belgrade Lakes Watershed Sustainability Project. (Source: Colby College)

Installing an effective shoreline buffer can be one of the easiest ways to help improve water quality. Naturally vegetated shorelines are often the "last line of defense" for trapping and treating polluted stormwater runoff before it gets to the lake. A healthy, vegetated shoreline will not only act as a buffer between the pond and adjacent shoreline development, but will also provide great benefit to wildlife as more species live in (and rely on) shoreline riparian zones than any other habitat type (Maine Audubon, 2006). Increasing development pressures throughout the watershed, and especially within the shoreland zone of Great Pond, and the effects of climate change (more frequent and more intense precipitation and increased volume and velocity of stormwater runoff) means that healthy, vegetated shoreline buffers will be even more important for achieving water quality goals and maintaining a healthy lake ecosystem.

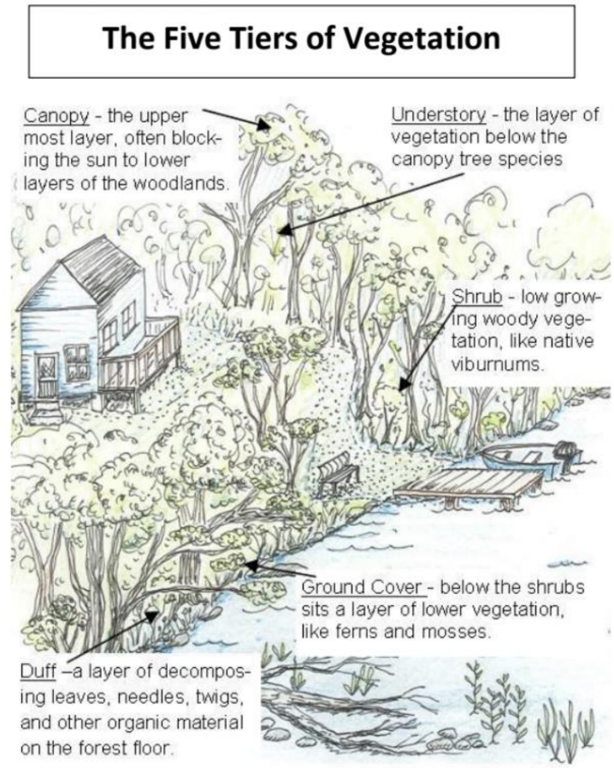
In 2011, researchers at Colby College organized shoreline photographic surveys for all of the Belgrade Lakes. The shoreline of Great Pond was divided into nine sections, and georeferenced photographs were taken to document shoreline development and buffer conditions around the lake. The photos were provided to towns to help track changes in the shoreland zone. The surveys confirm that many properties on Great Pond have very limited to non-effective shoreline buffers.

Shoreline buffer installation on a lake front property. (Source: https://www.uwsp.edu/cnr-ap/UWEXLakes/Pages/resources/WiLakeshoreRestorationProject/techniques.aspx)

The 2018 watershed survey confirmed a general lack of effective shoreline buffers on Great Pond with 158 NPS sites documented as residential, beach access, or boat access sites, many of which need to improve or establish shoreline buffers. An additional 88 properties were added to the 'LakeSmart Referral List' during the watershed survey. These properties included sites with no active erosion, but lacked a buffer or had a very limited or non-effective buffer.

This plan recommends the development of a large-scale **Buffer Campaign** with easy-to-follow guidance for installing effective and functional shoreline buffers with the goal of establishing or improving 100 buffers over the next 10 years.

The Great Pond Buffer Campaign will include recommendations for new and existing shoreline buffers following established LakeSmart guidelines. LakeSmart currently requires a vegetative buffer zone that is at least 10-feet deep (on average) comprised of at least three of the five total vegetation stand types (duff layer, ground cover, shrubs, understory, and canopy) to ensure that stormwater runoff is captured and infiltrated within the buffer, raindrops are interrupted by overstory vegetation, and the overall function of the shoreline is maximized. Outreach efforts will highlight the importance of **buffer quality**, as a healthy and functioning shoreline buffer includes more than just the installation of native plantings. The quality of the soil and a healthy duff layer is just as important when constructing an effective vegetated shoreline. The program will likely assess existing buffers for soil quality and buffer effectiveness in addition to establishing new buffers.



Example of an effective shoreline buffer with five tiers of vegetation. (Source: Maine Lakes)

SEPTIC SYSTEMS

While phosphorus loading from septic systems appears to have a small impact on the water quality of Great Pond based on the watershed modeling (3%), just one or two failing septic systems leaching nutrient-rich wastewater into the lake could result in localized water quality problems. This plan proposes the following strategies for better understanding the effect of septic systems on the water quality of Great Pond. Proposed load reduction targets from septic systems are conservative estimates that can be further refined when more information is available regarding the state of septic systems in the watershed. To accomplish this, the following steps are proposed:

1) Prepare a **septic system database** with known state septic records & update following a septic survey and annual requests to watershed towns;

2) Target property owners located on parcels with **at risk coarse soils** and old or ageing systems and offer technical assistance;
3) Offer landowners free septic evaluations & septic designs for high priority systems **Goal: 20 free evaluations, 10 system designs;**
4) Provide cost-share grants to assist landowners with replacing problem septic systems **Goal: 5 systems (targeted outreach to landowners with systems >20 years old and/or failing or malfunctioning systems)**;
5) Conduct community outreach regarding **DEP Small Community Septic System grants** for malfunctioning systems to eligible landowners with high priority systems;
6) Require **proof that septic systems have been installed to code** when properties change from seasonal to year-round status, and require replacement if proof is not available;
7) Create a system for adequately **tracking septic inspections** conducted for all real estate transactions in the shoreland zone; this may include an ordinance that requires new homeowners to submit a copy of their inspection report to the town;
8) Create a permitting system and **registration requirement for rental properties on the shoreline** to minimize impacts from undersized septic systems.

NEW SOURCES OF NPS POLLUTION

The prevention of new sources of phosphorus from the watershed will be key to the success of the management strategies described above. As the water quality in the lake improves, Great Pond will continue to be a desirable place to live and to visit, resulting in new development in the watershed. Prevention strategies will include ongoing public education, municipal planning, and land conservation. Project partners will need to:

1) **Attend regular select board meetings** to update town officials about watershed activities;
2) Work with town officials to **strengthen town ordinances**, ensure timely **enforcement of current rules** that protect water quality, and upgrade infrastructure to adapt to changes in precipitation;
3) **Update the 2009 build-out analysis** to determine the most suitable areas in the watershed for future development and areas best reserved for land conservation, and if recent watershed development and/or ordinance enforcement has changed the projected results;
4) Meet annually to review and discuss progress on the plan and update planning goals;
5) **Create a sustainable funding plan** to cover the cost of watershed restoration projects, long-term monitoring and possible future treatment of the internal load.

6) Work with towns to **hire full-time code enforcement officers** to enforce existing laws and ordinances, which will ultimately protect water quality, improve the tax base and prevent shifting of the tax base to upland properties.

INFORMATION, EDUCATION & OUTREACH

The Belgrade Lakes Association and 7 Lakes Alliance are the primary entities conducting public outreach in the watershed. BLA currently hosts an annual meeting each summer for all interested watershed residents, provides watershed updates on its website, and distributes an annual newsletter each summer. BLA does extensive outreach through their Stop Milfoil Campaign and leads the LakeSmart program for Great Pond and Long Pond, among other outreach activities. 7 Lakes provides technical assistance to the association and the watershed towns to protect and preserve the natural resources within the watershed. 7 Lakes administers the YCC, the Courtesy Boat Inspection (CBI) program, and provides public lectures and guided nature walks.

All **general outreach** activity will continue in the watershed with the addition of:

1. Develop an **outreach strategy/communications committee** to guide outreach activities;
2. Develop and maintain a **Great Pond WBMP web page** for public to access information;
3. Develop an **online video series** of short educational clips that can be viewed by the public;
4. Introduce a program to provide **welcome packets to new property owners** in the shoreland zone with water quality educational materials.

Targeted outreach efforts will focus on Towns, shorefront property owners, road associations, homeowner associations, developers, watershed landowners, and properties with identified NPS sites. This includes:

1. Prepare a list of **NPS sites on town-owned property** and send to towns for their annual budget planning;
2. Prepare a list of **NPS sites on state roads** and meet with Maine DOT to discuss improvements;
3. Follow-up with **educational materials** for 88 landowners listed on the LakeSmart referral form (2018); reach out to 10 landowners with existing LS certification and documented NPS sites;
4. Design a **Buffer Campaign** with easy-to-follow guidance/recipes for installing an effective shoreline buffer and canvas the watershed with the goal of installing 100 buffers;
5. Target landowners and road associations to **promote the use of bluestone from local gravel pits** for use on driveways and roads and provide incentive to switch over to new surface material.

6. Conduct targeted outreach to watershed landowners and developers about the need to **control phosphorus from all new development** and the ordinances that address this.
7. **Host meetings with local groups** to discuss NPS sites, water quality, and funding opportunities:
   - Business owners in the Village District
   - Summer camp owners/managers
   - USDA/NRCS
   - Local gravel pit operators
   - Homeowner associations
   - Road associations
8. Host workshops including:
   - **Gravel road workshops** in the watershed working directly with road associations,
   - **Regional buffer workshops** such as "Are you Buff Enough" in coordination with sister lake associations,
   - **LakeSmart workshops** in targeted neighborhoods, and **LakeSmart Boat Tours.**
   - **Ordinance workshops** in partnership with watershed towns to promote the understanding of the need and public support for effective regulations that control phosphorus from all new development.

ACTION PLAN

The Great Pond WBMP provides strategies for achieving the water quality goal. The loading analysis for Great Pond weighed the pros and cons of different management options for reducing in-lake phosphorus concentrations. These recommendations are outlined in detail in the plan and were presented to the TAC for review and feedback. The action plan was developed with input from both the TAC and the watershed steering committee. The action plan represents solutions for improving water quality in Great Pond based on the best available science.

The action plan is divided into six major objectives, along with a schedule for completion, description of potential funding sources, and a list of project partners assigned to each task (Table 16). The objectives focus on:

1) Addressing the External Watershed Load
2) Monitoring the Internal Watershed Load
3) Addressing New Sources of NPS Pollution
4) Education, Outreach, & Communication
5) Building Local Capacity
6) Long-Term Monitoring & Assessment

*Table 16. **Great Pond watershed Action Plan & management measures**.*

	Action Plan & Management Measures	Schedule	Who	Potential Funding Sources	Estimated Cost (10 years)
A. External Phosphorus Load in Great Pond					
A1	Review list of 18 high priority sites outlined in the 2018 watershed survey report and develop a **candidate site list** for future 319 grant applications	Years 1-10	7 Lakes, BLA, Steering Committee	n/a	$500
A2	Look more closely at the impact of **agriculture and logging** in the watershed by hosting meetings with USDA/NRCS to create an inventory, better understand extent of impact, and offer technical assistance to address NPS problems	Years 2-3	7 Lakes, KCSWCD, USDA/NRCS	7 Lakes, BLA	$4,000
Address High & Medium Impact NPS Sites					
A3	Address NPS sites on residential properties ***Goal: 68 residential sites (11 high & 57 medium impact)***	Years 2-10	7 Lakes (YCC), BLA, homeowners	US EPA (319), Maine DEP, Landowners	$187,000
A4	Address NPS sites on state and town roads and public properties ***Goal: 10 sites (3 high impact, 7 medium impact)***	Years 2-10	7 Lakes, KCSWCD, Towns, Maine DOT	US EPA (319), Maine DEP, Towns of Belgrade, Rome	$190,000
A5	Address NPS sites on private gravel roads ***Goal: 10 sites (3 high impact, 7 medium impact)***	Years 2-10	7 Lakes, KCSWCD, Road Associations	US EPA (319), Maine DEP, 7 Lakes, Landowners, Rd Associations	$175,000

	Action Plan & Management Measures	Schedule	Who	Potential Funding Sources	Estimated Cost (10 years)
A6	Address NPS sites on commercial properties ***Goal: 7 commercial sites (2 high impact, 5 medium impact)***	Years 2-10	7 Lakes, KCSWCD, Commercial property owners	US EPA (319), Maine DEP, Commercial Property Owners	$59,500
A7	Address NPS sites on driveways ***Goal: 15 driveway sites (5 high impact, 10 medium impact)***	Years 2-10	7 Lakes, KCSWCD, Landowners	US EPA (319), Maine DEP, Landowners	$86,250
A8	Address NPS sites on "Other" sites (e.g. boat access, trail/path, etc.) ***Goal: 10 sites (1 high impact, 9 medium impact)***	Years 2-10	7 Lakes, 7 Lakes, BLA, Landowners	US EPA (319), Maine DEP, 7 Lakes, Landowners	$22,500
Address Low Impact NPS Sites					
A9	Work with residential property owners to address low-impact residential NPS sites (including driveways, trails/paths, boat access, beach access, construction) ***Goal: Address 100% of low-impact residential related sites (116 sites)***	Years 1-10	7 Lakes, BLA, Landowners	Landowners, 7 Lakes (YCC), BLA	$126,000
A10	Target shorefront properties to become LakeSmart ***Goal: 50% of shorefront property owners participating by 2031***	Years 1-10	7 Lakes, BLA	7 Lakes, BLA, Landowners, US EPA (319), Maine DEP	$125,000
A11	Install residential buffers on non-NPS list properties ***Goal: Install new or improve existing buffers on 100 residential properties (non-watershed survey sites)***	Years 1-10	7 Lakes, BLA, landowners	Landowners, 7 Lakes (YCC), BLA	$49,000

	Action Plan & Management Measures	Schedule	Who	Potential Funding Sources	Estimated Cost (10 years)
A12	Work with road associations and homeowners to address low-impact private road sites ***Goal: Address 5 low-impact road sites***	Years 5-10	7 Lakes, BLA, KCSWCD, Road Associations	Road Associations, 7 Lakes, KCSWCD	$7,500
A13	Address remaining low-impact sites on state/town roads, and public properties ***Goal: Address 3 remaining publicly owned NPS sites***	Years 5-10	7 Lakes, Towns, Maine DOT	Maine DOT, Towns	$16,500
Reduce NPS from Septic Systems					
A14	Prepare a **septic system database** with known state septic records & update following a septic survey and annual requests to watershed towns	Ongoing	7 Lakes, BLA, Colby, Consultant, Towns	Grants, 7 Lakes, BLA	$5,000
A15	Target property owners located on parcels with **at risk coarse soils** and old or ageing systems and offer technical assistance.	Year 1-3	7 Lakes, BLA, Maine State Soil Scientist	Grants, 7 Lakes, BLA	$32,500
A16	Offer landowners free septic evaluations & septic designs for high priority systems ***Goal: 20 free evaluations, 10 system designs***	Years 3-4	7 Lakes, BLA, KCSWCD, Site Evaluators	Grants	$25,000
A17	Provide cost-share grants to assist landowners with replacing problem septic systems ***Goal: 5 systems (targeted outreach to landowners with systems >20 years old and/or failing or malfunctioning systems)***	Years 4-10	7 Lakes, BLA, KCSWCD, DHHS, Towns	Grants	$50,000
A18	Conduct community outreach regarding **DEP Small Community Septic System grants** for malfunctioning systems to eligible landowners with high priority systems.	Years 1-10	BLA, 7 Lakes, Town of Belgrade, Town of Rome	n/a	$500

Action Plan & Management Measures		Schedule	Who	Potential Funding Sources	Estimated Cost (10 years)
A19	Require **proof that septic systems have been installed to code** when properties change from seasonal to year-round status, and require replacement if proof is not available	Years 1-10	Town of Belgrade, Town of Rome	Towns	$1,500
A20	Create a system for adequately **tracking septic inspections** conducted for all real estate transactions in the shoreland zone; this may include an ordinance that requires new homeowners to submit a copy of their inspection report to the town	Years 1-2	Town of Belgrade, Town of Rome	Towns	$5,000
A21	Create a permitting system and **registration requirement for rental properties on the shoreline** to minimize impacts from undersized septic systems	Years 2-4	Town of Belgrade, Town of Rome	Towns	$10,000
External Phosphorus Load Total					**$1,178,250**

Action Plan & Management Measures		Schedule	Who	Potential Funding Sources	Estimated Cost (10 years)
B. Internal Phosphorus Load in Great Pond					
In-Lake Treatment					
B1	Complete the analysis of **Great Pond sediments** and share results with project partners	Year 1	Colby	7 Lakes, BLA	$0
B2	Review annual water quality data for **trends**: a) increased anoxia (AF), b) decline in water quality and Secchi, c) increase in P and blue-green algae to inform decision to treat internal load	Years 1-10	7 Lakes	7 Lakes, BLA	$7,200
B3	Develop **thresholds** for moving forward with treatment: Prevention & Remediation	Year 1 & 2	7 Lakes, Steering Committee	7 Lakes, BLA	$2,500
B4	Develop **treatment options and a draft funding plan** based on estimated treatment costs	Years 1 & 2	7 Lakes, Steering Committee, Consultant	7 Lakes, BLA	$3,500
Internal Phosphorus Load Total					**$13,200**

	Action Plan & Management Measures	Schedule	Who	Potential Funding Sources	Estimated Cost (10 years)
C. Prevent New Sources of NPS Pollution					
General Tasks					
C1	Attend regular Select Board meetings to update towns about watershed activities and needs ***Goal: Minimum 2 meetings/year***	Years 1-10	7 Lakes, BLA	7 Lakes, BLA	$1,000
C2	Work with town officials to **promote cleaning up winter sand** and ongoing road maintenance	Years 1-10	7 Lakes, BLA	7 Lakes, BLA	$1,000
C3	Work with landowners/road associations to conduct annual road maintenance on **gravel roads**	Years 1-10	7 Lakes, BLA	7 Lakes, BLA	$1,000
C4	Provide a monetary rebate to homeowners that install buffers ***Goal: 25 properties/year***	Years 1-5	7 Lakes, BLA	BLA	$25,000
C5	Work with local landscape nurseries to provide discounts for buffer plantings ***Goal: 3-5 local nurseries participating***	Years 1-5	7 Lakes, BLA	BLA	$500
C6	Address new NPS sites not identified in 2018 watershed survey ***Goal: 50 sites (10 high impact, 40 medium impact)***	Years 2-10	7 Lakes, BLA, Landowners	US EPA (319), Maine DEP, BLA, Landowners	$150,000
Future Development & Conservation					
C7	Continue working with landowners to protect undeveloped land throughout the watershed ***Goal: 2,000 acres conserved***	Years 1-10	7 Lakes, landowners	7 Lakes	$2,500
C8	Work with municipal officials to identify areas of the watershed with the greatest threat to roads and culverts	Years 2-5	7 Lakes, BLA, Towns	7 Lakes	$1,000
C9	Update the 2009 **build-out analysis**, comparing original projections to current development patterns after 20 years, and update projections for next 20	Year 8-10	Consultant	BLA, grant	$1,500

	Action Plan & Management Measures	Schedule	Who	Potential Funding Sources	Estimated Cost (10 years)
Municipal Planning					
C10	Conduct a **review of current ordinances** in both towns to determine what improvements have been made since the 2009 assessment, and what work is still needed to improve ordinances to be sufficiently protective of water quality	Years 2-3	BLA, 7 Lakes, Towns, Colby	BLA, Towns	$3,500
C11	Urge towns to **expand hours for code enforcement** officers to adequately enforce current ordinances	Years 1-10	BLA, 7 Lakes, community members	BLA, 7 Lakes, Towns	$1,500
C12	Develop a **watershed-wide P control ordinance** for all new development (including single family residential units and roads and seasonal to year-round conversions)	Years 3-5	7 Lakes, BLA, Towns, Consultant	BLA, 7 Lakes, Towns	$10,000
C13	Include provisions for **3rd party site review**, and long-term maintenance as a requirement for all new building permits	Years 3-5	7 Lakes, BLA, Towns, Consultant	BLA, 7 Lakes, Towns	$2,000
Climate Change					
C14	Utilize a **climate model** to anticipate effects of extreme events on lake water quality	Years 2-3	Colby, Consultant	Grants	$5,000
C15	Develop a **Climate Change Action Plan** as a pilot project for other lakes in the region and statewide	Years 3-4	7 Lakes, Colby, Consultant	Grants	$15,000
C16	Host **climate change workshops** or webinars to provide information about ways landowners can adapt to climate change and help protect water quality	Years 2, 3 & 4	Colby, 7 Lakes, Consultant	Grants	$2,500
C17	Create an online video about potential effects of climate change on Great Pond	Years 3-4	Colby, 7 Lakes	Grants	$1,000

Action Plan & Management Measures		Schedule	Who	Potential Funding Sources	Estimated Cost (10 years)
C18	Set up an **automated precipitation monitoring program** (e.g., automated rain gauge) to document occurrence and intensity of rainfall in the watershed	Year 2-10	Colby, 7 Lakes	Grants	$6,000
C19	Conduct a **stream-crossing survey** to assess whether culverts at road/stream crossings require upgrades.	Years 2-4	7 Lakes, KCSWCD, Consultant	Grants, BLA	$5,000
C20	Work with watershed towns and Maine DOT to apply for grants to fund and implement **culvert upgrade projects**	Years 5-10	7 Lakes, KCSWCD, Towns, Maine DOT	Towns, Maine DOT, Maine DEP	$225,000
Prevent New Sources of NPS Pollution Total					**$460,000**

	Action Plan & Management Measures	Schedule	Who	Potential Funding Sources	Estimated Cost (10 years)
D. Education, Outreach & Communications					
General Outreach					
D1	Develop an outreach strategy/**communications committee** to get the word out to the community; meet quarterly to discuss plan objectives	Year 1-2	7 Lakes, BLA, interested stakeholders	7 Lakes, BLA	$8,000
D2	Develop and maintain a Great Pond WBMP **web page** for public to access information	Year 1-2	7 Lakes, BLA	7 Lakes, BLA	$5,000
D3	Keep partner **websites** updated regarding on-going monitoring efforts and NPS pollution projects	Years 1-10	7 Lakes, BLA, Towns	Towns, 7 Lakes	$5,000
D4	Provide **welcome packets** to new property owners with water quality educational materials	Years 1-10	7 Lakes, BLA	7 Lakes, BLA	$5,000
D5	Prepare and distribute **press releases** about watershed improvement activities, grant projects, and successful projects	Year 1-2	7 Lakes, BLA, Consultants	7 Lakes, BLA	$1,000
D6	Develop an **online video series** of short educational clips that can be viewed by the public (including climate change)	Year 2-4	Outreach Committee, Colby, 7 Lakes	Grants, 7 Lakes, BLA	$5,000
Targeted Outreach					
D7	Prepare a list of NPS sites on **town-owned property** and send to towns for their annual budget planning (town beaches and roads)	Year 1	7 Lakes, BLA, Towns	7 Lakes, BLA	$2,000
D8	Follow-up with educational materials for 88 landowners listed on the **LakeSmart referral** form (2018); reach out to 10 landowners with existing LS certification and documented NPS sites	Year 1-2	7 Lakes, BLA, Town	7 Lakes, BLA, Grants	$6,400

Action Plan & Management Measures		Schedule	Who	Potential Funding Sources	Estimated Cost (10 years)
D9	Design a **Buffer Campaign** with easy to follow guidance/recipes for installing effective shoreline buffers and canvas the watershed	Year 1-2	7 Lakes, BLA, Towns	Grants, Landowners	$5,000
D10	Host a meeting with **business owners** in the Village District to discuss watershed survey results and possible funding opportunities	Year 1-2	7 Lakes, BLA	7 Lakes, BLA	$1,000
D11	Meet with **summer camp owners/ managers** to review 2018 watershed survey results and discuss next steps; meet with Camp Runoia to walk site; update road management plan for Camp Bomazeen	Years 1-2	7 Lakes, BLA, Summer Camp Owners/ Managers	7 Lakes, BLA	$5,000
D12	Set up a meeting with local **gravel pit operators** to discuss current operation practices as it relates to water quality	Years 2-3	7 Lakes, BLA, Gravel Pit Operators	7 Lakes, BLA	$1,000
D13	Prepare a list of NPS sites on **state roads** and meet with Maine DOT to discuss improvements	Years 1-2	Maine DOT	7 Lakes, BLA	$2,000
D14	Meet with **homeowner associations** with known NPS sites (e.g., Crystal Springs) to discuss results of the watershed survey and LakeSmart	Years 1-2	7 Lakes, BLA, Homeowner Associations	7 Lakes, BLA	$1,500
D15	Send letters to and meet **road associations** with documented NPS problems to determine interest in future 319 grant cost-sharing opportunities	Years 1-2	7 Lakes, BLA, Road Associations	7 Lakes, BLA	$3,000

Action Plan & Management Measures		Schedule	Who	Potential Funding Sources	Estimated Cost (10 years)
D16	Conduct outreach to landowners/road associations to **promote use of bluestone from local gravel pits** for use on driveways and roads; work with local pit owners to have materials readily available; identify roads where not currently used and provide **incentive** to switch over to new surface material.	Years 1-10	7 Lakes, BLA, Road Associations, Landowners	7 Lakes, BLA, Maine DEP	$10,000
Workshops					
D17	Host **gravel road workshops** in the watershed working directly with road associations	Years 2, 4 & 6	7 Lakes, KCSWCD, Maine DEP	7 Lakes, US EPA (319)	$6,000
D18	Coordinate with sister lake associations to host **regional buffer workshops** such as "Are you Buff Enough"	Years 1-10	7 Lakes, BLA	7 Lakes, BLA	$5,000
D19	Host a **LakeSmart workshop** in targeted neighborhoods & LakeSmart Boat Tours	Years 2, 4, 6, 8, 10	7 Lakes, BLA	7 Lakes, BLA	$5,000
D20	Host an Ordinance workshop for landowners and developers	Year 2-3	7 Lakes, BLA, Towns	7 Lakes	$2,500
Other					
D21	Work with lake associations in **upstream watersheds** that contribute phosphorus to Great Pond (North Pond, Salmon Lake/McGrath Pond, East Pond) to reduce phosphorus inputs to their lakes	Ongoing, Years 1-10	7 Lakes, NPA, MP-SLA, EPA	7 Lakes	$10,000
D22	Work with **local realtors and towns** to track property transfers and subdivisions	Years 1-10	7 Lakes, BLA	7 Lakes, BLA	$10,000
Education, Outreach & Communications Total					**$104,400**

	Action Plan & Management Measures	Schedule	Who	Potential Funding Sources	Estimated Cost (10 years)
E. Build Local Capacity					
Fundraising					
E1	Develop and maintain a **fundraising committee** to help implement the plan	Year 1-2	7 Lakes, BLA, interested stakeholders	n/a	n/a
E2	Create a sustainable funding plan to pay for the cost of watershed restoration projects, long-term monitoring and future in-lake treatment ***Goal: $2,000,000 raised by 2031***	Year 1-2	7 Lakes, BLA	7 Lakes, BLA, private donors	$5,000
E3	Apply for US EPA Clean Water Act Section 319 watershed implementation grants to address NPS sites ***Goal: 4 phases of 319 implementation projects***	Years 1, 3, 5, and 7	7 Lakes, Consultants	7 Lakes, BLA	$12,000
E4	Fundraise for **septic system cost-sharing grants**	Years 1-3	7 Lakes, BLA, Towns	7 Lakes, BLA, Grants	n/a
E5	Apply for other state, Federal or private foundation **grants** that support planning recommendations	Years 1-10	7 Lakes, Consultants	7 Lakes, BLA	$7,500
Steering Committee & Partnerships					
E6	Steering Committee to **meet annually** to discuss action items and goals	Annually, Years 1-10	7 Lakes, BLA, Steering Committee	n/a	n/a
E7	Reach out to new potential SC members including local businesses, realtors, and septic inspectors	Year 1, 5 & 8	7 Lakes, BLA	n/a	n/a
E8	Continue working with watershed towns to strengthen **stakeholder relationships** and bolster community support for restoration efforts	Years 1-10	7 Lakes, BLA	n/a	n/a

Action Plan & Management Measures		Schedule	Who	Potential Funding Sources	Estimated Cost (10 years)
E9	Coordinate with Colby and Bates College annually regarding **ongoing scientific research projects** (example, NASA study, *Gloeotrichia*)	Annually, Years 1-10	7 Lakes, BLA, Colby, Bates	n/a	n/a
E10	Develop a comprehensive list of projects and an accessible database will be created to track activities conducted by the numerous project partners that work in the watershed	Years 3-5 and ongoing	7 Lakes, BLA	Grants	$7,500
Build Local Capacity Total					**$32,000**

	Action Plan & Management Measures	Schedule	Who	Potential Funding Sources	Estimated Cost (10 years)
F. Conduct Long-Term Monitoring & Assessment					
Baseline Lake Monitoring					
F1	Continue collecting **baseline water quality data** to inform long-term management actions (see future monitoring plan)	Years 1-10	7 Lakes, Colby College, Maine DEP, Volunteers	Private Donors, Grants	$100,000
F2	Recruit and train two **new certified volunteer lake monitors** to collect SDT and DO/Temp	Years 1-3	7 Lakes, BLA, LSM	n/a	$0
F3	Track and document the presence and duration of ***Gloeotrichia*** **and metaphyton**	Years 1-10	7 Lakes, Colby, Volunteer Monitors	7 Lakes, BLA	$10,000
F4	Monitor for **plankton** during summer months	Years 1-10	7 Lakes, Colby	7 Lakes, BLA	$5,000
F5	Assess extent of **diatom bloom** at turnover	Years 1-10	7 Lakes, Colby	7 Lakes, BLA	$2,000
F6	Investigate the **rise of cyanobacteria** from the bottom of the lake at intermediate depths	Years 2-4	7 Lakes, Colby	7 Lakes, BLA, Colby	$3,000
F7	Determine the extent of ephemeral anoxia at shallower depths	Years 2-4	7 Lakes, Colby	7 Lakes, BLA, Colby	$1,500
F8	Conduct **winter sampling** for DO/Temp and P samples during ice-on	Years 1-5	7 Lakes, Colby	7 Lakes, BLA, Colby	$3,000
Septic Systems					
F9	Design a **septic survey**, compile septic records, look at grandfathered systems, create septic database	Years 2-4	7 Lakes, BLA, DEP	Grants	$6,500
NPS Pollution					

Action Plan & Management Measures		Schedule	Who	Potential Funding Sources	Estimated Cost (10 years)
F10	Set up **NPS Site Tracker** & update annually	Ongoing (Years 1-10)	7 Lakes, BLA	US EPA (319)	$5,000
F11	Conduct **spring site visits to roads and logging sites** with known issues in spring that did not make the 2018 NPS site list (e.g., Wilder Rd.)	Year 1	7 Lakes, BLA, Volunteers	7 Lakes, BLA	$1,610
F12	Conduct an informal watershed survey for **new NPS sites** 5 and 10 years after initial survey	Years 3 and 8	7 Lakes, BLA	7 Lakes, BLA, grants	$20,000
F13	Update 2010/2011 GIS-based **shoreline photos** and share with towns to assist with compliance in the shoreland zone; include documentation of buffer quality.	Years 2 and 7	Colby, 7 Lakes, BLA	Colby, 7 Lakes, BLA	$10,000
F14	Collect and analyze **stormwater runoff** from golf course	Year 2-3	7 Lakes, Volunteer Monitors	7 Lakes, BLA	$1,200
Streams					
F15	Assess **fluvial geomorphic indicators** in targeted streams via a stream walk	Year 1-5	7 Lakes, Maine DEP	7 Lakes, BLA	$1,500
F16	Collect **water quality data at targeted stream outlets** to assess P inputs; consider use of game cameras and stream gauge along with collection of samples from intermittent streams during storm events to determine P loading from select tributaries	Years 1-3 (3-year baseline)	7 Lakes, BLA, Maine DEP, Volunteers	Grants	$15,000
F17	Train volunteer **"stream watchers"** to take pictures during storms or install game cameras; set up Google file for uploading photos; work with Maine DEP to train volunteers on how to collect storm samples	Years 3-5	Maine DEP, 7 Lakes, Volunteers	Grants, 7 Lakes, BLA, Colby	$1,500
Invasive Plants & HABs					

Action Plan & Management Measures		Schedule	Who	Potential Funding Sources	Estimated Cost (10 years)
F18	Participate in fundraising activities to **support programs that prevent the additional spread of milfoil** and other invasive aquatic plants in Great Pond (e.g., CBI, invasive plant surveys, STOP MILFOIL, etc.)	Years 1-10	7 Lakes, BLA, volunteers	7 Lakes, BLA, State Funding	*see note
F19	Develop a **HAB monitoring protocol**	Years 1-2	7 Lakes, Colby, Maine DEP	7 Lakes, BLA, Colby	$1,500
Other					
F20	Develop a subcommittee to look at the **economic value of Great Pond** that can be used for public outreach	Years 1-3	Colby, 7 Lakes, KVCOG, BLA	7 Lakes	$1,500
Conduct Long-Term Monitoring & Assessment Total					**$189,810**

Great Pond WBMP Project 10-Year Grand Total	**$1,967,660**

** The CBI program is expected to cost $150,000 to implement over a 10-year period. While this is critical lake management project, the costs are not included in the 10-year WBMP, nor are IAP remediation costs such as the STOP MILFOIL Campaign.*

7. Monitoring Activity, Frequency and Parameters

Maine water quality standards requires Great Pond to have a stable or improving trophic state and be free of culturally induced algal blooms. Measuring changes in water quality of the lake is a necessary component of successful watershed planning because it informs the planning process by evaluating progress. If improvements in water clarity, phosphorus or other parameters are evident, or if water quality is stable, then planning objectives are being met. Whereas, if water quality gets worse, then additional management strategies may be needed.

FUTURE BASELINE MONITORING

An assessment of existing water quality monitoring data in Great Pond was completed as part of the water quality analysis (1970 - 2020). The TAC determined that ongoing baseline monitoring efforts supported by BLA, 7 Lakes and Colby should continue on Great Pond over the next 10 years in order to assess and track annual changes in water quality and the effects of the proposed work to reduce NPS pollution in the watershed. Future baseline monitoring should be expanded at Station 1 and 2 to include:

7 Lakes interns collecting data on Great Pond. (Photo: 7 Lakes)

1) **Water Clarity** measured biweekly April through October.
2) **Temperature, Dissolved Oxygen, pH, and Conductivity** profiles collected biweekly April through October and monthly during the winter.
3) **Phosphorus & Metals** collected from profile grab samples using a grab sampling device biweekly every 2 m from 0 – 20 m April through October and monthly during the winter.
4) **Phytoplankton** collected biweekly May through October at 2 m and analyzed using a FlowCam.
5) **Chlorophyll-*a, DO,* Temp, PAR** collected continuously from Goldie at Station 2 at 2m and 6m (Chl-a), at 4 depths for DO, at odd meters (temp), and above the surface and 2 m (PAR).

6) **Continue submitting lab splits** collected from the same sample grab, for TP analysis at HETL for all depths, or for a minimum of 10% of the samples taken during each station visit; depths should be chosen randomly to capture variation in the water column.

7) **Begin collecting regular samples at Station 3** (in approximately 10 m of water) to monitor ephemeral stratification and anoxia, and potential release of phosphorus from shallower depths. A DO logger could be deployed about a foot above the sediment surface to capture continuous data from mid-July to mid-September.

8) **Add TKN, silicate, and chlorophyll-a concentrations** in an epilimnetic core samples. Currently Chl-a is only measured in situ on Goldie.

9) Adjust phytoplankton monitoring to include **phytoplankton and zooplankton composition and abundance.**

10) Establish a **harmful algal bloom (HAB) toxin monitoring program**.

11) Track and document the **presence of *Gloeotrichia* and metaphyton**.

12) Assess the extent of **diatom blooms**.

7 Lakes will continue to work with project partners including BLA, Colby College, Lake Stewards of Maine (LSM) volunteer water quality monitors, and Maine DEP to conduct long-term water quality monitoring at Great Pond, and to analyze the results of this data to inform future watershed management planning and assessment.

STREAM MONITORING

Great Pond receives flows from several prominent perennial streams including Great Meadow Stream, Robbins Mill Stream, Rome-Trout Brook, and Bog Brook as well as numerous intermittent streams and drainages. These deliver stormwater runoff from roads and development throughout the watershed. **Currently, there is no reliable or consistent monitoring data available for these tributaries.** Therefore, a significant degree of uncertainty exists regarding phosphorus loading from these areas. Documenting in-stream phosphorus concentrations in the Great Pond watershed will help inform future watershed planning in these drainages by determining to what extent runoff from streams plays in the phosphorus equation. Observed data can be incorporated into modelled predictions to better inform current watershed modeling.

Stream monitoring is recommended and should occur over a time frame of at least three years to develop a baseline phosphorus concentration for each tributary. Any future stream monitoring and assessment programs should:

1) Develop a strategic stream monitoring plan before collecting samples. The plan should incorporate sample collection under a range of flow conditions each year, with strong emphasis on high flow conditions in order improve the accuracy of phosphorus loading estimates for Great Pond, and careful selection of sampling locations (easily accessible and as near as possible to the outlet of the tributary) to visit during least three (3) storm events per year, and at a minimum be analyzed for **Total Phosphorus** and **Turbidity** in addition to flow.
2) Due to the intermittent nature of streams, **automated samplers may be deployed to collect flow during storm events,** or watershed volunteers will be trained to monitor flow during storms to determine if a sample can be collected. Employing game cameras and a stream gauge may be useful for documenting high flows at each stream simultaneously with limited volunteer resources.
3) **Assess fluvial geomorphic conditions** in targeted streams via a stream walk.
4) Train volunteer "storm watchers" to take pictures during storms.

8. Measurable Milestones, Indicators & Benchmarks

The following section provides a list of interim, measurable milestones to document progress in implementing management strategies outlined in the action plan (Table 16). These milestones are designed to help keep project partners on schedule. Additional criteria are outlined to measure the effectiveness of the plan by documenting loading reductions and changes in water quality over time thus providing the means by which the steering committee can reflect on how well implementation efforts are working to reach established goals.

Photo Credit: 7 Lakes Alliance

Environmental, social, and programmatic indicators, and proposed benchmarks represent short-term (1-2 years), mid-term (3-5 years), and long-term (6-10 years) targets for improving the water quality in Great Pond. The steering committee will review the criteria for each milestone annually to determine if progress is being made, and then determine if the watershed plan needs to be revised if targets are not being met. This may include updating proposed management practices and the loading analysis, and/or reassessing the time it takes for phosphorus concentrations to respond to watershed planning actions. Great Pond's low flushing rate and long residence time may cause a lag in water quality response time. In addition, a reduction as small as the one recommended in this plan may not be easily detected within the concurrent effects that climate change is likely to have on lake trophic parameters. The flushing rate for Great Pond is 0.43 flushes per year. This means that it takes more than 1.89 years for the volume of the lake to completely pass or flush through the lake. It is generally accepted that it takes around seven times the flushing period to change the entire volume of water. For Great Pond, this would be 13 years.

Environmental Milestones are a direct measure of environmental conditions. They are measurable quantities used to evaluate the relationship between pollutant sources and environmental conditions. Table 17 (below) outlines the water quality benchmarks, and interim targets for improving water quality of Great Pond over the next 10 years.

Table 17. Water quality benchmarks and interim targets for Great Pond

Environmental Milestones			
Water Quality Benchmarks	***Interim Targets****		
	Years 1-2	*Years 3-5*	*Years 6-10*
a) Increase in average annual water clarity (SDT) **Current:** 6.4 m **Goal:** 6.5 m	6.4 m *(▲ 0 m)*	6.45 m *(▲ 0.05 m)*	6.5 m *(▲ 0.1 m)*
b) Phosphorus loading reductions from external phosphorus sources. **Current:** 2,864 kg/yr **Goal:** 2,734 kg P/yr (reduce by 130 kg P/yr)	2,851 kg/yr *(▼ 13 kg/yr)*	2,799 kg/yr *(▼ 65 kg/yr)*	2,734 kg/yr *(▼ 130 kg/yr)*
c) Decrease in average in-lake total phosphorus concentration. **Current:** 9 ppb **Goal:** 8.5 ppb	9 ppb *(▼ 0 ppb)*	8.8 ppb *(▼ 0.2 ppb)*	8.5 ppb *(▼ 0.5 ppb)*

** Benchmarks are cumulative unless otherwise noted. Years 1-2 (2021-2023); Years 3-5 (2023-2026); Years 6-10 (2026-2031)*

Social Milestones measure changes in social or cultural practices and behavior that lead to implementation of management measures and water quality improvements. Table 18 (below) outlines the social indicators, benchmarks and interim targets for the Great Pond WBMP.

Table 18. Social indicators, benchmarks, and interim targets.

Social Milestones			
Indicators	***Benchmarks & Interim Targets****		
	Years 1-2	*Years 3-5*	*Years 6-10*
a) Number of landowner meetings organized (gravel pit operators, summer camps, business owners, homeowner associations, etc.)	4 meetings	6 meetings *(8 total)*	8 meetings *(16 total)*
b) Number of people viewing online video series	n/a	300 views	1000 views
c) Number of educational workshops held (road associations, homeowner associations, gravel road workshop, buffer workshop, boat tours, etc.)	4 workshops	6 workshops *(10 total)*	8 workshops *(18 total)*
d) Number of "welcome packets" distributed to new property owners in the watershed	4 packets	10 packets	25 packets
e) Number of homeowners installing buffers through the Buffer Initiative. **Goal:** 200 new or expanded shoreline buffers	20 sites	30 sites *(50 sites total)*	50 sites *(100 total)*
f) Number of LakeSmart site visits and new landowners participating (cumulative) **Goal:** 50% of landowners participating	20% of all shoreline properties	30% of all shoreline properties	50% of all shoreline properties
g) Number of property owners addressing NPS sites. **Goal:** 100% of low-impact sites or 116 sites	10 sites	40 sites *(50 total)*	66 sites *(116 total)*
h) Number of landowners participating in septic system incentive program. **Goal:** 20 evaluations, 10 septic designs, 5 upgrades	n/a	8 evaluations, 4 designs, 2 upgrades	20 evaluations, 10 designs, 5 upgrades
i) Number of planning board/selectman meetings attended to strengthen town ordinances and relationships with town officials. **Goal:** 2 meetings/yr	4 meetings *(4 total)*	6 meetings *(10 total)*	10 meetings *(20 total)*
j) Pollutant load reductions from upstream watersheds as a result of watershed projects (indirect load) **Goal:** 5 kg P/yr	1 kg P/yr	2 kg P/yr *(3 kg P total)*	3 kg P/yr *(5 kg P total)*
k) Number of educational workshops held (road associations, homeowner associations, gravel road workshop, buffer workshop, climate change, boat tours, etc.)	4 workshops	6 workshops *(10 total)*	8 workshops *(18 total)*
l) Number of planning meetings attended to improve municipal ordinances	4 meetings	9 meetings *(13 total)*	2 meetings *(15 total)*
m) Percent of rental properties participating in septic system registration program	10% of properties	50% of rental properties	100% of rental properties
n) Percent of new construction projects utilizing LID and P control plans	10%	25%	100%
o) Amount of additional hours for town CEOs/town/year	400	600	800

** Benchmarks are cumulative unless otherwise noted. Years 1-2 (2021-2023); Years 3-5 (2023-2026); Years 6-10 (2026-2031)*

Programmatic Milestones are indirect measures of watershed protection and restoration activities. Rather than indicating that water quality reductions are being met, these programmatic measurements list actions intended to meet the water quality goal. Table 19 (below) outlines the programmatic indicators, benchmarks and interim targets for the Great Pond WBMP.

Table 19. Programmatic indicators, benchmarks, and interim targets for Great Pond.

Programmatic Milestones			
Indicators	***Benchmarks & Interim Targets****		
	(Years 1-2)	*(Years 3-5)*	*(Years 6-10)*
a) Number of NPS sites addressed. **Goal:** 25 high-impact, 95 medium-impact sites	24 sites	36 sites *(60 total)*	60 sites *(120 total)*
b) Number of Steering Committee Meetings **Goal:** 1 meeting/year	2 meetings (2 total)	3 meetings *(5 total)*	5 meetings *(10 total)*
c) Amount of funding raised for water quality projects. **Goal:** $1,500,000	$250,000	$500,000 *($750,000 total)*	$750,000 *($1,500,000 total)*
d) Number of 319 projects to address high & medium impact sites. **Goal:** Four phases of 319 projects	Phase I	Phase II	Phase III & IV
e) Number of new ordinances passed that help protect water quality	0 ordinances	2 ordinances	4 ordinances

** Benchmarks are cumulative unless otherwise noted. Years 1-2 (2021-2023); Years 3-5 (2023-2026); Years 6-10 (2026-2031)*

POLLUTANT LOAD REDUCTIONS & COST ESTIMATES

The following pollutant load reductions and costs were estimated for the next 10-year planning cycle based on six primary planning objectives outlined in the Action Plan:

Table 20. Great Pond planning objectives, P load reduction targets & cost.

Planning Objective	Planning Action (2021-2031)	P Load Reduction Target	Cost
1	**Address the External P Load** (NPS sites, septic systems, LakeSmart, buffer campaign, upstream watersheds)	130 kg/yr	$1,178,250
2	**Internal P Load** (Sediment analysis, trends, thresholds)	n/a	$13,200
3	**Prevent New Sources of NPS Pollution** (NPS sites, land conservation, ordinances, enforcement, climate change adaptation)	n/a	$460,000
4	**Education, Outreach & Communications** (Public meetings, online videos, buffer campaign, LakeSmart, workshops, etc.)	n/a	$101,900
5	**Build Local Capacity** (Funding plan, steering committee, grant writing, relationship building- including Town government)	n/a	$24,500
6	**Long-Term Monitoring & Assessment** (Baseline monitoring, plankton monitoring, septic systems, stream monitoring, invasive plants, etc.)	n/a	$189,810
	TOTAL	**130 kg/yr**	**$1,967,660**

Actual pollutant load reductions will be documented as work is completed as outlined in this plan. This includes reductions for completed NPS sites to help demonstrate phosphorus and sediment load reductions as the result of BMP implementation. Pollutant loading reductions will be calculated using methods approved and recommended by Maine DEP and the US EPA and reported to Maine DEP for any work funded by 319 grants using an NPS site tracker.

9. Plan Oversight, Partner Roles, and Funding

PLAN OVERSIGHT

Implementation of a ten-year watershed plan cannot be accomplished without the help of a central organization to oversee the plan, and a diverse and dedicated group of project partners and the public to support the various aspects of the plan. The following organizations will be critical to the plan's success and are excellent candidates for the watershed plan steering committee. The committee will need to meet at least annually to update the action plan, to evaluate the plan's success, and to determine if the water quality goal is being met.

PARTNER ROLES

7 Lakes Alliance will serve as the designated entity for overseeing plan implementation and plan updates. 7 Lakes will provide 319 grant management and administration, serve on the steering committee, provide outreach and education opportunities in the watershed, manage the YCC, CBI, and milfoil removal programs, and be the general liaison between all watershed partners and technical advisors.

Belgrade Lakes Association (BLA) will serve on the project steering committee, provide project match as available, provide outreach and education opportunities in the watershed, and work with a fundraising committee to raise funds from outside sources to support the plan.

Colby College will continue to be an important project partner to provide ongoing research related to water quality in the watershed.

Kennebec County Soil & Water Conservation District (KCSWCD) may provide technical assistance, assistance for road projects, pollutant load reduction calculations, and sponsorship for grant funding.

Landowners & Road Associations will address NPS issues on their properties and provide a private source of matching funds by contributing to fundraising efforts and participating in watershed projects and LakeSmart.

Maine Department of Environmental Protection (Maine DEP) will provide watershed partners with ongoing guidance, technical assistance and resources, and the opportunity for financial assistance through the NPS grants program including the US EPA's 319 grant program. Maine DEP will also serve on the steering committee.

Maine Lakes may provide support to the 7 Lakes LakeSmart Program Manager to evaluate and certify properties and provide LakeSmart signs for landowners meeting certification requirements.

Towns of Belgrade and Rome will serve on the watershed steering committee, and may provide funding for water quality monitoring, match for watershed restoration projects, and support for the CBI and YCC programs. The towns will also play a key role in addressing any documented NPS sites on town roads and municipal/public property and providing training and education for municipal employees.

US Environmental Protection Agency (US EPA) may provide Clean Water Act Section 319 funds and guidance.

ACTION PLAN IMPLEMENTATION & FUNDING

7 Lakes will develop and coordinate a public-private Fundraising Plan and will coordinate and implement the proposed Action Plan. Expected partners are 7 Lakes, BLA, local towns, Maine DEP, KCSWCD, landowners, road associations, businesses, and private donors.

Many of these partners have worked together for over 20 years. Accomplishments include developing and implementing the 2009 Long Pond Watershed-Based Management Plan, which included Great Pond; conducting four 319 implementation grants on Great Pond and Long Pond since 2009; and developing this 2021 Great Pond Watershed-Based Management Plan. 7 Lakes, BLA, and local towns also have a long track record of working together on other large, successful programs including the STOP MILFOIL campaign (2012-present), the Youth Conservation Corps (1996-present), Courtesy Boat Inspections (2007-present), and other programs.

There are a number of opportunities for acquiring funding to support implementation of the watershed management plan. The list below contains a few of the better-known State and Federal funding options. Additional support from private foundation grants, local fundraising efforts, monetary contributions by participating landowners, and financial support from municipal partners will be needed to adequately fund this plan.

- Maine DEP Courtesy Boat Inspection (CBI) Program Grants – A cost-share program to help fund locally-supported CBI programs. For more information: https://www.maine.gov/dep/water/grants/invasive/index.html

- Maine DEP Invasive Aquatic Plant Removal Grants – Administered by Maine DEP to assist communities planning and managing removal of invasive aquatic plant infestations. For more information: https://www.maine.gov/dep/water/grants/invasive/index.html

- Maine DEP Small Community Grant Program (SCG) – Administered by Maine DEP, this program provides grants to Municipalities to help replace malfunctioning septic systems that are polluting a waterbody or causing a public nuisance. For more information: https://www.maine.gov/dep/water/grants/scgp.html

- Maine DEP Stream Crossing Upgrade Grant Program – A competitive grant program for the upgrade of municipal culverts and stream crossings that improve fish and wildlife habitats and improve community safety. For more information: https://www.maine.gov/dep/land/grants/stream-crossing-upgrade.html

- Maine DOT's Municipal Partnership Initiative (MPI) – This program funds projects of municipal interest on state infrastructure working with Maine DOT as a partner to develop, fund, and build the project. For more information: https://www.maine.gov/mdot/pga/

- Maine Natural Resource Conservation Program (MNRCP) – A cooperative program between Maine DEP and US Army Corps of Engineers, administered by The Nature Conservancy, funding the restoration, enhancement, preservation, and creation of wetland habitat. For more information: https://www.maine.gov/dep/land/nrpa/ILF_and_NRCP/index.html

- US EPA Clean Water Act (Section 319) Watershed Nonpoint Source (NPS) Grant Program – Administered by Maine DEP, 319 grants assist communities implementing a watershed-based management plan for waters named on Maine DEP's NPS Priority Watershed List. For more information: https://www.maine.gov/dep/water/grants/319.html

10. References

7 Lakes Alliance (2020a). Great Pond Gloeotrichia Monitoring Summary 2015-2020. Danielle Wain, Lake Science Director.

7 Lakes Alliance (2020b). Great Pond Plankton Data Summary. Danielle Wain, Lake Science Director.

7 Lakes Alliance (2020c). Great Pond Water Quality Summary 2015-2020. December 2020. Danielle Wain, Lake Science Director.

Bacon, Linda (2016). Harmful Algal Blooms and Cyanotoxins in Maine. Maine Lakes Society Annual Meeting (PowerPoint), June 25, 2016.

Beginning with Habitat (n.d.). Focus Area of Statewide Ecological Significance- Belgrade Esker and Kettle Complex. Accessed Online: https://www.maine.gov/dacf/mnap/focusarea/belgrade_esker_kettle_complex_focus_area.pdf

Belgrade Lakes Association (2019). 2018 Great Pond Watershed Survey Report. January 2019. 111 pp.

Boyle, Kevin and Roy Bouchard (2003). Water Quality Effects on Property Prices in Northern New England. Lakeline 23(3), pp. 24-27.

Collins, Stephen (2003) "The Great Mudpuppy Escape (sort of)," Colby Magazine: Vol. 92 : Iss. 4 , Article 6. https://digitalcommons.colby.edu/colbymagazine/vol92/iss4/6

Deeds, Amirbahman, Norton & Bacon (2020): A hydrogeomorphic and condition classification for Maine, USA, lakes, Lake and Reservoir Management. https://doi.org/10.1080/10402381.2020.1728597

Ecological Instincts (2020a). Great Pond Lake Loading Response Model Results. December 2020. 23 pp.

Ecological Instincts (2020b). Great Pond Preliminary WQ Analysis. Prepared for April 22, 2020 Technical Advisory Committee Meeting.

FBE, 2009a. Buildout Analysis; Long Pond & Great Pond Watersheds. September 2009. 36 pp.

FBE, 2009b. Long Pond Municipal Ordinance Review; Linking Development Rules to Water Quality Protection. September 2009. 39 pp.

Kennebec County Soil & Water Conservation District (2009). Long Pond Watershed-Based Management Plan. December 2009. 171 pp.

King, Whitney (2020). Great Pond Sediment Analysis Summary. December 2020.

King & Laliberte (2005). Analysis of the Effects of Gloeotrichia echinulate on Great Pond and Long Pond, Maine. May 12, 2005. Accessed Online: http://www.colby.edu/chemistry/Gloeotrichia/Gloeotricia%20Review%202005.pdf

Lake Stewards of Maine. Gloeotrichia. Accessed Online: https://www.lakestewardsofmaine.org/programs/other-programs/gloeotrichia/#:~:text=Gloeotrichia%20(pronounced%20%E2%80%9Cglee%2Doh,summer%2C%20in%20relatively%20low%20densities.

Lake Stewards of Maine (2020). Distribution of Water Quality Data, Figure 8. Distribution of Trophic State Index in Maine Lakes from Transparency Data. Accessed Online: https://www.lakestewardsofmaine.org/distribution-of-water-quality-data/

Loon Conservation Associates (LCA) (2020). Belgrade Lakes Common Loon Monitoring Summary Report. Prepared by Lee Attix. December 2, 2020. Accessed Online: https://www.belgradelakesassociation.org/Portals/0/PDFs/General/2020%20-%20BLA%20COLO%20Summary%20Report.pdf?ver=2020-12-02-192934-393

Maine Audubon, 2006. Conserving Wildlife in Maine's Shoreland Habitats. https://www.maine.gov/ifw/docs/MEAud-Conserving-Wildlife-Shoreland-Habitats.pdf

Maine Audubon, 2020. Audubon Loon Counts: Maine, 1983-2020. http://www.gulfofmaine.org/kb/2.0/record.html?recordid=9175

Maine Climate Council (MCC) Scientific and Technical Subcommittee (2020). Scientific Assessment of Climate Change and Its Effects in Maine. August 2020. 130pp. https://www.maine.gov/future/sites/maine.gov.future/files/inline-files/GOPIF_STS_REPORT_092320.pdf

Maine DEP (2008). Phosphorus Control Action Plan and Total Maximum Daily Load (TMDL) Report for Long Pond- Belgrade, Rome, and Mount Vernon, Kennebec County, Maine. Maine DEPLW-0888.

Maine DEP (2017a). Cyanobacteria (Blue-Green Algae). Accessed online: http://www.maine.gov/dep/water/lakes/cyanobacteria.html

Maine Department of Inland Fisheries & Wildlife, 2000. Great Pond Lake Survey and Map. Accessed online: https://www.maine.gov/ifw/docs/lake-survey-maps/kennebec/great_pond.pdf

Maine Department of Inland Fisheries & Wildlife (2020). 2020 Fish Stocking Reports. Accessed Online: https://www.maine.gov/ifw/fishing-boating/fishing/fishing-resources/fish-stocking-report.html

Maine Department of Marine Resources, Maine Rivers, & US Fish & Wildlife Service Gulf of Maine Program (2004). All about Maine Alewives. July 2004. Accessed online: https://www.fws.gov/gomcp/pdfs/alewife%20fact%20sheet.pdf

Maine Revised Statutes, §465-A. Standards for classification of lakes and ponds. Accessed online: http://legislature.maine.gov/statutes/38/title38sec465-A.html

Maine State Economist, Department of Administrative and Financial Services (2018a). "Maine Population Outlook 2016 to 2026". https://www.maine.gov/dafs/economist/sites/maine.gov.dafs.economist/files/inline-files/Maine%20Population%20Outlook%20to%202026.pdf

Maine State Economist, Department of Administrative and Financial Services (2018b). "Maine State and County Population Projections 2036". *Demographic Projections – Data Files*. https://www.maine.gov/dafs/economist/sites/maine.gov.dafs.economist/files/inline-files/MaineStateCountyPopulationProjections2036.pdf

Maine State Economist, Department of Administrative and Financial Services (2018c). "Maine City and Town Population Projections 2036". *Demographic Projections, Data Files*. https://www.maine.gov/dafs/economist/sites/maine.gov.dafs.economist/files/inline-files/MaineCityTownPopulationProjections2036.pdf

Matthew Scott et al. (2010). Crayfish records in Maine from 1939-2003 and 2001-2004. Accessed Online: http://www.gulfofmaine.org/kb/2.0/record.html?recordid=9677

Rothschild, Harriet T., "The Effect of Cyanobacterium Gloeotrichia echinulata in the Belgrade Lakes, Maine" (2016). *Honors Theses.* Paper 829. https://digitalcommons.colby.edu/honorstheses/829

Sarnacki, A. (2019, October 16). The largest amphibians in Maine have invaded its lakes and ponds. Bangor Daily News. Accessed Online: https://bangordailynews.com/2019/10/16/act-out/the-largest-amphibians-in-maine-have-invaded-its-lakes-and-ponds/

Shute & Wilson (2013), University of Southern Maine. Metaphyton in Our Maine Lakes.Accessed online: https://belgradelakesassociation.org/Portals/0/PDFs/Resources%20Water%20Quality/Metaphyton%20Algae/Metaphyton-by-Shute-2013.pdf

US EPA (2019). Recommended Human Health Recreational Ambient Water Quality Criteria or Swimming Advisories for Microcystins and Cylindrospermopsin. EPA Document Number: 822-R-19-001. May 2019. Accessed online:

https://www.epa.gov/sites/production/files/2019-05/documents/hh-rec-criteria-habs-document-2019.pdf

US EPA (2017a). Nutrient Policy and Data; Cyanobacteria/Cyanotoxins. Accessed online: https://www.epa.gov/cyanohabs/learn-about-cyanobacteria-and-cyanotoxins

VLMP (2013) Chinese Mystery Snail Sightings. Accessed Online: http://www.gulfofmaine.org/kb/2.0/record.html?recordid=9788

WRS, Inc. (2021). Internal Load Estimates for phosphorus in Great Pond. January 10, 2021.

APPENDIX A. GREAT POND NPS SITES

GREAT POND NPS SITES

Impact of NPS Sites: The impact rating is an indicator of how much soil and phosphorus erodes into the lake from a given site. Factors such as slope, soil type, amount and severity of eroding soil, and buffer size are considered. Generally, low impact sites are those with limited transport of soil off-site, medium impact sites exhibit sediment transportation off-site, but the erosion does not reach high magnitude, and high impact sites are those with large areas of significant erosion and direct flow to water.

Site	Location	Flow into lake via	Land Use	Problems	Slope	Size of Exposed/ Eroded Area	Recommendations	Impact	Cost	Technical Level
1-01	Gravel Road	not determined	Commercial; Gravel Pit or Logging (Log Yard); Construction	Surface Erosion - Moderate; Soil - Bare	Moderate	100x50+	Seed/hay	Low	Low	Low
1-02	Wooster Hill Road (CMP 516)	Ditch, Minimal Vegetation	Driveway; New construction	Culvert - Unstable inlet/outlet, undersized (too high?); Soil - bare	Flat		Culvert - Enlarge, and/or lower height; Roads/Driveways - Reshape (crown) vegetate shoulder; Construction site - Silt Fence/EC Berms	Low	Low	Low
1-03	Camp road	Stream	Private Road	Surface Erosion - moderate; road Shoulder Erosion - Slight; Roadside Plow/Grader Berm	Moderate	Entire road	Ditch - install turnouts; Roads/Driveways - Remove Grader/plow berms; add new surface material: gravel; Reshape (Crown); Install Runoff Diverters: broad-based dip	Med	Med	Med
1-04	Homestead Road, intersection with private drive, realtor's sign	Stream	Private Road	Surface Erosion - Severe	Steep	50x15	Ditch- Install ditch; Roads/Driveways - Add new surface material: gravel; reshape (crown); Other - Install runoff diverter (waterbar)	Med	Med	Med

Site	Location	Flow into lake via	Land Use	Problems	Slope	Size of Exposed/ Eroded Area	Recommendations	Impact	Cost	Technical Level
2-01	71 Crystal Spring Lane	Minimal vegetation	Residential	Surface Erosion - slight; Soil - bare; Shoreline - Undercut, Inadequate shoreline vegetation, erosion	Moderate	50x10	Paths & Trails - Stabilize foot path; Roof Runoff - Infiltration trench at roof dripline; Other - Mulch/ECM, Rip rap; Vegetation - Add to/extend buffer, no raking, reseed bare soil & thinning grass	Low	Med	Med
2-02	56 Hillside Lane	Directly into lake	Residential	Surface Erosion - slight; Soil - Bare; Shoreline - Inadequate shoreline vegetation, erosion	Moderate	5x6	Other - Mulch/ECM; Vegetation - Add to/extend buffer, reseed bare soil & thinning grass	Low	Low	Low
2-03	74 Hillside Lane	Directly into lake	Residential	Surface erosion-moderate; Soil - bare; Shoreline - Inadequate shoreline vegetation, erosion	Moderate	50x15	Paths & Trails - Define foot path, infiltration steps; Mulch/ECM; Vegetation - Add to/extend buffer, no raking, reseed bare soil & thinning grass (nothing grew)	Med	Med	Med
2-04	75 Hillside Lane	Minimal vegetation	Residential	Surface erosion - Slight; Soil - bare; Roof runoff erosion; Shoreline - inadequate shoreline vegetation, erosion	Moderate	12x3	Roof runoff - infiltration trench at roof dripline; Other - Mulch/ECM; Vegetation - add to/extend buffer, no raking	Low	Low	Low
2-05	71 Hillside Lane	Directly into lake	Residential	Surface erosion - moderate; Soil - bare; Shoreline - undercut, lack of shoreline vegetation, erosion	Moderate	30x30	Other - Mulch/ECM, rip rap; Vegetation - establish buffer, no raking, reseed bare soil & thinning grass	Med	Low	Low
2-06	67 Hillside Lane	Minimal vegetation	Residential	Surface erosion - slight; Soil - Uncovered pile; Roof runoff erosion; Shoreline - erosion (back of camp)	Flat	20x8	Roof runoff - infiltration trench at roof dripline (dripline edge); Other - Mulch/ECM (cover dirt pile)	Low	Low	Low

Site	Location	Flow into lake via	Land Use	Problems	Slope	Size of Exposed/ Eroded Area	Recommendations	Impact	Cost	Technical Level
2-07	65 Hillside Lane	Minimal vegetation	Residential	Surface Erosion - slight; Soil - bare; Shoreline - Undercut, Inadequate shoreline vegetation, erosion	Moderate	10x10; shoreline 2x40	Paths & Trails - Define foot path, infiltration steps, ECM; Other - Mulch/ECM, Rip Rap; Vegetation - Establish Buffer	Med	Low	Low
2-08	57 Hillside Lane	Minimal vegetation	Residential	Surface erosion - slight; Roof Runoff Erosion	Flat	2x100	Roof Runoff - Infiltration trench at roof dripline; Other - Mulch/ECM, Rain garden; Vegetation - No raking?	Low	Med	Med
2-09	200 Feet from Rome Rd on Crystal Spring Lane	Stream	Town Road	Culvert - Unstable Inlet/Outlet	Steep	10x10	Culvert - Armor inlet/outlet	Low	Med	Med
2-10	Rome Public Beach	Directly into lake	Municipal/ Public; Beach Access	Surface erosion - slight; Soil - Bare; Shoreline - erosion; Other - Invasive plants on shoreline (multiflora rose)	Moderate	5x10, 20x30	Other - Mulch/ECM; Vegetation - Add to/extend buffer, reseed bare soil & thinning grass (too dry)	Med	Med	Low
2-11	Hoyt Island Camps Public Docks	Minimal vegetation	Commercial; Boat Access (not a launch, docks only)	Surface erosion - slight; Soil - Bare	Moderate	30x20	Roads/Driveways - Add new surface material (finish crushed rock project??), rubber razor (already exists); Other - Maintain/clean out rubber razor, Mulch/ECM	Med	Low	Low
2-12	124 Nickerson Lane	Directly into lake	Residential	Surface erosion - moderate; Soil - bare; Shoreline - inadequate shoreline vegetation, erosion	Moderate	10x30 inter-mittent	Roof runoff - roof dripline, gutter downspout; Other - Rip rap; Vegetation - Add to/extend buffer (will it grow?)	Med	Low	Low

Site	Location	Flow into lake via	Land Use	Problems	Slope	Size of Exposed/ Eroded Area	Recommendations	Impact	Cost	Technical Level
2-13	Nickerson Lane	Directly into lake	Residential	Surface Erosion - slight; Soil - bare; Shoreline - Inadequate shoreline vegetation	Moderate	10x10	Paths & Trails - ECM; Roof runoff - Infiltration at roof dripline; Other - Mulch/ECM (cover bare soil, paths); Vegetation - Add to/extend buffer	Low	Low	Low
2-14	64 Nickerson Lane	Minimal vegetation	Driveway (gravel)	Ditch - Moderate erosion; Road Shoulder Erosion - Slight; Soil - Bare	Moderate	300	Ditch - Reshape ditch (too V, could be U), install check dams, install sediment pools (at the end of the ditch towards the water)	High	Med	High
2-15	40 Robbins Lane	Directly into lake	Residential	Shoreline - Undercut	Moderate	2x6	Other - Rip rap	Med	Low	Low
2-16	42 Robbins Lane	Directly into lake	Residential	Shoreline - Inadequate shoreline vegetation, erosion	Moderate	8x2	Other - Rip rap; Vegetation - Add to/extend buffer (access to water?)	Low	Low	Low
2-17	Rome Road #13 Pole	Minimal vegetation	State Road	Surface erosion - Slight; Ditch - Slight erosion; Soil - Bare, Delta in Stream, winter sand; Shoreline - erosion (stream); Other - Invasive plants (near road, stream; knot weed)	Moderate	25x2	Ditch - Armor with stone, install check dams; Other Suggestions - Remove invasive plants	Low	Med	Med
2-18	Perennial Stream between Nickerson and Frederick's Lane	Stream	State Road	Culvert - Undersized; Road Shoulder Erosion - Moderate; Soil - Winter sand	Steep	35x15; both sides of road	Culvert - Enlarge, lengthen; Ditch - Vegetate, armor with stone; Roads/Driveways - Vegetate Shoulder	Med	High	High

Site	Location	Flow into lake via	Land Use	Problems	Slope	Size of Exposed/ Eroded Area	Recommendations	Impact	Cost	Technical Level
2-19	Rte 225, Rome Road, Corner of Crystal Springs & Robbins Mill Stream	Stream	State Road	Surface Erosion - Moderate; Soil - bare (sand), winter sand	Flat	20x40	Roads/Driveways - Add new surface material: gravel, blue stone gravel, Install Detention wall, Install runoff diverters	Med	High?	High
3-01	83 Crystal Spring Lane	Directly into lake	Residential	Surface erosion - Slight; Soil - Bare; Shoreline - Lack of Shoreline vegetation, erosion, unstable access	Moderate	10x5	Other - Mulch/ECM, rip rap; Vegetation - Add to/extend buffer (access), reseed bare soil & thinning grass	Low	Low	Low
3-02	76 Crystal Spring Lane	Directly into lake	Residential: beach access, boat access	Surface erosion - moderate; Soil - bare; Shoreline - Lack of shoreline vegetation, erosion	Moderate	60x15	Roads/Driveways - Add new surface material: gravel, install runoff diverters: open to culvert; Vegetation - Extend buffer	Med	Med	Med
3-03	93 Crystal Spring Lane	Directly into lake	Residential	Surface erosion - moderate; Soil - bare; Shoreline - Lack of shoreline vegetation, erosion, erosion, unstable access (behind dock)	Steep	12x10	Other - Mulch/ECM, rip rap; Vegetation - Add to/extend buffer	Low	Low	Low
3-04	125 Crystal Spring Lane	Directly into lake	Residential	Surface erosion - Moderate; Soil - Bare; Shoreline - Undercut, inadequate shoreline vegetation (will anything grow? Slight berm), erosion	Steep	20x3 east side, shoreline 8x6, west side 15x15	Paths & Trails - ECM; Roof Runoff - Infiltration trench at roof dripline; Other - Mulch/ECM, rip rap; Vegetation - add to/extend buffer?	Med	Low	Low: Med
3-05	175 Crystal Spring Lane	Directly into lake	Residential	Surface Erosion - Moderate; Shoreline -	Steep	10x4	Other - Mulch/ECM, Rip rap; Vegetation - Add to/extend buffer (will it grow?)	Low	Low	Low

Site	Location	Flow into lake via	Land Use	Problems	Slope	Size of Exposed/ Eroded Area	Recommendations	Impact	Cost	Technical Level
				Inadequate Shoreline vegetation, erosion						
3-06	171 Crystal Spring Lane	Directly into lake	Residential	Surface erosion - slight; Soil - Bare; Shoreline - Inadequate shoreline vegetation, erosion; Other - Invasive plants on shoreline (knotweed)	Steep	35x4	Other - Mulch/ECM, rip rap; Vegetation - Add to buffer	Low	Low	Low
3-07	169 Crystal Spring Lane	Directly into lake	Residential	Soil - Bare; Shoreline - Inadequate Shoreline Vegetation, erosion	Steep	7x5	Other - Rip rap; Vegetation - Add to/extend buffer	Low	Low	Low
3-08	Culvert/perennial stream between 165 & 187 Crystal Spring Lane	Directly into lake	Residential	Surface Erosion - Slight; Ditch - Slight erosion; Soil - bare	Moderate	20x5	Culvert - Install Plunge Pool (I/O): Armor with stone	Low	Med	Med
3-09	163 Crystal Spring Lane	Directly into lake	Residential	Surface Erosion - Slight; Soil - Bare	Steep	4x10	Other - Mulch/ECM; Vegetation - Add to/Extend Buffer	Low	Low	Low
3-10	157 Crystal Spring Lane	Minimal vegetation	Residential	Soil - Bare; Shoreline - Inadequate Shoreline Vegetation, erosion	Moderate	15x4	Other - Mulch/ECM, rip rap; Vegetation - Add to/extend buffer	Low	Low	Low
3-11	145 Crystal Spring Lane	Directly into lake	Residential: Beach access	Surface Erosion - Moderate; Soil - Bare (sand beach rills); Shoreline - Erosion; Other - Invasive plants on shoreline	Moderate	8x4	Other Suggestions - Remove invasive plants; Other - Mulch/ECM (under temp deck); Vegetation - Add to/Extend buffer	Med	Low	Low

Site	Location	Flow into lake via	Land Use	Problems	Slope	Size of Exposed/ Eroded Area	Recommendations	Impact	Cost	Technical Level
				(knotweed, 50% of frontage)						
3-12	141 Crystal Spring Lane	Directly into lake	Residential	Surface erosion - slight; Soil - Bare; Shoreline - Erosion	Steep	15x6 (wider steps as well)	Other - Mulch/ECM; Vegetation - Establish buffered (on west side of dock stairs), reseed bare soil and thinning grass	Low	Low	Low
3-13	Between 133 & 135 Crystal Spring Lane	Stream	Residential	Shoreline - Undercut, erosion	Moderate	40x3	Ditch - Armor with stone: rip rap (stream banks)	High	Med	Med
4-01	200 Hathaway Lane	Directly into lake	Driveway (gravel); Trail or Path	Surface erosion - Slight; Soil - bare	Moderate	3x10	Roads/Driveways - Install Runoff diverters: Rubber razor (needs another one); Paths & Trails - Stabilize foot path	Med	Med	Med
4-02	174 Hathaway Lane	Directly into lake	Trail or Path (Residential)	Surface erosion - Slight; Soil - bare; Shoreline - Inadequate Shoreline vegetation	Moderate	10x5	Paths & Trails - Stabilize Foot Path; Vegetation - add to/extend buffer	Low	Low	Low
4-03	166 Hathaway Lane	Directly into lake	Trail or Path (Residential)	Surface erosion - moderate; Soil - bare; Shoreline - Lack of Shoreline vegetation	Moderate	30x12	Paths & Trails - Install runoff diverter (waterbar); Vegetation - Establish buffer	Med	Med	Med
4-04	148 Hathaway Lane	Directly into lake	Driveway (gravel), residential	Surface erosion - Severe; Soil - Bare; Shoreline - Inadequate shoreline vegetation	Moderate	100x15	Roads/Driveways - Reshape (crown), install runoff diverters	High	Med	Med
4-05	Hathaway Lane running into #148	Directly into lake	Private Road	Surface erosion - moderate; Soil - bare	Moderate	150x15	Roads/Driveways - Build up, add new surface material, Install runoff diverters: broad-based dip	Med	Med	Med

Site	Location	Flow into lake via	Land Use	Problems	Slope	Size of Exposed/ Eroded Area	Recommendations	Impact	Cost	Technical Level
4-06	132 Hathaway Lane	Directly into lake	Residential	Surface erosion - slight; Soil - bare; Shoreline - Lack of shoreline vegetation	Moderate	Large areas	Other - Mulch/ECM; Vegetation - Establish buffer, reseed bare soil & thinning grass	Med	Med	Med
4-07	3 Delisle Lane	Directly into lake	Residential: Driveway	Surface erosion - moderate; Soil - bare; Shoreline - Inadequate shoreline vegetation	Moderate	75x15	Roads/Driveways - Add new surface material, install runoff diverters	Med	Med	Med
4-08	15 Delisle Lane	Directly into lake	Residential	Soil - Bare	Flat	40x90	Other - Mulch/ECM	Med	Low	Low
4-09	78 York Lane	Directly into lake	Residential	Soil - Bare	Flat	15x15	Other - Mulch/ECM	Low	Low	Low
4-10	134 Golden Pond	Directly into lake	Driveway	Surface erosion - slight	Moderate	50x12	Roads/Driveways - Add new surface material: Blue stone gravel, reshape (crown), Install runoff diverters	Med	Med	Med
5-01	North Crane Ln	Ditch	Private road (gravel)	Ditch erosion	Flat	2000x3	Enlarge ditch, armor culvert inlet/outlet, replace rusted culverts	High	High	High
5-02	South Crane Ln	Ditch	Private road (gravel)	Ditch erosion	Flat	600x3	Enlarge ditch, armor culvert inlet/outlets	High	High	Med
7-01	764 Horse Point Rd.	Directly into lake	Residential (shoreline)	Surface erosion - slight; Soil - bare; Shoreline - erosion	Moderate	4x5	Other Suggestions - Armor with stone or vegetate; Other - Mulch/ECM, Rip Rap; Vegetation - Add to/extend buffer	Low	Low	Low

Site	Location	Flow into lake via	Land Use	Problems	Slope	Size of Exposed/ Eroded Area	Recommendations	Impact	Cost	Technical Level
7-02	742 Horse Point Rd.	Directly into lake	Trail or Path; Beach Access	Soil - bare; Shoreline - Lack of shoreline vegetation	Moderate	30x20	Paths & Trails - Define foot path, stabilize foot path; Other - Mulch/ECM; Vegetation - Add to/extend buffer	Low	Low	Low
7-03	716 Horse Point Rd.	Directly into lake	Boat Access (old, used for docks & kayaks)	Surface erosion - slight; Soil - bare; Shoreline - erosion	Moderate	10x20	Roads & Driveways - Add new surface material: blue stone gravel, Install Runoff Diverters: Rubber Razor	Low	Low	Med
7-04	686 Horse Point Rd.	Directly into lake	Residential	Surface erosion - slight; Soil - bare	Moderate	40x15	Paths & Trails - Erosion control mulch	Med	Low	Low
7-05	7 Pearl Drive	Directly into lake	Residential	Surface erosion - slight; Soil - bare (some); Shoreline - Lack of shoreline vegetation	Moderate	30x25	Other - Mulch/ECM; Vegetation - Establish buffer (allow vegetation to grow up), reseed bare soil & thinning grass	Med	Low	Med
7-06	13 Julie's Way	Directly into lake	Residential	Surface erosion - slight; Soil - bare	Flat	10x10	Paths & Trails - Define foot path, erosion control mulch; Vegetation - establish buffer	Low	Low	Low
7-07	13 S. Pine Beach Rd.	Directly into lake	Residential	Surface erosion - slight; Soil - bare; Shoreline - erosion	Steep	6x10	Ditch - Vegetate; Other Suggestions - Retaining wall and cover bare soil; Roads/Driveways - Install Runoff diverters: rubber razor; Paths & Trails - Erosion control mulch; Other - Install runoff diverter (waterbar)	Med	Med	Med

Site	Location	Flow into lake via	Land Use	Problems	Slope	Size of Exposed/ Eroded Area	Recommendations	Impact	Cost	Technical Level
7-08	104 Pine Beach Road	Directly into lake	Construction site (Residential)	Roof runoff erosion	Flat	5x15	Roof Runoff- Infiltration trench at roof driplines; Other - Add to/extend buffer, reseed bare soil and thinning grass	Low	Low	Low
7-09	78 Pine Beach Road	Directly into lake	Residential	Surface erosion - slight; Soil - bare; Shoreline - erosion	Flat	20x15	Other - Install runoff diverter (waterbar), mulch/ECM	Low	Low	Low
7-10	72 Pine Beach Road	Directly into lake	Residential	Surface erosion - slight; Soil - bare; Shoreline - erosion	Flat	30x10	Paths & Trails - Erosion control mulch; Roof runoff - Drywell at gutter downspout; Other - Install runoff diverter (waterbar), Mulch/ECM; Vegetation - no raking	Med	Low	Low
7-11	66 Pine Beach Road	Directly into lake	Residential	Surface erosion - slight; Soil - Bare; Shoreline - Lack of shoreline vegetation	Flat	20x60	Paths & Trails - Define foot path; Roof runoff - Infiltration Trench at roof dripline; Other - Mulch/ECM; Vegetation - establish buffer	Low	Low	Low
7-12	54 Pine Beach Road	Directly into lake	Residential	Surface erosion - slight; Soil - bare; Shoreline - Lack of shoreline vegetation	Moderate	10x5	Other: Mulch/ECM or reseed bare soil & thinning grass; Vegetation - Add to/extend buffer	Low	Low	Low
7-13	48 Pine Beach Road	Minimal Vegetation	Residential	Surface erosion - moderate; Soil - Bare; Roof runoff erosion (contributing); Other - Driveway runoff causing erosion near shoreline	Moderate	10x10	Roof Runoff - Infiltration Trench at roof dripline back of house; Other - Mulch/ECM, rain garden (at base ditch); Vegetation - Reseed bare soil and thinning grass	Low	Low	Med

Site	Location	Flow into lake via	Land Use	Problems	Slope	Size of Exposed/ Eroded Area	Recommendations	Impact	Cost	Technical Level
7-14	44 Pine Beach Road	Directly into lake	Residential	Surface erosion - slight; Soil - bare; Roof runoff erosion; Shoreline - Inadequate shoreline vegetation	Steep	30x20	Paths & Trails - Infiltration steps; Roof Runoff - Infiltration trench at roof dripline, drywell at gutter downspout; Other - Mulch/ECM; Vegetation - Add to/extend buffer, No raking	Med	Med	Med
7-15	Camp Bomazeen-656 Horse Point Road	Directly into lake	Commercial	Surface erosion - Moderate; Soil - Bare, uncovered pile; Roof runoff erosion; Shoreline - Inadequate shoreline vegetation, unstable access; Other-lots of unused poorly maintained roads on steep slopes are eroding.	Steep	Multiple Areas across large parcel	Roads & Driveways - Add new surface material: blue stone gravel, reshape (crown), Install Runoff Diverters: Rubber Razor; Paths & Trails: Erosion Control Mulch; Roof Runoff: Infiltration Trench @ roof dripline; Vegetation: Add to/extend buffer, No Raking; Reseed bare soil & thinning areas; Other- Develop a Road Management Plan to minimize the effects of unused and poorly maintained roads, revegetate underused roads and vegetate or create narrow walking paths with ECM.	Med	High	Med
8-01	109 Merryweather Rd.	Minimal Vegetation	Private road, gravel	Surface erosion - moderate; soil bare	Steep	150x20	Roads/Driveways - Add new surface material: gravel, reshape (crown), Install runoff diverters: broad-based dip or rubber razor; Paths & Trails - Infiltration steps, install runoff diverter (waterbar), erosion control mulch (add to lower road); Other - Mulch/ECM (on paths)	Med	Med	Med

Site	Location	Flow into lake via	Land Use	Problems	Slope	Size of Exposed/ Eroded Area	Recommendations	Impact	Cost	Technical Level
8-02	9 & 10 Homeward Way	Directly into lake	Residential	Surface erosion - moderate; soil bare; Shoreline - Erosion, Unstable access	Moderate	60x16	Paths & Trails - Define foot path (access); Vegetation - Establish buffer; Other Suggestions - Install retaining structure to retain soil	Med	Med	Med
8-03	17 Harvey Way	Directly into lake	Residential	Surface erosion - slight; Soil - bare; Roof runoff erosion	Flat	15x5	Paths & trails - install runoff diverter (waterbar), ECM; Roof Runoff - Infiltration trench at roof dripline, drywell at gutter downspout; Other suggestions - Install retention areas in front of dock storage area	Low	Low	Low
8-04	19 Harvey Way	Directly into lake	Residential	Surface erosion - moderate; Soil - bare; Roof runoff erosion	Moderate	100x20	Roof runoff - Drywell at gutter downspout; Other Suggestions - Retaining device along high water beach, mulch common areas	High	Med	Med
8-05	12 Johns Way	Directly into lake	Residential	Surface erosion - moderate; soil - bare; Shoreline - Inadequate shoreline vegetation, erosion, unstable access	Moderate	150x10	Paths & Trails - Infiltration steps (access area, 1-2 steps); Other Suggestions - Stabilize edge of cut bank with retainer device at top high water mark on beach	Med	Med	Med
8-06	12 Johns Way in part	Directly into lake	Residential: starts at culvert on Horse Point Road	Other: Eroding stream channel at beach	Flat	20 linear feet along drainage	Other Suggestions - Stabilize eroding banks and create outlet w/ overflow	High	High	High
8-07	26 Brook Drive	Directly into lake	Residential	Surface erosion - Slight; Soil - bare; Shoreline- Erosion, unstable access	Flat	10x5	Paths & Trails - Infiltration steps; Other - Mulch/ECM; Vegetation - Reseed bare soil & thinning grass	Low	Low	Low

Site	Location	Flow into lake via	Land Use	Problems	Slope	Size of Exposed/ Eroded Area	Recommendations	Impact	Cost	Technical Level
8-08	Withers Way	Directly into lake	Residential	Surface erosion - slight; Soil - bare; Shoreline - Lack of shoreline vegetation, erosion; Other - Invasive plants on shoreline over large sandy beach	Flat	40x30	Paths & Trails - Define foot path; Other - Rain garden; Vegetation - Establish buffer; Other Suggestions - Install sand retaining structure and vegetate behind first trees	Low	Low	Low
8-09	13 Dragonfly Lane	Directly into lake	Residential (multi unit)	Surface erosion - slight; Soil - bare; Shoreline - Unstable access	Flat	5x5 (x2)	Paths & Trails - Infiltration steps, ECM; Other Suggestions - 4"x4" across beach accesses	Low	Low	Low
8-10	25 Speckle Drive	Directly into lake	Beach Access: Residential	Surface erosion - slight; Soil - bare; Shoreline - Lack of shoreline vegetation, erosion, unstable access	Moderate	10x5	Paths & Trails - waterbar; Vegetation - Establish buffer; Other suggestions - replace rotten timber to hold soil and vegetate berm	Low	Low	Low
9-01	140 Snug Harbor Road	Directly into lake	Trail or path	Surface erosion - Moderate	Moderate	10x2	Paths & Trails - Infiltration steps, install runoff diverter (waterbar), ECM	Low	Low	Med
9-02	134 Snug Harbor Road	Directly into lake	Beach access	Soil - Bare; Shoreline - Inadequate shoreline vegetation, erosion	Moderate	5x10	Construction site - mulch; Other - Rip rap; Vegetation - Add to/extend buffer	Low	Low	Low
9-03	130 Snug Harbor Road	Directly into lake	Trail or path	Surface erosion - moderate; Soil - bare; Shoreline - Erosion	Moderate	10x15	Paths & Trails - Infiltration steps, ECM; Other - Mulch/ECM	Low	Low	Low

Site	Location	Flow into lake via	Land Use	Problems	Slope	Size of Exposed/ Eroded Area	Recommendations	Impact	Cost	Technical Level
9-04	122 Snug Harbor Road	Directly into lake	Trail or path	Soil - Bare; Shoreline - Lack of shoreline vegetation, erosion	Moderate	20x20	Paths & Trails - stabilize foot path, infiltration steps; Other - Mulch/ECM, Rip rap; Vegetation - Establish buffer, no raking	Low	Med	Med
9-05	122 Snug Harbor Road	Directly into lake	Residential	Surface erosion - Moderate; Soil - Bare; Shoreline - Undercut, lack of shoreline vegetation, inadequate shoreline vegetation, erosion, unstable access	Moderate	20x30	Paths & Trails - Define foot path; Other - Mulch/ECM, rain garden, rip rap; Vegetation - establish buffer	Med	Med	Med
9-06	120 Snug Harbor Road	Directly into lake	Trail or path	Surface erosion - Moderate; Soil - Bare; Shoreline - Undercut, lack of shoreline vegetation, inadequate shoreline vegetation, erosion	Moderate	75x30	Roads/Driveways - Add new surface material: Blue stone gravel; Paths & Trails - ECM; Other - Mulch/ECM, rain garden, rip rap; Vegetation - Establish buffer, no raking	Med	Med	Med
9-07	120 Snug Harbor Road	Directly into lake	Driveway	Surface erosion - moderate; Soil - bare	Moderate	100x50	Ditch - Remove debris/sediment; Roads/Driveways - Add new surface material: Gravel, Blue Stone Gravel; vegetate shoulder, install runoff diverters: rubber razor and waterbar; Paths & Trails - ECM; Other - Infiltration trench; Vegetation - Add to/extend buffer	High	High	Med

Site	Location	Flow into lake via	Land Use	Problems	Slope	Size of Exposed/ Eroded Area	Recommendations	Impact	Cost	Technical Level
9-08	116 Snug Harbor Road	Directly into lake	Residential	Surface erosion - moderate; soil - bare; Shoreline - undercut, lack of shoreline vegetation	Moderate	20x20	Paths & Trails - Define foot path; Other - Mulch/ECM, rain garden, rip rap; Vegetation - establish buffer	Med	Med	Med
9-09	106-3 Snug Harbor Road	Directly into lake	Residential	Soil - bare; Shoreline - erosion	Moderate	25x10	Other - Mulch/ECM, rip rap	Low	Low	Low
9-10	94-4 Snug Harbor Road	Directly into lake	Residential	Soil - bare; Shoreline - undercut, erosion	Moderate	20x20	Paths & Trails - Define foot path, infiltration steps; Other - Mulch/ECM, rip rap	Low	Low	Low
9-11	94-6 Snug Harbor Road	Directly into lake	Residential	Soil - bare; Shoreline - erosion	Moderate	20x10	Paths & Trails - Infiltration steps, ECM; Other - Mulch/ECM; Vegetation - Establish buffer	Med	Med	Med
9-12	90 Snug Harbor Road	Directly into lake	Residential: Trail or Path	Soil - bare; Shoreline - erosion	Flat	10x10	Other - Mulch/ECM, rip rap; Vegetation - Add to/extend buffer	Low	Low	Med
9-13	90 Snug Harbor Road	Directly into lake	Residential: Beach Access	Soil - bare; Shoreline - undercut, erosion	Flat	5x20	Other - Mulch/ECM, rip rap; Vegetation - Establish buffer	Low	Low	Low
9-14	80 Snug Harbor Road	Directly into lake	Boat access (concrete)	Shoreline - erosion	Moderate	6x20	Technical Person to visit site and make recommendations	Unknown	Med	Med

Site	Location	Flow into lake via	Land Use	Problems	Slope	Size of Exposed/ Eroded Area	Recommendations	Impact	Cost	Technical Level
9-15	80 Snug Harbor Road	Directly into lake	Residential	Soil - Bare; Shoreline - Inadequate shoreline vegetation, erosion	Flat	25x15	Other - Mulch/ECM, rip rap; Vegetation - establish buffer (?)	Low	Low	Low
9-16	11 Gleason Shore Road	Directly into lake	Residential	Soil - Bare	Moderate	50x30	Paths & Trails - Define foot path, ECM; Other - Mulch/ECM	Med	Med	Low
9-17	13 Gleason Shore Road	Directly into lake	Residential	Soil - bare; Shoreline - erosion	Moderate	30x15	Paths & Trails - Install runoff diverter (waterbar), ECM; Other- Mulch/ECM; Vegetation - Add to/extend buffer	Low	Low	Low
9-18	23 Gleason Shore Road	Directly into lake	Residential	Soil - bare; Shoreline - Undercut, lack of shoreline vegetation, inadequate shoreline vegetation, erosion	Moderate	10x10	Paths & Trails - Define foot path, ECM; Other - Mulch/ECM, rain garden; Vegetation - Establish buffer	Med	Med	Med
9-19	23 Gleason Shore Road	Directly into lake	Residential	Soil - Bare; Shoreline - Inadequate shoreline vegetation, erosion, unstable access	Moderate	30x15	Paths & Trails - Define foot path, infiltration steps, ECM; Other - Mulch/ECM, rain garden; Vegetation - Add to/extend buffer	Med	Med	High
9-20	35 Gleason Shore Road	Directly into lake	Residential	Surface erosion - slight; Other - Steep grass slope that flows over concrete into water/lake	Steep	20x30	Paths & Trails - Install runoff diverter; Other - Rain garden, water retention swales; Vegetation - add to/extend buffer	Med	Med	Low

Site	Location	Flow into lake via	Land Use	Problems	Slope	Size of Exposed/ Eroded Area	Recommendations	Impact	Cost	Technical Level
9-21	43 Gleason Shore Road	Directly into lake	Boat access	Surface erosion - moderate; Soil - bare; Shoreline - Lack of shoreline vegetation, erosion	Steep	50x15	Roads/Driveways - Add new surface material: Gravel; Install runoff diverts: Rubber razor; Other - Mulch/ECM, Water retention swales; Vegetation - Add to/extend buffer	Med	Med	Med
10-01	83 Damren Road	Directly into lake	Beach Access (Residential)	Soil - Bare; Shoreline - Lack of shoreline vegetation, inadequate shoreline vegetation	Flat	10x10	Other - Mulch/ECM; Vegetation - Add to/extend buffer	Low	Low	Low
10-02	129 Loon Call Drive	Directly into lake	Residential	Soil - Bare; Other - Lots of concrete blocks	Flat	5x10	Paths & Trails - ECM; Other - Mulch/ECM; Other Suggestions - Remove large stones, put from flagstone & mulch	Low	Low	Low
10-03	79a Hatch Cove Road	Directly into lake	Residential	Shoreline - Undercut	Moderate	5x5	Other - Rip rap	Low	Low	High
10-04	75 Hatch Cove Road	Directly into lake	Residential	Surface erosion - moderate; Soil - bare; Other - Artificial grass at shoreline 15'x25'	Moderate	15x15	Roads & Driveways - Add new surface material: gravel; Other - Fill crevices more between granite block shoreline wall	Med	Low	Low
10-05	79 Hatch Cove Road	Directly into lake	Residential	Shoreline - Undercut	Flat	20x20	Other - Rip rap	Low	Med	Med
10-06	79 Hatch Cove Road	Directly into lake	Boat Access	Soil - Bare; Surface Erosion- Slight; Shoreline - Inadequate shoreline vegetation, erosion	Moderate	50x50	Other - Mulch/ECM, infiltration trench; Vegetation - Add to/extend buffer	Low	Med	Med

Site	Location	Flow into lake via	Land Use	Problems	Slope	Size of Exposed/ Eroded Area	Recommendations	Impact	Cost	Technical Level
10-07	87 Hatch Cove Road	Directly into lake	Residential	Soil - Bare; Shoreline - Inadequate shoreline vegetation, erosion	Moderate	20x30	Other - Mulch/ECM, infiltration trench; Vegetation - Add to/extend buffer	Low	Low	Low
10-08	93 Hatch Cove Road	Directly into lake	Residential	Soil - Bare; Shoreline - Lack of shoreline vegetation	Moderate	10x20	Other - Mulch/ECM, infiltration trench; Vegetation - Add to/extend buffer	Med	Low	Low
10-09	93 Hatch Cove Road	Directly into lake	Residential	Surface erosion - moderate; Soil - bare; Shoreline - lack of shoreline vegetation	Moderate	5x10	Other - Mulch/ECM, rip rap; Vegetation - add to/extend buffer	Low	Med	Med
10-10	93 Hatch Cove Road	Directly into lake	Residential	Surface erosion - slight; Soil - bare; Shoreline - lack of shoreline vegetation	Moderate	10x200	Other - Mulch/ECM; Vegetation - Establish buffer, add to/extend buffer	Med	High	Med
10-11	121 Hatch Cove Road	Directly into lake	Trail or Patch (Dock)	Surface erosion - slight; Soil - bare; Shoreline - Inadequate shoreline vegetation	Moderate	10x10	Paths & Trails - ECM	Low	Low	Low
10-12	125 Hatch Cove Road	Directly into lake	Boat access (some gravel)	Surface erosion - slight; Soil - bare	Moderate	5x10	Roads & Driveways - Add new surface material: gravel; Other - Mulch/ECM	Low	Low	Low
10-13	115 Hill Farm Road	Directly into lake	Residential: Boat access (wood)	Surface erosion - slight; Soil - bare	Moderate	10x15	Roads & Driveways - Add new surface material: gravel; Other - Mulch/ECM	Low	Low	Low
10-14	123 Hill Farm Road	Directly into lake	Residential	Soil - Bare; Shoreline - Lack of shoreline vegetation, erosion	Moderate	10x10	Other - Mulch/ECM; Vegetation - Add to/extend buffer	Low	Low	Low

Site	Location	Flow into lake via	Land Use	Problems	Slope	Size of Exposed/ Eroded Area	Recommendations	Impact	Cost	Technical Level
10-15	0 Hatch Cove Road	Directly into lake	Boat Access	Soil - Bare	Moderate	15x60	Roads & Driveways - Add new surface material: gravel; Other - Mulch/ECM	Med	Med	Low
10-16	Pine Island Road	Directly into lake	Commercial	Soil - Bare	Steep	10x10	Other - Mulch/ECM, Rain garden, water retention swales, rip rap; Vegetation - Establish buffer	Low	Low	Low
10-17	Pine Island Road	Directly into lake	Commercial	Soil - Bare; Shoreline - Lack of shoreline vegetation, inadequate shoreline vegetation	Moderate	15x15	Vegetation: Establish buffer	Med	Low	Low
10-18	234 Pine Island Road	Directly into lake	Residential	Soil - Bare; Shoreline - undercut, lack of shoreline vegetation	Steep	10x15	Other - Mulch/ECM, Rip rap	Low	Med	Med
11-01	Cyr Road	Ditch	Private road (road association)	Ditch - Moderate erosion (water from top of hill to culvert unchecked and down to diversion)	Steep	100x6	Culvert - Install plunge pool (I/O); Ditch - Install check dams; Roads/Driveways - Reshape (crown)	Med	Med	Med
11-02	571 Cyr Road	Directly into lake	Residential	Surface erosion - Severe; Roof runoff erosion	Moderate	100x20	Roads/Driveways - Install runoff diverters: waterbar to base of drive; Paths & Trails - Define foot path, stabilize foot path, infiltration steps, install runoff diverter (waterbar), ECM; Roof Runoff- Infiltration Trench @ roof dripline; Other - Mulch/ECM	High	Med	Med

Site	Location	Flow into lake via	Land Use	Problems	Slope	Size of Exposed/ Eroded Area	Recommendations	Impact	Cost	Technical Level
11-03	555 Cyr Road	Directly into lake	Residential: Construction Site, Boat Access	Surface erosion - Moderate; Shoreline - Undercut, lack of vegetation (by boat launch), erosion	Moderate	100x4	Paths & Trails - Define foot path, ECM (by shore); Other - Install runoff diverter (waterbar); Vegetation - Reseed bare soil & thinning grass	Med	Low	Med
11-04	559 Cyr Road	Directly into lake	Residential	Roof Runoff Erosion (some, most diverted into the woods plus mulch); Shoreline - Lack of shoreline vegetation, erosion	Flat	10x12	Roof runoff- Infiltration trench at roof dripline; Other - Mulch/ECM; Vegetation - Establish buffer, no raking	Med	Low	Low
11-05	551 Cyr Road	Minimal vegetation	Residential	Surface erosion - slight; Roof runoff erosion (small area by side steps but straight to lake)	Moderate	5x2	Paths & Trails - Define foot path (well worn by side of house), install runoff diverter (waterbar), ECM; Roof Runoff - Infiltration trench at roof dripline	Low	Low	Low
11-06	539 Cyr Road	Directly into lake	Residential; trail or path	Roof Runoff Erosion; Shoreline - Erosion (on path), Unstable access (by dock)	Moderate	1 spotty	Paths & Trails - Stabilize foot path, install runoff diverter (waterbar), ECM; Other - Install runoff diverter (by water), Mulch/ECM	Low	Low	Low
11-07	272 Hemlock Point Road	Directly into lake	Residential	Surface erosion - moderate; Soil - bare; Shoreline - erosion (sheet)	Flat	50x30	Paths & Trails - Define foot path; Roof runoff (to woods; Other - Mulch/ECM, Rain garden (at lake and by side yard); Vegetation - Add to/extend buffer, no raking, reseed bare soil and thinning grass	Med	Med	Med

Site	Location	Flow into lake via	Land Use	Problems	Slope	Size of Exposed/ Eroded Area	Recommendations	Impact	Cost	Technical Level
11-08	303 Wanser Lane	Directly into lake	Residential	Surface erosion - moderate (rills); Soil - bare (from drive, picnic table); Roof runoff erosion	Moderate	200 to 6 at shore	Paths & Trails - Define foot path, infiltration steps, install runoff diverter (waterbar), ECM; Roof runoff - Infiltration trench at roof dripline; Other - Install runoff diverter (waterbar); Vegetation - Establish buffer (no buffer)	High	Med	Med
11-09	311 Wanser Lane	Minimal vegetation	Residential	Surface erosion - Moderate; Roof runoff erosion; Shoreline - Lack of shoreline vegetation, erosion	Steep	75x15	Roof Runoff - Infiltration trench at roof dripline, drywell at gutter downspout; Vegetation - Establish buffer	Med	Med	Med
11-10	315 Wanser Lane	Stream	Residential	Surface Erosion - slight (on back side), moderate (behind wood to stream; Soil - Bare (on paths toward lake); Shoreline - Inadequate shoreline vegetation, erosion (base)	Flat	40x3, 3x6	Paths & Trails - Stabilize foot path (specifically behind house), install runoff diverter (waterbar), erosion control mulch; Roof runoff - Drywell at gutter downspout (extend or drywell); Vegetation - Add to/extend buffer	Med	Med	Med
11-11	321 Wanser Lane	Directly into lake	Residential	Surface erosion - Moderate (sheet and small rill from house to lake); Soil - bare (almost a road to the lake); Shoreline - Inadequate shoreline vegetation	Steep	150x10	Roads/Driveways - Install Runoff Diverters: Open top culvert (lawn across), rubber razor; Paths & Trails - install runoff diverter (waterbar); Other - Install runoff diverter (waterbar), Rain garden (where drain comes out), infiltration trench; Vegetation - Establish buffer	High	Med	Med

Site	Location	Flow into lake via	Land Use	Problems	Slope	Size of Exposed/ Eroded Area	Recommendations	Impact	Cost	Technical Level
11-12	333 Wanser Lane	Stream	Residential	Surface erosion - slight (rill); Shoreline - Erosion, unstable access	Moderate	4x12	Paths & Trails - Define foot path, stabilize foot path; Roof runoff - Drywell at gutter downspout (extend gutters to woods); Other - Mulch/ECM; Vegetation - Add to/extend buffer	Low	Low	Low - Med
11-13	341 Wanser Lane	Directly into lake (some); Minimal vegetation (some)	Residential	Surface erosion - sheet erosion down path; Soil - Bare (on paths, to door to lake, starts at dive and spots all down to ferns and lake); Shoreline - Inadequate shoreline vegetation (cutting), erosion (within 10 feet)	Steep	30x 10 (shorefront), 10' each (paths), So. 6x20	Paths & Trails - Define foot path, infiltration steps (by backdoor and north lake path), ECM; Roof runoff - Drywell at gutter downspout (extend south side); Other - Install Runoff Diverter (repair); Vegetation - add to/extend buffer (close to lake)	Med	Med	Med
11-14	347 Wanser Lane	Directly into lake	Trail or Path	Surface Erosion - Moderate (path to lake), Soil - Bare (path); Shoreline - Unstable access (could use work)	Steep	100x6 (path)	Paths & Trails - Define foot path, stabilize foot path, infiltration steps (***), install runoff diverter (waterbar), ECM; Other - Mulch/ECM	Med	Med	Med
12-01	Burton Woods Road	Ditch	Private road	Surface erosion - Slight; Culvert - clogged (left side)	Moderate		Culvert - Remove clog; Other Suggestions - Remove leaves, debris	Low	Med	Med
12-02	201 Burton Woods Road	Minimal vegetation	Trail or Path (Residential)	Surface erosion - slight; Soil - Bare (path from parking)	Steep	36x5	Paths & Trails - Infiltration steps (needs crushed rock), ECM	Low	Low	Low
12-03	195 Burton Woods Road (driveway)	Minimal vegetation	Driveway: gravel	Surface erosion - moderate; Roof runoff erosion	Steep	6x3	Roads/Driveways - Install runoff diverters, rubber razor (need to repair)	Low	Low	Low

Site	Location	Flow into lake via	Land Use	Problems	Slope	Size of Exposed/ Eroded Area	Recommendations	Impact	Cost	Technical Level
12-04	195 Burton Woods Road	Directly into lake	Residential	Roof runoff erosion	Steep	25x15	Roof Runoff - Infiltration trench at roof dripline; Other - Install runoff diverter (waterbar), Mulch/ECM, water retention swales, rip rap; Vegetation - Establish buffer	Med	Med	Med
12-05	189 Burton Woods Road	Directly into lake	Driveway	Surface erosion - severe	Moderate		Roads/Driveways - Install runoff diverters: Broad-based dip, Open top culvert, Rubber razor, waterbar	High	Med	Med
12-06	189 Burton Woods Road	Directly to lake	Residential	Surface erosion - severe; Roof runoff erosion; Shoreline - Lack of shoreline vegetation	Moderate		Paths & Trails - Define foot path, install runoff diverter (waterbar), Roof runoff - Infiltration trench at roof dripline, rain barrel (full gutter, no vegetation); Other - Mulch/ECM	High	High	High
12-07	187 Burton Woods Road	Directly to lake	Residential	Shoreline - Undercut, Lack of shoreline vegetation, erosion, unstable access; Other - Large stream coming through woods - erosion in outlet	Steep	12x5	Other - Mulch/ECM, rip rap; Vegetation - establish buffer	Med	Med	Med
12-08	173 Burton Woods Road	Minimal vegetation	Driveway	Surface erosion - slight	Steep	100 sf	Roads/Driveways - Install runoff diverters: open top culvert or rubber razor	Low	Low	Low
12-09	173 Burton Woods Road	Directly to lake	Residential	Shoreline - Undercut, lack of shoreline vegetation, erosion	Steep	30x10	Other - ECM, rip rap; Vegetation - Establish buffer, no raking, reseed bare soil & thinning grass	Med	Med	Med

Site	Location	Flow into lake via	Land Use	Problems	Slope	Size of Exposed/ Eroded Area	Recommendations	Impact	Cost	Technical Level
12-10	169 Burton Woods Road	Directly to lake (over lawn??)	Residential	Surface erosion - Severe (from base of driveway and stairs, runs down lawn to lake)	Steep	100 sf	Paths & Trails - Define foot path, infiltration steps, install runoff diverter (waterbar), ECM; Other - Rain garden, water retention swales; Vegetation - Establish buffer	High	Med	Med
12-11	164 Burton Woods Road	Minimal vegetation	Driveway	Surface erosion - severe	Steep	200 feet	Roads/Driveways - Add new surface material: gravel, install runoff diverters	Med	Med	Med
12-12	164 Burton Woods Road	Directly into lake	Residential	Roof runoff erosion (damage to gutters); Shoreline - Lack of shoreline vegetation, erosion (by dock)	Moderate	30x30	Roof runoff - Infiltration trench at roof dripline, drywell at gutter downspout; Other - Mulch/ECM, Rain garden; Vegetation - establish buffer	Low	Med	Low
12-13	163 Burton Woods Road	Directly into lake	Residential	Roof Runoff erosion (drainage from house 10' from water); Shoreline	Flat	10x50	Roof runoff - downspout not attached, questioned water runoff front house (under), rain garden (not sure), water retention swales (not sure)	Low	Med	Med
12-14	161 Burton Woods Road	Minimal vegetation	Residential: Construction site	Surface erosion - severe (lakeside side yard below drive - under water bar to yard); Roof runoff erosion (roof along drive runoff)	Steep	100	Roof runoff (A Frame); Construction site (work in progress)	High	Med	Med
12-15	206 Endicott Road	Directly into lake	Residential; trail or path	Surface erosion - Moderate; Shoreline - Inadequate shoreline vegetation, erosion, unstable access	Moderate	3x5	Roads/Driveways - Install runoff diverters: rubber razor, waterbar (at base of dive into yard; Paths and Trails - Define foot path, infiltration steps (repair by water), ECM; Other -	Med	Med	Med

Site	Location	Flow into lake via	Land Use	Problems	Slope	Size of Exposed/ Eroded Area	Recommendations	Impact	Cost	Technical Level
							Mulch/ECM (next to stairs and by water); Vegetation - Establish buffer, add to/extend buffer, no raking			
12-16	198 Endicott Road	Directly into lake	Residential	Surface erosion - Moderate (rill & sheet); Roof runoff erosion; Shoreline - Undercut, Inadequate shoreline vegetation, erosion	Moderate	50x40	Paths & Trails - Define foot path; Roof runoff - Drywell at gutter downspout; Other - Mulch/ECM, rip rap (in ditch); Vegetation - Establish buffer	Med	Med	Med
12-17	190 Endicott Road	Directly into lake	Residential: Driveway	Surface erosion - Moderate; Roof runoff erosion (driveway to lawn to lake)	Moderate	50x10	Roads/Driveways - Install runoff diverters: waterbar	Med	Low	Med
12-18	188 Endicott Road	Directly into lake	Residential	Surface erosion - slight; Shoreline - undercut, inadequate shoreline vegetation, erosion	Moderate	30x5	Other - rip rap, repair water retention bare on shoreline; Vegetation - add to/extend buffer	Low	Med	Med
12-19	0 Gables End	Ditch, Minimal Veg	Residential	Surface erosion - Moderate (goes into wood to lake), Roof runoff erosion (both side and under porch	Moderate	6x1	Roof runoff - infiltration trench at roof dripline, drywell at gutter downspout	Med	Med	Med
12-20	31 Gables End	Minimal vegetation	Residential	Surface erosion - slight; soil -bare	Steep	30x10	Other - Rain garden; Vegetation - Add to/extend buffer	Low	Low	Med
12-21	35 Gables End	Minimal vegetation	Residential	Surface erosion - severe; Roof runoff erosion; Other - from side doors downhill	Steep	40x15	Paths & Trails - Define foot path, infiltration steps, ECM; Roof runoff - drywell at gutter downspout	High	Med	Med

Site	Location	Flow into lake via	Land Use	Problems	Slope	Size of Exposed/ Eroded Area	Recommendations	Impact	Cost	Technical Level
				toward water, bare roots no soil						
12-22	242 Grandview Drive	Minimal vegetation	Residential	Surface erosion - slight (sheet, side yard down lawn to lake)	Steep	40x12	Paths & Trails - Define foot path, install runoff diverter (waterbar) on lawn; Other - Rain garden	Med	Med	Med
13-01	Pinkham's Cove Road between 140 + 134	Stream	Private Road	Surface erosion - moderate; Culvert - Unstable Outlet; Ditch - Moderate erosion	Flat	20x2	Culvert - Armor outlet; Ditch - armor with stone, reshape ditch; Other Suggestions - check roadway site at spring time to aide suggestions	Low	Low	Med
13-02	172 Pinkham's Cove Road	Stream	Driveway	Surface erosion - moderate; Culvert - Unstable outlet; Soil - bare	Moderate	20x30	Culvert - Armor outlet; Roads/Driveways - Install runoff diverters; Vegetation - establish buffer at shorefront, no raking at shorefront	Med	Med	Med
13-03	116 Pinkham's Cove Road	Directly into lake	Residential	Surface erosion - moderate; Shoreline - Lack of shoreline vegetation, erosion	Flat	40x10	Vegetation - Establish buffer	Low	Low	Low
13-04	Pinkham's Cove Road between 36-025 & 36-026	Directly into lake	Boat access	Surface erosion - moderate; Road shoulder erosion - moderate at boat launch; Soil - bare	Flat	100x10	Roads/Driveways - Boat launch, Install runoff diverters; Other Suggestions - Stabilize bank at launch site, rip rap	Med	Med	Low
13-05	11 Pickerel Lane	Directly into lake	Driveway	Surface erosion - moderate; Road shoulder erosion - moderate	Moderate	200x8	Roads/Driveways - Add new surface material, reshape (crown), install runoff diverters: rubber razors (rehab & lengthen & stabilize razor	High	High	Med

Site	Location	Flow into lake via	Land Use	Problems	Slope	Size of Exposed/ Eroded Area	Recommendations	Impact	Cost	Technical Level
							drainage outlet); Other Suggestions: Define parking area and divert at bottom of parking area			
13-06	29 Pickerel Lane	Directly into lake	Residential	Shoreline - Undercut, Lack of shoreline vegetation	Steep	100x5	Other - Rip rap; Vegetation - Establish buffer; Other suggestions - terrace parking	Med	Med	Med
13-07	Between 29-31 Pickerel Lane	Directly into lake	Private Road	Surface erosion - slight	Flat	150x30	Other Suggestions - cut down berm at telephone pole 19, Hyper elevate road away from lake, berm at driveway 31-029	Low	High	High
13-08	35 Pickerel Lane	Directly into lake	Residential	Surface erosion - slight; Soil - bare; Roof runoff erosion	Moderate	20x5	Roof runoff - Drywell at gutter downspout; Other - rain garden; Vegetation - establish buffer	Low	Low	Low
13-09	43 Pickerel Lane	Directly into lake	Residential	Surface erosion - moderate; Soil - bare	Moderate	30x75	Paths & Trails - Redo runoff diverter (waterbar), ECM; Vegetation - Establish buffer	Med	Low	Low
13-10	59 Pickerel Lane	Directly into lake	Residential	Surface erosion - moderate; Soil - bare	Moderate	12x40	Paths & Trails - stabilize foot path, ECM; Other - Mulch/ECM Vegetation - Establish buffer	Low	Low	Low
13-11	65 Pickerel Lane	Directly into lake	Residential	Surface erosion - moderate	Moderate	15x15	Paths & Trails - Install runoff diverter (waterbar); Other - Infiltration Trench; Other suggestions - Dispense minimal phosphate-free fertilizer, keep it on and in the green	Low	Low	Low

Site	Location	Flow into lake via	Land Use	Problems	Slope	Size of Exposed/ Eroded Area	Recommendations	Impact	Cost	Technical Level
14-01	16 Tabert Lane	Directly into lake	Residential	Surface erosion - moderate; Soil - bare; Roof runoff erosion	Moderate	100x30	Roads/Driveways - Install runoff diverters: rubber razor; Paths & Trails - Define foot path, ECM; Roof runoff - extend trench at roof dripline; Other - Mulch/ECM (sitting area), rain garden; Vegetation - establish buffer	Med	Low	Low
14-02	9 Perch Road	Directly into lake	Residential	Surface erosion - moderate; Soil - bare	Flat	30x45	Paths & Trails - ECM; Other - Mulch/ECM; Vegetation - Add to/extend buffer, no raking	Low	Low	Low
14-03	92 Lord Lane	Directly into lake	Residential	Surface erosion - slight; Soil - bare	Flat	30x15	Paths & Trails - Define foot path, ECM; Other - Mulch/ECM; Vegetation - Establish buffer, no raking, reseed bare soil & thinning grass; Other Suggestions - ECM or pea stone Fire pit site	Low	Low	Low
14-04	5 Perch Road	Directly into lake	Residential; Construction Site; Trail or Path	Surface erosion - moderate; Soil - bare	Moderate	See Note	Path & Trails - Define foot path, stabilize foot path, install runoff diverter (waterbar), ECM; Other - Mulch/ECM;	Med	Med	Low
14-05	2 Togue Road	Directly into lake	Trail or Path (Residential)	Surface erosion - moderate; Soil - bare	Steep	15x12	Paths & Trails - Define foot path (keep dog on it); ECM; Other - Mulch/ECM, Install runoff diverter at kayak and seating area; Other suggestions - Pick up dog waste	Med	Low	Low
14-06	225 Fosters Point Road	Directly into lake	Residential	Surface erosion - moderate; Soil - bare	Moderate	30x30	Paths & Trails - Stabilize foot path, ECM; Other - Mulch/ECM; Vegetation - Add	Med	Med	Low

Site	Location	Flow into lake via	Land Use	Problems	Slope	Size of Exposed/ Eroded Area	Recommendations	Impact	Cost	Technical Level
							to/extend buffer (on banking); no raking (allow naturalize)			
14-07	243 Fosters Point Road	Directly into lake	Residential	Soil - Bare; Other - dog waste	Flat	12x100	Paths & trails - Define foot path, ECM; Other - Mulch/ECM; Vegetation - Add to/extend buffer, no raking	Med	Med	Low
14-08	261 Fosters Point Road	Directly into lake	Residential	Surface erosion - slight; Soil -bare	Moderate	15x6	Paths & Trails - stabilize foot path, ECM; Other - Rip rap; Vegetation - add to/extend buffer, no raking	Low	Med	Med
14-09	267 Fosters Point Road	Directly into lake	Residential	Surface erosion - moderate; Soil - bare	Flat	60x12	Paths & Trails - ECM; Other - Mulch/ECM; Vegetation - Add to/extend buffer	Low	Low	Low
14-10	420 Fosters Point Road	Directly into lake	Driveway: gravel	Surface erosion - moderate	Steep	15x60	Roads/Driveways - add new surface material: blue stone gravel, Install detention basin (at end), Install runoff diverters: rubber razor	Med	Med	Med
16-01	44 Cardinal Lane	Directly into lake	Driveway	Surface erosion - moderate; Shoreline - Lack of shoreline vegetation	Moderate	600x12	Ditch - Install ditch; Roads/Driveways - Remove grader/plow berms, add new surface material: blue stone gravel, reshape (crown), install runoff diverters: rubber razor; Vegetation: establish buffer, add to/extend buffer	Med	Med-High	Med
16-02	20 Rough Lane	Directly into lake	Residential: Driveway	Surface erosion - slight; Soil - bare; Roof runoff erosion; Shoreline -	Moderate	45x25, driveway 100x12	Roads/Driveways - Build up, Add new surface material: blue stone gravel, reshape (crown), install runoff diverters; Paths &	Med	Med	Med

Site	Location	Flow into lake via	Land Use	Problems	Slope	Size of Exposed/ Eroded Area	Recommendations	Impact	Cost	Technical Level
				Lack of shoreline vegetation			trails - Define foot path; Roof runoff - Infiltration trench at roof dripline, rain barrel; Other - Mulch/ECM, infiltration trench; Vegetation - establish buffer			
16-03	22 Rough Lane	Ditch	Driveway	Surface erosion - moderate	Moderate	200x12	Roads/Driveways - Remove grade/plow berms, build up, add new surface material: blue stone gravel, reshape (crown), install runoff diverters	Low	Med	Med
16-04	Castle Island Rd Stream Crossing	Stream	State Road	Culvert- Unstable outlet, undersized; Road Shoulder Erosion- Slight (upstream stream bank covered in road sand); Other- Stream bank erosion (downstream around culvert outlet and along RH side).	Moderate	80 x 3	Culvert- Armor culvert inlet/outlet, enlarge	High	High	High
17-01	32 McHugh Lane	Directly into lake	Driveway	Surface erosion - Slight; Soil - Bare; Shoreline - Lack of shoreline vegetation	Moderate	40x8	Roads/Driveways - Add new surface material: blue stone gravel, Install runoff diverters: rubber razor; Paths & Trails - Define foot path, infiltration steps (?), Install runoff diverter (waterbar), ECM; Vegetation - Establish buffer, add to/extend buffer	Low	Low	Low
17-02	34 Markland Lane	Stream	Driveway	Surface erosion - Slight; Ditch - undersized; Road Shoulder Erosion - Slight	Flat	100 yards	Ditch - Install ditch; Roads/Driveways - Remover grader/plow berms, build up,	Med	Med	Med

Site	Location	Flow into lake via	Land Use	Problems	Slope	Size of Exposed/ Eroded Area	Recommendations	Impact	Cost	Technical Level
							add new surface material: blue stone gravel			
17-03	290 Woodland Camp Road	Directly into lake	Residential	Surface erosion - slight; Soil - Bare; Roof runoff erosion	Flat	35x75	Paths & Trails - Define foot path, infiltration steps (side of bldg), ECM; Roof runoff - Infiltration Trench at roof dripline, rain barrel; Other - Mulch/ECM, infiltration trench, rip rap (near storm drain)	Low	Low-Med	Low
17-04	216 Woodland Camp Road (pier on lake)	Directly into lake	Residential	Surface erosion - slight; Soil - bare; Shoreline - Undercut, lack of shoreline vegetation, erosion	Flat	100x20	Other - Rip rap; Vegetation - Add to/extend buffer, reseed bare soil & thinning grass; Other Suggestions - Fill in holes in causeway (3)	Low	Med	Med
17-05	156 Woodland Camp Road	Directly into lake	Residential	Surface erosion - slight; Soil - Bare; Shoreline - erosion	Flat	30x10	Other - Mulch/ECM, rip rap; Vegetation - No raking	Low	Low	Low
17-06	143 + 148 Woodland Camp Road	Minimal vegetation	Residential	Surface erosion - slight; Soil - Bare; Shoreline - erosion	Flat	50x30 bare soil; 90 shoreline	Paths & Trails - Define foot path, ECM; Other - Rip rap - Vegetation - Establish buffer, no raking	Low	Low	Low
17-07	142 Woodland Camp Road	Directly into lake	Residential	Surface erosion - Moderate; Shoreline - undercut, erosion	Moderate	25x6	Other - Rip rap; Vegetation - Reseed bare soil & thinning grass	Low	Low	Low
17-08	128 Chester Thwing Road	Directly into lake	Residential	Soil - Bare	Flat	25x25	Paths & Trails - Define foot path; Vegetation - Establish buffer, no raking	Low	Low	Low

Site	Location	Flow into lake via	Land Use	Problems	Slope	Size of Exposed/ Eroded Area	Recommendations	Impact	Cost	Technical Level
17-09	19 Carr Lane	Directly into lake	Residential	Other - New construction, no silt fence	Flat	5x20	Paths & Trails - Define foot path, stabilize foot path; Construction Site - Silt fence/ EC Berms	Low	Low	Low
17-10	21 Carr Lane	Directly into lake	Residential	Surface erosion - slight; Shoreline - erosion	Moderate	50x5	Other - Rip rap	Low	Med	Low
17-11	310 Woodland Camp Rd.	Directly into lake	Private Road (gravel)	Road Shoulder Erosion: Moderate; Shoreline: Undercut; Other: Long exposed gravel road close to water	Flat	300x12 (road); 300x4 (shore)	Roads/Driveways- Add New Surface Material (Blue stone gravel), reshape (crown); Other Suggestions: Rip rap along shoreline at edge of road where needed.	High	High	Med
17-12	310 Woodland Camp Rd.	Directly into lake	Construction site (residential)	Surface erosion- slight; Soil- bare; Roof Runoff Erosion; Shoreline- Inadequate shoreline vegetation; Other: Drainage across property needs extra attention due to location of house on narrow spit of land in order to prevent runoff to water and into house.	Moderate	70x 20 (x2)	Infiltrate Roof Runoff; Vegetation: Add to/extend buffer; Other Suggestions: Stabilize area around house, add berm around perimeter of property, and add drainage to shed water away from house.	Med	High	Med
18-01	157 Main St.	Stream	Commercial	Surface erosion - slight; Soil - bare; Shoreline - Lack of shoreline vegetation	Flat	30x75	Vegetation - establish buffer (consider berm), reseed bare soil & thinning grass	Low	Low	Low
18-02	145 Main St.	Stream	Residential	Surface erosion - slight; Soil - bare	Moderate	5x3	Roads/Driveways - Build up (berm from driveway to shed),	Low	Low	Low

Site	Location	Flow into lake via	Land Use	Problems	Slope	Size of Exposed/ Eroded Area	Recommendations	Impact	Cost	Technical Level
							install catch basin (from Village Inn driveway), Waterbar (EC Berm			
18-03	107 Main St.	Directly into lake	Residential	Surface erosion - moderate; Shoreline - Lack of shoreline vegetation, erosion	Flat	20x2	Other - Rip rap (prefer vegetation); Vegetation - Establish buffer	Med	Low	Low
18-04	Town Road - Hulin Road - Across from Pole 21-5	Stream	Town Road	Road Shoulder Erosion - Moderate; Soil - Winter sand;	Flat	20x40	Roads/Driveways - Install detention basin; Other Suggestions - Remove winter sand from site, not dump next to stream; cloud out catch basin	High	High	Med-High
18-05	Culvert Off Hulin Road, next to garage	Stream	Town Road	Culvert - Clogged; Road Should Erosion - moderate; Soil - Winter sand; Other: Road material washed straight to stream	Moderate	200x5	Culvert - Remove clog; Roads/Driveways - Stabilize shoulder, install detention basin; Other Suggestions - Redesign retention basin	High	High	High
18-06	Corner of Kingfisher & Hulin	Stream	Private Road: gravel	Surface erosion - moderate; Roadside Plow/Grader Berm	Moderate	75x12	Roads/Driveways - Remove grader/plow berms, build up, install runoff diverters: rubber razor	Med	Med	Low
18-07	8 Kingfisher Road	Stream	Driveway	Surface erosion - moderate	Flat	75x20	Roads/Driveways - Add new surface material; Roof Runoff - infiltration trench at roof dripline, drywell at gutter downspout	Med	Med	Low
18-08	8 Kingfisher Road	Stream	Trail or Path; Residential	Surface erosion - moderate; Soil - Bare	Steep	60x6	Paths & Trails - Infiltration Steps; Roof runoff - Infiltration	Low	Low	Low

Site	Location	Flow into lake via	Land Use	Problems	Slope	Size of Exposed/ Eroded Area	Recommendations	Impact	Cost	Technical Level
							trench at roof dripline; Other - Mulch/ECM			
18-09	18 Red Oaks Lodge Road	Stream	Trail or Path; Residential	Surface erosion - slight; Soil - bare; Roof runoff erosion; Shoreline - Lack of shoreline vegetation	Moderate	150x10	Paths & Trails - Stabilize foot path, infiltration steps, ECM (lower level); Vegetation - Establish buffer	Med	Med	Med
18-10	44 Abena Shores Road	Directly into lake	Residential	Shoreline - Undercut, lack of shoreline vegetation, erosion	Flat	10x3	Vegetation - establish buffer	Low	Low	Low
18-11	48 Abena Shores Road	Directly into lake	Driveway (gravel)	Surface erosion - moderate	Moderate	100x10	Roads/Driveways - Build Up, Add new surface material: blue stone gravel, install runoff diverters: rubber razor	Med	Med	Med
18-12	Abena Shores (next to 48, no house)	Minimal Vegetation	Trail or Path; Residential	Surface erosion - moderate, sever; Soil - bare	Steep	125x10	Roads/Driveways - Install runoff diverters: waterbar; Paths & Trails - Define foot path, install runoff diverter (waterbar), ECM	High	Med	Med
18-13	Abena Shores at Hersom Road	Directly into lake	Private Road	Surface Erosion - Severe; Roadside plow/Grader berm	Moderate	200x4	Roads/Driveways - remover grader/plow berms; Ditch - install turnouts	Med	Med	Med
18-14	60 Abena Shores Road	Directly into lake	Residential	Surface erosion - moderate; Soil - Bare	Moderate	40x6	Paths & Trails - ECM; Other Suggestions - Limit ATV use	Med	Med	Low
18-15	89 Abena Shores Road	Directly into lake	Residential	Surface erosion - slight; Soil - bare; Roof runoff erosion	Flat	30x15	Paths & Trails - ECM at shoreline; Roof Runoff - Infiltration trench	Low	Low	Low

Site	Location	Flow into lake via	Land Use	Problems	Slope	Size of Exposed/ Eroded Area	Recommendations	Impact	Cost	Technical Level
18-16	48 Red Oak Lodge Road	Directly into lake	Residential	Surface erosion- slight; Soil - Bare; Shoreline - inadequate shoreline vegetation, erosion	Moderate	75x10	Culvert - remove clog (at edge of driveway); Other - Mulch/ECM, Rain garden (at culvert outlet next to driveway); Vegetation - Add to/extend buffer; Other Suggestions: If erosion resulting from dock storage, consider other location	Low	Low	Low
18-17	13 Dern Lane	Directly into lake	Residential	Surface Erosion - Slight; Soil - bare; Shoreline - inadequate shoreline vegetation, erosion	Flat	30x10	Roads/Driveways - Build up (add berm to driveway front edge); Other - Install runoff diverter (waterbar); Roof runoff - repair downspout outlet pipe; Vegetation - Reseed bare soil & thinning grass	Low	Low	Low
18-18	67 Main St.	Stream	Commercial (church parking lot)	Surface erosion - moderate; Culvert - Clogged	Flat	100x50	Culvert - Remove clog, enlarge, install plunge pool (enlarge); Roads/Driveways - Add new surface material: Blue stone gravel	Med	Med	Med
18-19	43 Main St. (SEE NOTE)	Stream	Town Road	Road Shoulder Erosion - Moderate	Moderate	100x10	Ditch - Install turnouts; Roads/Driveways - Reshape (crown), Vegetate shoulder (stabilize)	Med	Med	Med
18-20	1203 West Road (SEE NOTE)	Stream	Town Road	Road Shoulder Erosion - Moderate	Moderate	250x10	Roads/Driveways - Build up, stabilize shoulder	Med	Med	Med
18-21	14 Rupus Lane	Directly into lake	Trail or Path (Residential)	Surface erosion- Moderate (path)	Moderate	50x5	Paths & Trails - Clean out runoff diverter, ECM; Roof	Low	Low	Low

Site	Location	Flow into lake via	Land Use	Problems	Slope	Size of Exposed/ Eroded Area	Recommendations	Impact	Cost	Technical Level
							runoff - Infiltration trench at roof dripline			
18-22	1 Center Drive	Directly into lake	Municipal/Public	Surface erosion - Moderate; Shoreline - Unstable access	Moderate	12x12	Roads/Driveways - Install runoff diverters; Paths & Trails - Stabilize foot path, ECM; Other - Rain garden, Infiltration trench	Med	Med	Med
18-23	23 Marina Drive	Directly into lake	Commercial	Surface erosion - Moderate; Shoreline - Unstable access	Flat	20x10	Paths & Trails - Install runoff diverter (waterbar); Vegetation - Reseed bare soil & thinning grass, install beach (?)	Med	Low	Low
18-24	7 Cranberry Lane	Directly into lake	Residential	Surface erosion - slight; Soil - Bare; Roof runoff erosion	Moderate	20x15	Roof runoff - Infiltration trench at roof dripline; Other - Mulch/ECM; Vegetation - reseed bare soil & thinning grass	Low	Low	Low
18-25	22 Hersom Road	Directly into lake	Residential	Surface erosion - slight; Soil - Bare; Roof runoff erosion	Moderate	30x20	Paths & Trails - Infiltration steps (retrofit existing); Roof runoff - Infiltration trench at roof dripline; Other - Mulch/ECM	Med	Low	Low
18-26	26 Hersom Road	Directly into lake	Residential	Surface erosion - slight, moderate; Soil - Bare; Shoreline - Inadequate shoreline vegetation, erosion	Steep	15x8	Paths & Trails - Infiltration steps; Other - Mulch/ECM, rain garden; Vegetation - Establish buffer	Low	Low	Low
18-27	0 Boatway Lane	Stream	Municipal/Public	Surface erosion - slight; Soil - bare; Shoreline - Inadequate shoreline vegetation	Moderate	30x8	Roads/Driveways - Add new surface material; Vegetation - add to/extend buffer	Low	Low	Low

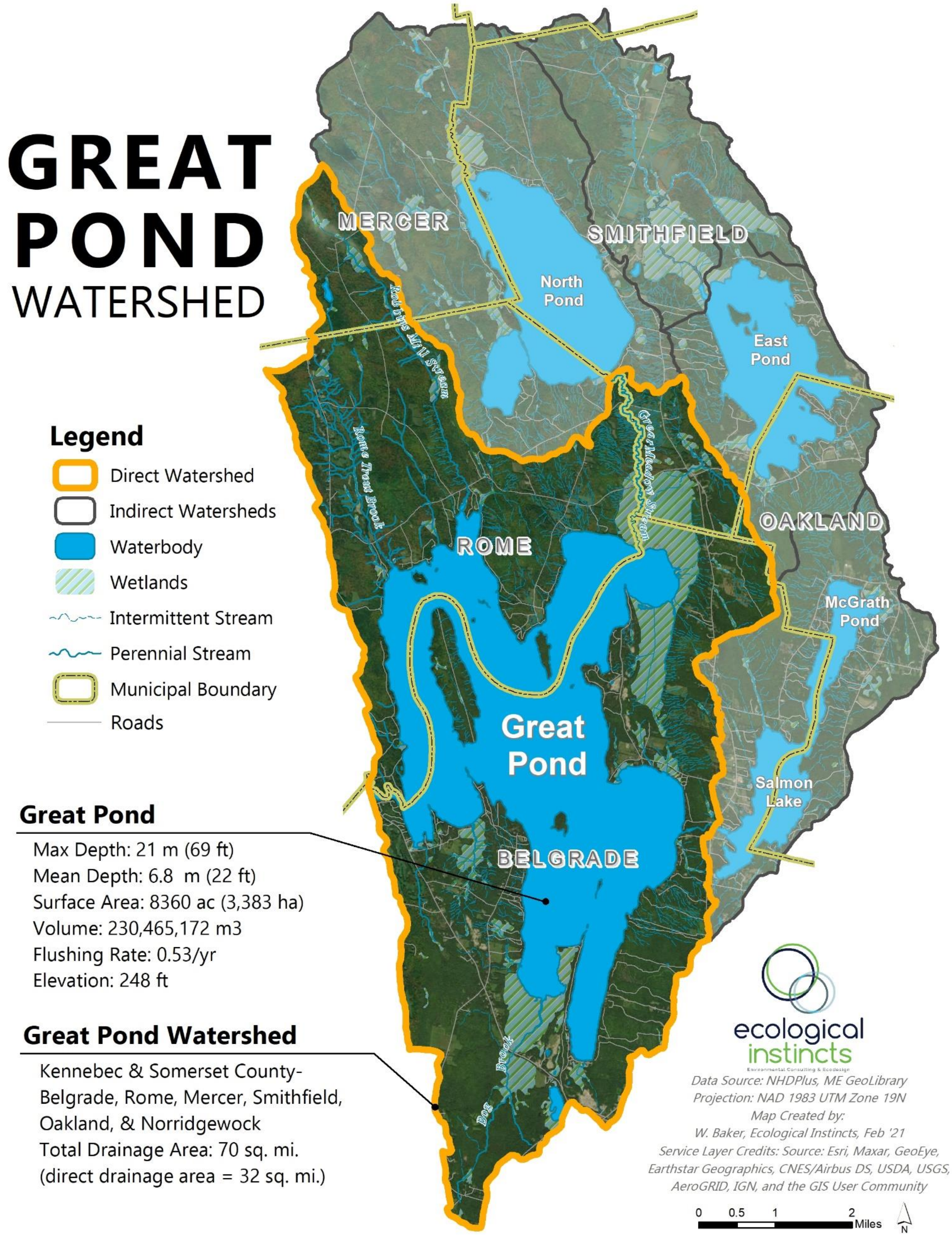
Site	Location	Flow into lake via	Land Use	Problems	Slope	Size of Exposed/ Eroded Area	Recommendations	Impact	Cost	Technical Level
18-28	Boat House Way (Boat ready area)	Directly into lake	Municipal/Public	Road Shoulder Erosion - Moderate	Flat	35x6	Roads/Driveways - Build up, add new surface material	Med	Low	Low
18-29	36 Boatway Lane	Directly into lake	Residential	Surface erosion - slight; Soil - bare	Moderate	10x3	Paths & Trails - Install runoff diverter (waterbar), ECM (at dock); Roof runoff - Infiltration trench at roof dripline	Low	Low	Low
19-01	59 Homestead Drive	Directly into lake	Driveway (paved)	Surface erosion - Moderate; Shoreline - Inadequate shoreline vegetation	Moderate	10x40	Roads/Driveways - Vegetate shoulder; Vegetation - add to/extend buffer; Other Suggestions - Add crush stone aprons at runoff points	Med	Low	Low
19-02	22 South Mountain Drive	Minimal Vegetation	Residential	Surface erosion - Slight; Soil - Bare	Flat	35x15	Other - Mulch/ECM or Vegetation: Reseed bare soil & thinning grass	Low	Low	Low
19-03	Mountain Drive, Between UP #32 & #33	Ditch	Private Road	Culvert - Unstable outlet, clogged, undersized	Moderate	20' culvert	Culvert - Armor inlet/outlet, replace (with 18" culvert), enlarge	Low	Med	Med
19-04	279 Mountain Drive	Minimal Vegetation	Trail or Path (camp site)	Surface erosion - slight; Soil - Bare	Moderate	200x20	Paths & Trails - Stabilize foot path, ECM	Low	Med	Low
19-05	261 Mountain Drive	Directly into lake	Residential	Surface erosion - Slight; Soil - Bare; Shoreline - Lack of shoreline vegetation	Moderate	40x80	Vegetation - establish buffer	Med	Med	Low
19-06	209 Mountain Drive	Minimal Vegetation	Residential	Surface erosion - Slight; Soil - Bare; Shoreline - Inadequate shoreline vegetation	Moderate	30x10	Roads/Driveways - Install runoff diverters: rubber razor; Vegetation - extend buffer	Med	Med	Med

Site	Location	Flow into lake via	Land Use	Problems	Slope	Size of Exposed/ Eroded Area	Recommendations	Impact	Cost	Technical Level
19-07	187 Mountain Drive	Directly into lake	Residential	Surface erosion - moderate; Soil - bare; Shoreline - lack of shoreline vegetation	Steep	80x20	Other - Install runoff diverter (waterbar), mulch/ECM; Vegetation - establish buffer	Med	Med	Low
19-08	143 Mountain Drive	Directly into lake	Residential	Surface erosion - moderate; Soil - bare; Shoreline - Lack of shoreline vegetation	Steep	100x10	Paths & Trails - Stabilize foot path, install runoff diverter (waterbar)	Med	Low	Low
20-01	16 Lambert Lane	Directly into lake	Residential: Potential septic issue	Surface erosion - Moderate	Moderate	35x4; 12x4	Paths & Trails - Define foot path, stabilize foot path, install runoff diverter (waterbar)	Low	Med	Med
20-02	16 Lambert Lane	Directly into lake (through buffer)	Residential	Surface erosion - slight; Culvert (through driveway) - Unstable inlet/outlet; Roof runoff erosion	Moderate	30x2; 20x2; 10x2; 10x2; 10x2	Culvert - Armor inlet/outlet; Roof runoff - Infiltration trench at roof dripline	Low	Low	Low
20-03	288 Drury Lane	Directly into lake; Stream	Residential: Driveway/Parking (#4)	Surface erosion - Moderate; Soil - bare (#2); Roof Runoff (#1); Shoreline (#3)	Moderate	#1 -18x2; #2 - 40x10; #3 - 30x2, 40x2; #4 - 60x40	Roads/ Driveways - Install runoff diverters: rubber razor, waterbar (or gentle berm); Roof runoff - Infiltration trench at roof dripline; Other - Mulch/ECM	Med	Med	Med
20-04	Next door to 288 Drury Lane	Directly into lake; Stream	Residential: Driveway (#3)	Surface erosion - moderate (#2-3); Culvert (#4) - Unstable inlet/outlet; Soil (#2) - bare; Roof runoff erosion (#1)	Moderate	#1 - 35x2, 15x2; #2 - 60x4; #3 - 125x20; #4 60x40	Culvert - Armor inlet/outlet (#4); Roads/Driveways - Install runoff diverters (#3): Rubber razor; Roof runoff (#1) - Infiltration trench at roof dripline; Other - Mulch/ECM (#1)	High	Med	Med

Site	Location	Flow into lake via	Land Use	Problems	Slope	Size of Exposed/ Eroded Area	Recommendations	Impact	Cost	Technical Level
20-05	108 Marsh Lane	Directly into lake	Residential	Shoreline - undercut, erosion	Flat	20x8	Paths & Trails - Rip rap (existing rip rap needs to replace 20' long)	Low	Low	Low
20-06	120 Marsh Lane	Directly into lake	Residential: Construction site	Soil - bare	Flat	18x12	Other - Mulch/ECM	Low	Low	Low
20-07	Starbird Lane	Ditch?	Private Road	Culvert - Unstable inlet/outlet, undersized	Flat		Culvert - Armor inlet/outlet, replace, enlarge	Low	Low	Low
20-08	Starbird Lane	Directly into lake	Residential	Surface erosion - slight; Soil - bare	Moderate	20x6	Paths & Trails - Stabilize foot path, ECM	Low	Low	Low
20-09	129 Starbird Lane	Minimal Vegetation	Residential	Surface erosion - slight	Moderate	8x2, 24x2	Other - Gravel spreader, some gravel in place needs more	Low	Low	Low
20-10	Taconnet Parking Lot	Directly into lake	Commercial	Culvert/Swale - Clogged	Moderate		Other Suggestions - Sediment basin and swale in place but need to be cleaned out; drainage pit is higher than swale	High	High	High
20-11	8 Camp Relief Lane	Directly into lake	Trail or Path	Surface erosion - slight (#1); Soil - bare (#2)	Moderate	#1 - 50x3, #2 - 40x30	Paths & Trails - ECM	Low	Low	Low
21-01	12 Hoyt Island	Directly into lake	Trail or Path	Surface erosion - slight; Soil - bare	Flat	20x8	Paths & Trails - ECM	Low	Low	Low
21-02	Indian Island	Directly into lake	Trail or Path : Boat access	Surface erosion - moderate; Soil -bare; Roof runoff erosion (first building contributes to water on trail); Shoreline - erosion	Steep	40x5	Paths & Trails - Infiltration steps (or terrace), Install runoff diverter (waterbar), ECM (on trail and by dock on slope); Roof runoff - infiltration trench at roof dripline	Low	Low	Low

Site	Location	Flow into lake via	Land Use	Problems	Slope	Size of Exposed/ Eroded Area	Recommendations	Impact	Cost	Technical Level
21-03	Pine Island Camp - Pine Island	Directly into lake	Commercial: Beach Access - Trail or path	Surface erosion - Moderate, severe; Soil - bare; Roof runoff erosion; Shoreline - Undercut, erosion, unstable access	Moderate	Multiple eroded areas over large area (See photos)	Paths & Trails - stabilize foot path, infiltration steps, ECM; Roof runoff - Infiltration trench at roof dripline, drywell at gutter downspout; Other - Install runoff diverter (waterbar), Mulch/ECM, Infiltration trench, rip rap; Vegetation - Establish buffer (shoreline retaining rip rap needed w. shore)	High	High	High
21-04	Oak Island	Directly into lake	Beach Access	Surface erosion - moderate; Soil - bare; Shoreline - undercut, erosion	Moderate	20x10	Stabilize foot path	Low	Low	Low

APPENDIX B. WATERSHED MAPS


GREAT
POND
WATERSHED
Legend
Direct Watershed
Indirect Watersheds
Waterbody
Wetlands
Intermittent Stream
Perennial Stream
Municipal Boundary
Roads
MERCER
SMITHFIELD
OAKLAND
ROME
BELGRADE
North Pond
East Pond
McGrath Pond
Salmon Lake
Great Pond
Great Meadow Stream
Bog Brook
Great Pond
Max Depth: 21 m (69 ft)
Mean Depth: 6.8 m (22 ft)
Surface Area: 8360 ac (3,383 ha)
Volume: 230,465,172 m3
Flushing Rate: 0.53/yr
Elevation: 248 ft
Great Pond Watershed
Kennebec & Somerset County-
Belgrade, Rome, Mercer, Smithfield,
Oakland, & Norridgewock
Total Drainage Area: 70 sq. mi.
(direct drainage area = 32 sq. mi.)
ecological instincts
Data Source: NHDPlus, ME GeoLibrary
Projection: NAD 1983 UTM Zone 19N
Map Created by:
W. Baker, Ecological Instincts, Feb '21
Service Layer Credits: Source: Esri, Maxar, GeoEye,
Earthstar Geographics, CNES/Airbus DS, USDA, USGS,
AeroGRID, IGN, and the GIS User Community
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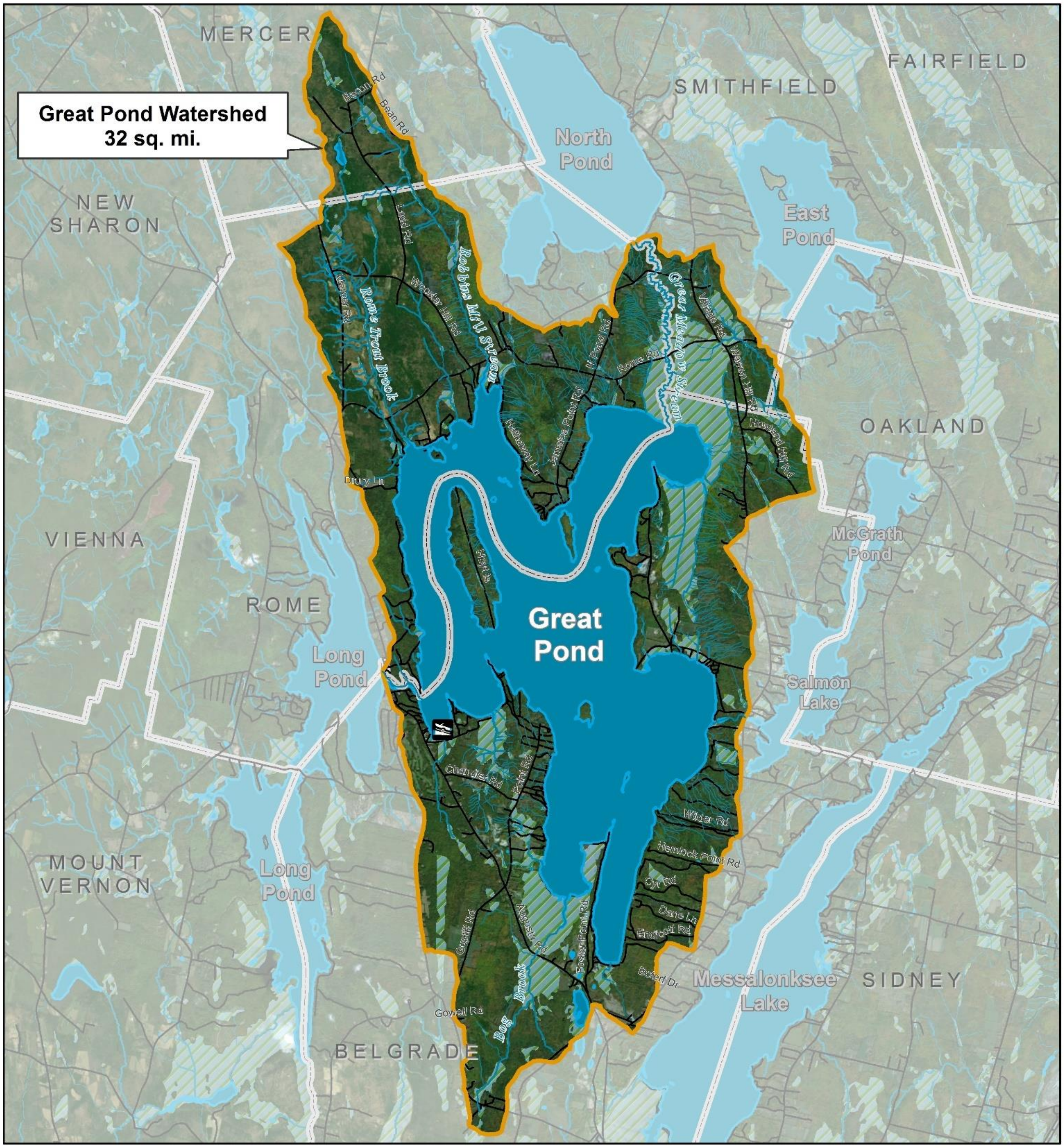
N



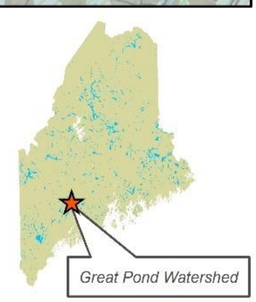
Great Pond Watershed - Base Map

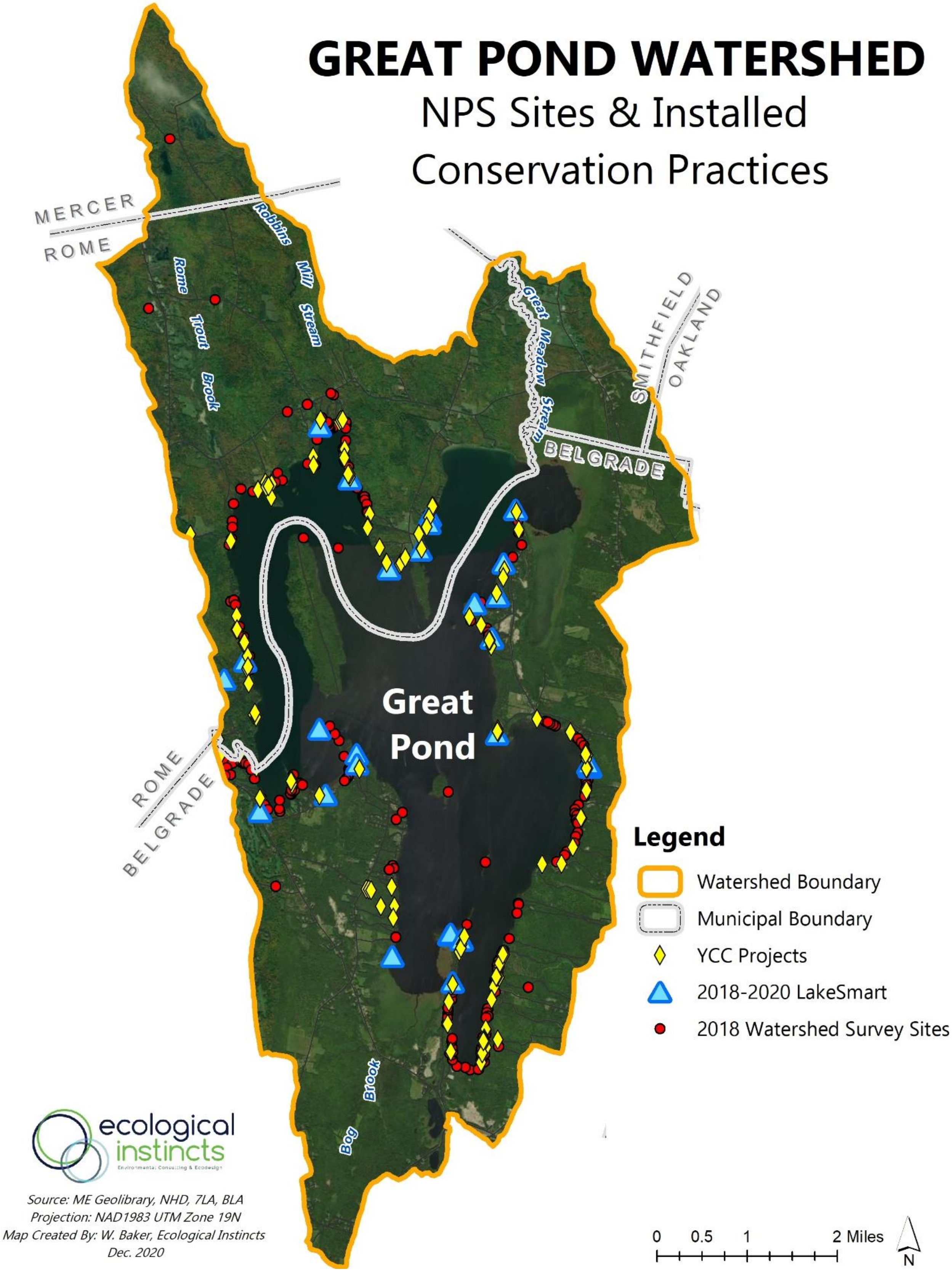
Great Pond Watershed | Wetlands | Waterbody
Perennial Streams | Perennial / Intermittent Streams
Town Boundary | Roads | Boat Launch

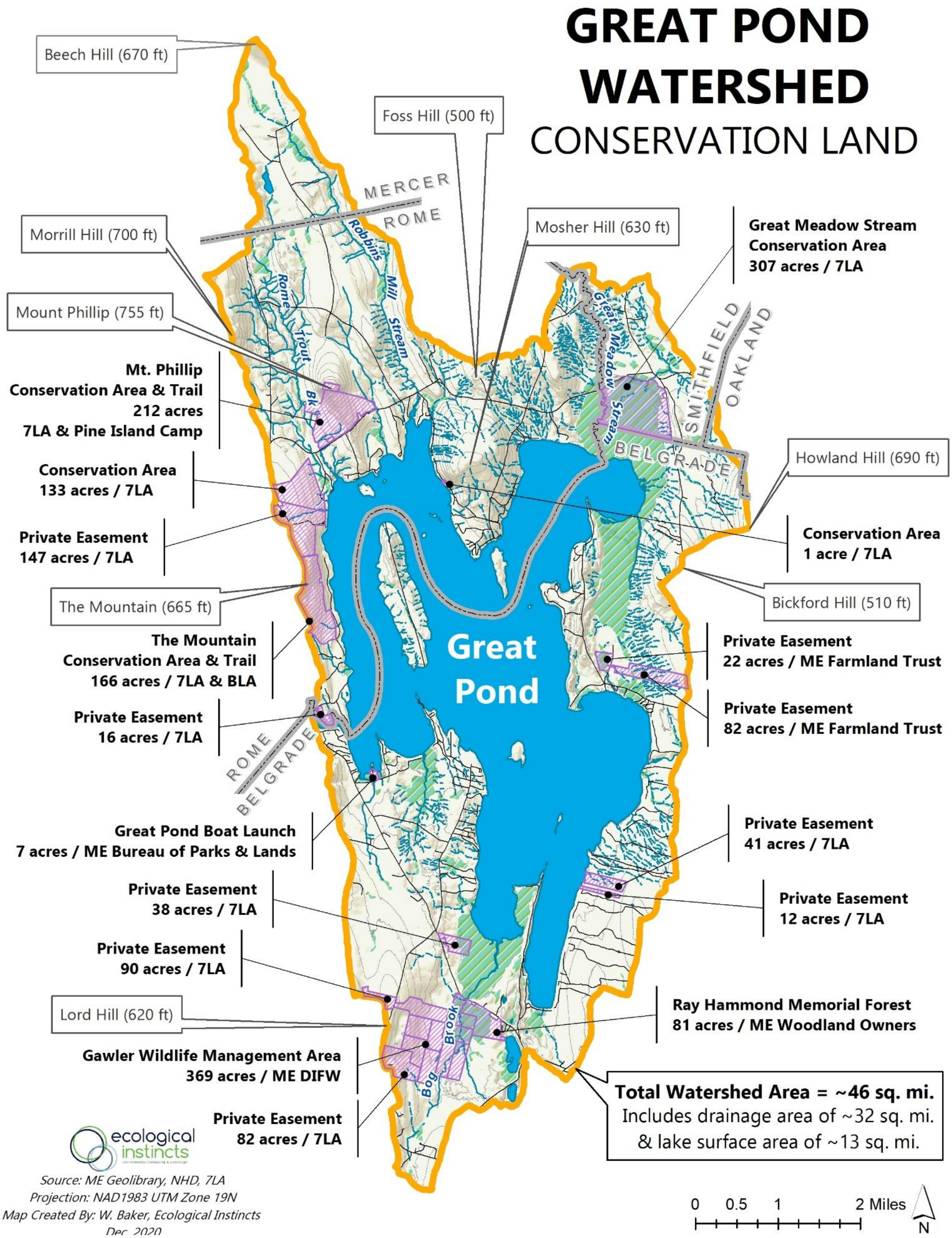
ecological instincts
Environmental Consulting & Ecodesign

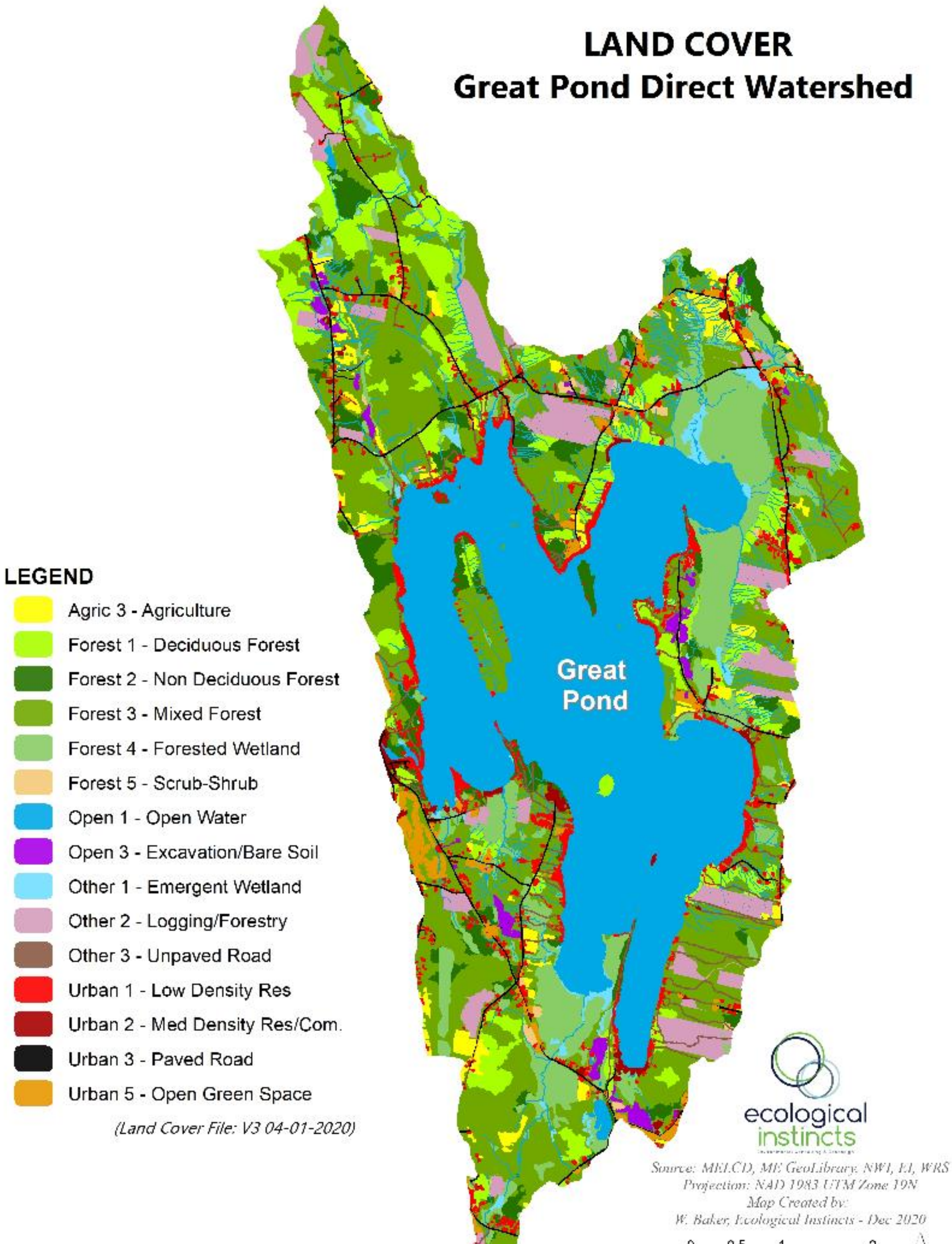
0 0.5 1 2 Miles
N

Data Source: 7LA, MEGIS, NHD, NWI / Projection: NAD 1983 UTM Zone 19N
Map Created by: Whitney A. Baker, WB GIS Services - April 2018
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

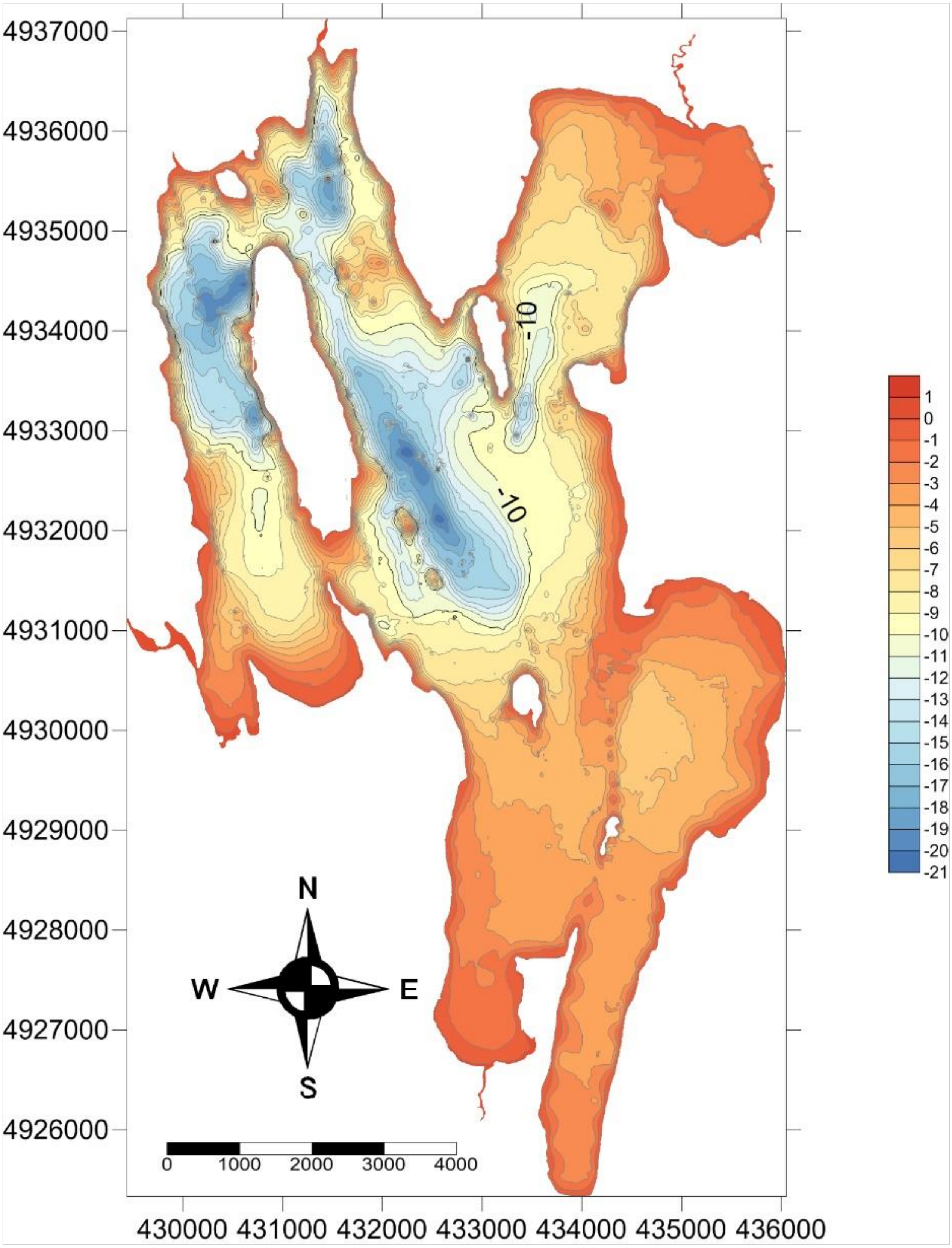


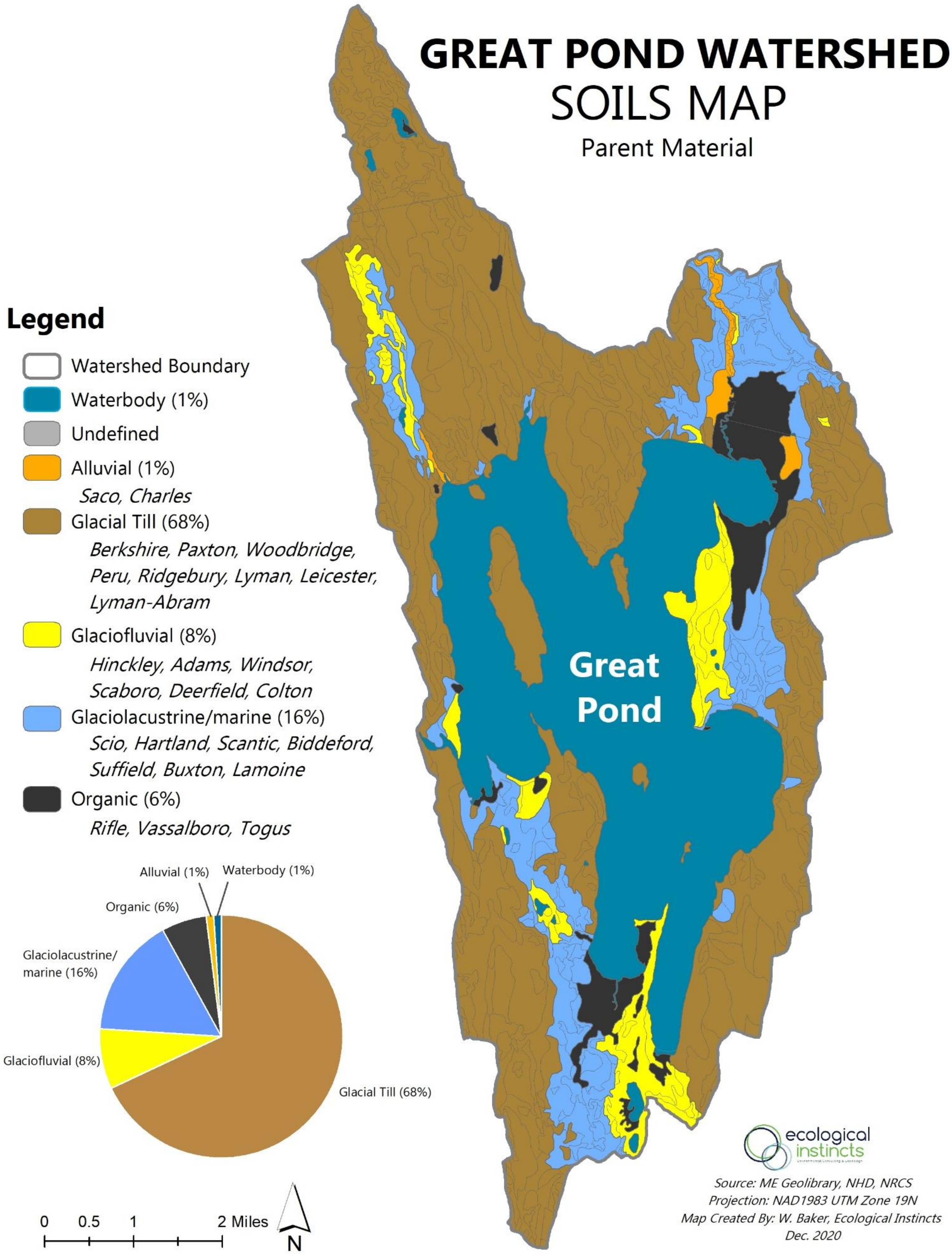

GREAT POND WATERSHED
NPS Sites & Installed
Conservation Practices
MERCER
ROME
Robbins
Mill
Stream
Rome
Trout
Brook
Great
Meadow
Stream
SMITHFIELD
OAKLAND
BELGRADE
Great
Pond
ROME
BELGRADE
Bog
Brook
Legend
Watershed Boundary
Municipal Boundary
YCC Projects
2018-2020 LakeSmart
2018 Watershed Survey Sites
ecological instincts
Environmental Consulting & Ecodesign
Source: ME Geolibrary, NHD, 7LA, BLA
Projection: NAD1983 UTM Zone 19N
Map Created By: W. Baker, Ecological Instincts
Dec. 2020
0 0.5 1 2 Miles
N

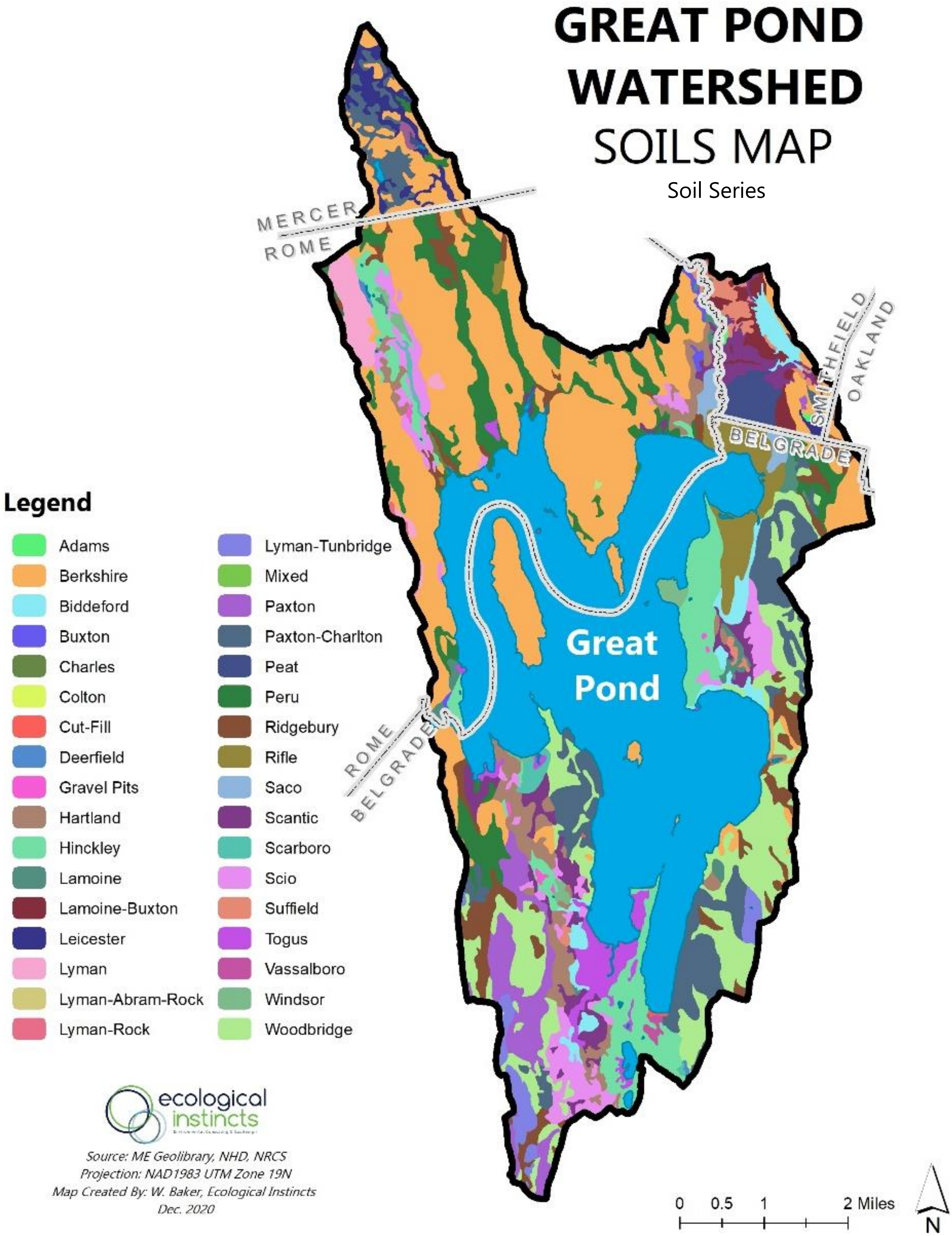

GREAT POND
WATERSHED
CONSERVATION LAND
Beech Hill (670 ft)
Foss Hill (500 ft)
MERCER
ROME
Morrill Hill (700 ft)
Mosher Hill (630 ft)
Great Meadow Stream
Conservation Area
307 acres / 7LA
Robbins Mill Stream
Rome Trout Bk
Great Meadow Stream
SMITHFIELD
OAKLAND
Mount Phillip (755 ft)
Mt. Phillip
Conservation Area & Trail
212 acres
7LA & Pine Island Camp
BELGRADE
Howland Hill (690 ft)
Conservation Area
133 acres / 7LA
Conservation Area
1 acre / 7LA
Private Easement
147 acres / 7LA
Bickford Hill (510 ft)
The Mountain (665 ft)
Great
Pond
The Mountain
Conservation Area & Trail
166 acres / 7LA & BLA
Private Easement
22 acres / ME Farmland Trust
Private Easement
16 acres / 7LA
Private Easement
82 acres / ME Farmland Trust
ROME
BELGRADE
Great Pond Boat Launch
7 acres / ME Bureau of Parks & Lands
Private Easement
41 acres / 7LA
Private Easement
38 acres / 7LA
Private Easement
12 acres / 7LA
Private Easement
90 acres / 7LA
Ray Hammond Memorial Forest
81 acres / ME Woodland Owners
Lord Hill (620 ft)
Bog Brook
Gawler Wildlife Management Area
369 acres / ME DIFW
Total Watershed Area = ~46 sq. mi.
Includes drainage area of ~32 sq. mi.
& lake surface area of ~13 sq. mi.
Private Easement
82 acres / 7LA
ecological instincts
Source: ME Geolibrary, NHD, 7LA
Projection: NAD1983 UTM Zone 19N
Map Created By: W. Baker, Ecological Instincts
Dec. 2020
0 0.5 1 2 Miles
N

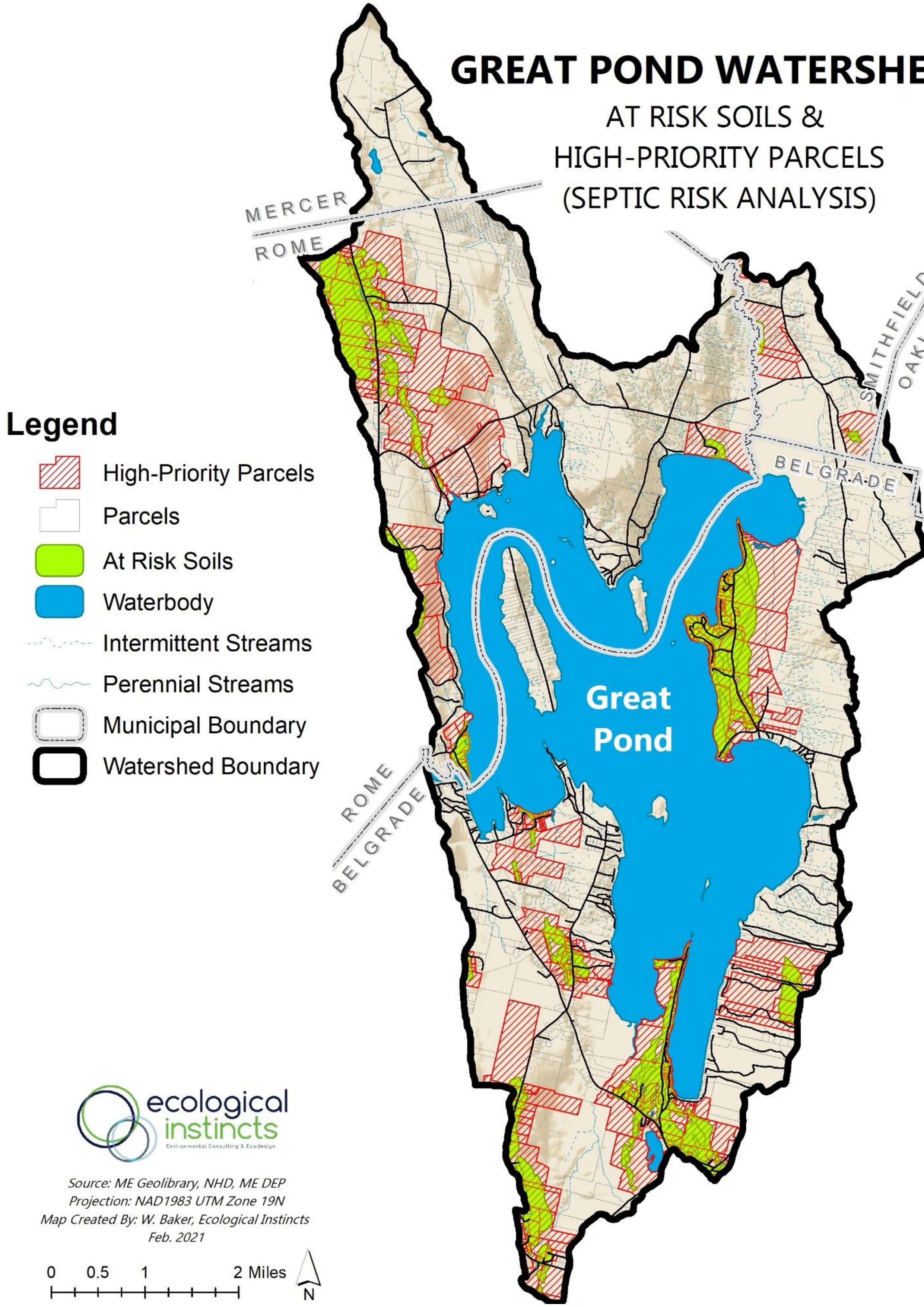

LAND COVER
Great Pond Direct Watershed
Great Pond
LEGEND
Agric 3 - Agriculture
Forest 1 - Deciduous Forest
Forest 2 - Non Deciduous Forest
Forest 3 - Mixed Forest
Forest 4 - Forested Wetland
Forest 5 - Scrub-Shrub
Open 1 - Open Water
Open 3 - Excavation/Bare Soil
Other 1 - Emergent Wetland
Other 2 - Logging/Forestry
Other 3 - Unpaved Road
Urban 1 - Low Density Res
Urban 2 - Med Density Res/Com.
Urban 3 - Paved Road
Urban 5 - Open Green Space
(Land Cover File: V3 04-01-2020)
ecological instincts
Source: MELCD, ME GeoLibrary: NWI, EI, WRS
Projection: NAD 1983 UTM Zone 19N
Map Created by:
W. Baker, Ecological Instincts - Dec 2020
0 0.5 1 2
Miles
N

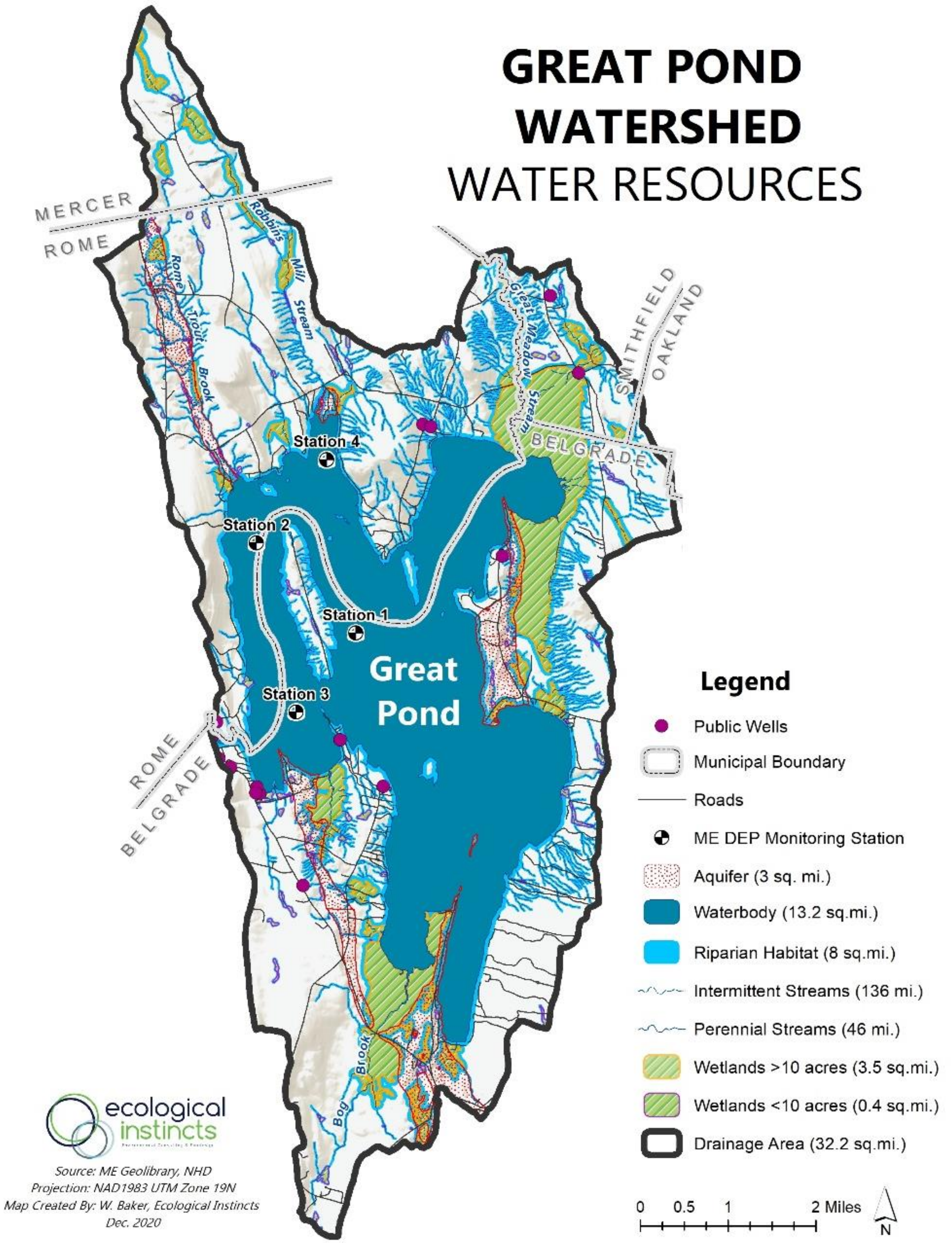
Great Pond Bathymetric Map

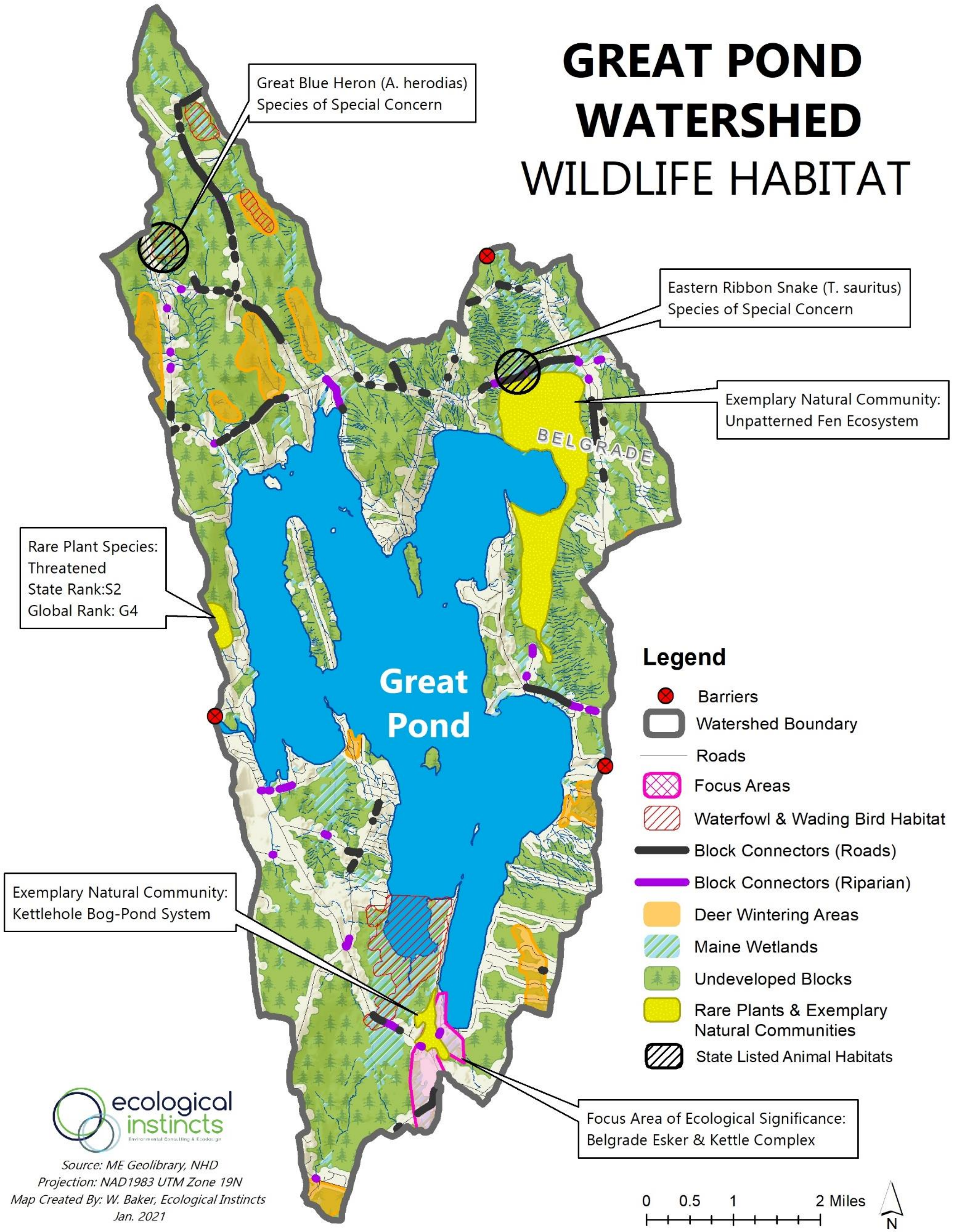



GREAT POND WATERSHED
SOILS MAP
Parent Material
Legend
Watershed Boundary
Waterbody (1%)
Undefined
Alluvial (1%)
Saco, Charles
Glacial Till (68%)
Berkshire, Paxton, Woodbridge, Peru, Ridgebury, Lyman, Leicester, Lyman-Abram
Glaciofluvial (8%)
Hinckley, Adams, Windsor, Scaboro, Deerfield, Colton
Glaciolacustrine/marine (16%)
Scio, Hartland, Scantic, Biddeford, Suffield, Buxton, Lamoine
Organic (6%)
Rifle, Vassalboro, Togus
Alluvial (1%)
Waterbody (1%)
Organic (6%)
Glaciolacustrine/marine (16%)
Glaciofluvial (8%)
Glacial Till (68%)
Great Pond
0
0.5
1
2 Miles
N
ecological instincts
Source: ME Geolibrary, NHD, NRCS
Projection: NAD1983 UTM Zone 19N
Map Created By: W. Baker, Ecological Instincts
Dec. 2020

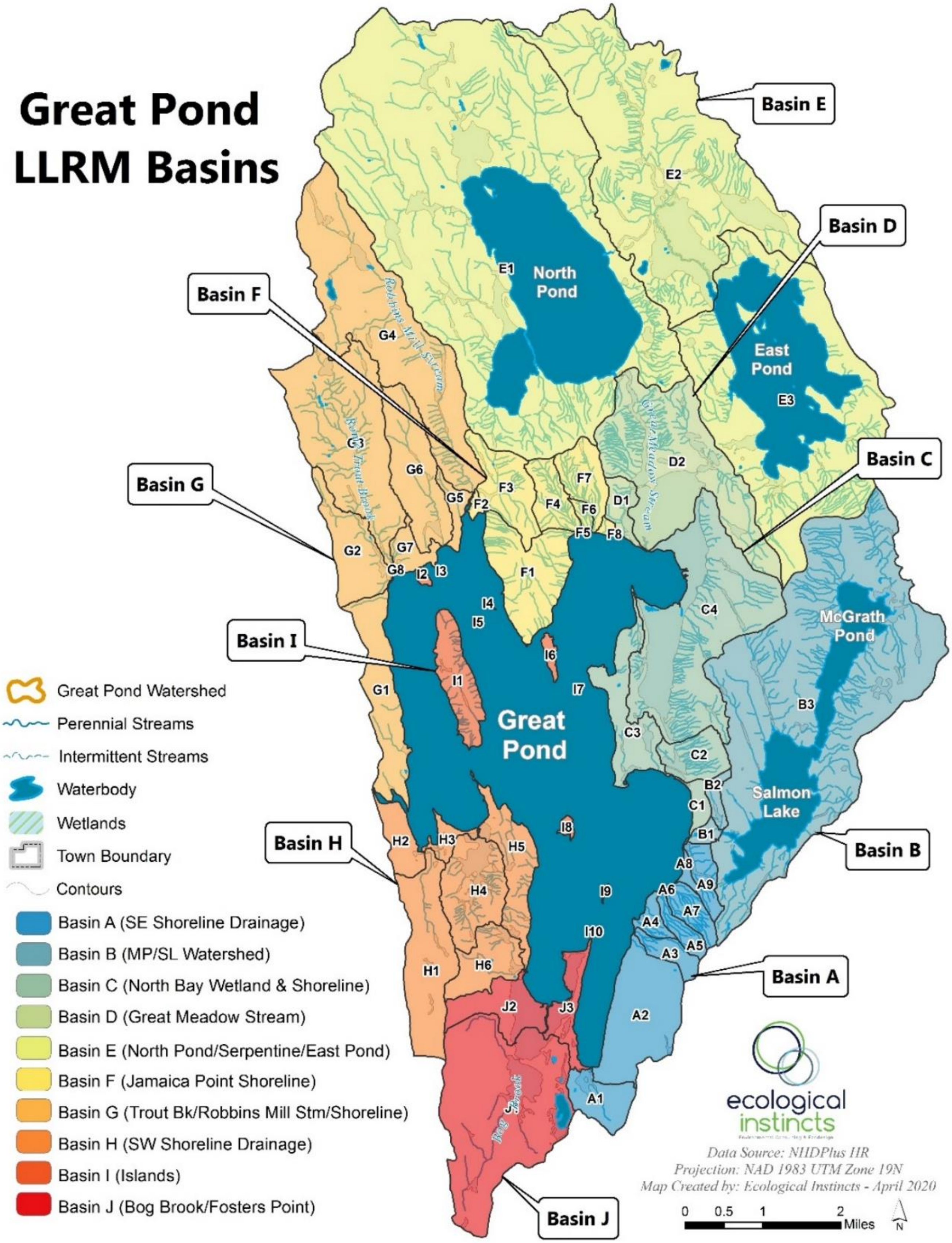

GREAT POND WATERSHED
SOILS MAP
Soil Series
MERCER
ROME
SMITHFIELD
OAKLAND
BELGRADE
ROME
BELGRADE
Great Pond
Legend
Adams
Berkshire
Biddeford
Buxton
Charles
Colton
Cut-Fill
Deerfield
Gravel Pits
Hartland
Hinckley
Lamoine
Lamoine-Buxton
Leicester
Lyman
Lyman-Abram-Rock
Lyman-Rock
Lyman-Tunbridge
Mixed
Paxton
Paxton-Charlton
Peat
Peru
Ridgebury
Rifle
Saco
Scantic
Scarboro
Scio
Suffield
Togus
Vassalboro
Windsor
Woodbridge
ecological instincts
Source: ME Geolibrary, NHD, NRCS
Projection: NAD1983 UTM Zone 19N
Map Created By: W. Baker, Ecological Instincts
Dec. 2020
0 0.5 1 2 Miles
N


GREAT POND WATERSHED
AT RISK SOILS &
HIGH-PRIORITY PARCELS
(SEPTIC RISK ANALYSIS)
Legend
High-Priority Parcels
Parcels
At Risk Soils
Waterbody
Intermittent Streams
Perennial Streams
Municipal Boundary
Watershed Boundary
MERCER
ROME
SMITHFIELD
OAKLAND
BELGRADE
ROME
BELGRADE
Great Pond
ecological instincts
Environmental Consulting & Ecodesign
Source: ME Geolibrary, NHD, ME DEP
Projection: NAD1983 UTM Zone 19N
Map Created By: W. Baker, Ecological Instincts
Feb. 2021
0 0.5 1 2 Miles
N


GREAT POND
WATERSHED
WATER RESOURCES
MERCER
ROME
Robbins
Mill
Stream
Rome
Trout
Brook
Great
Meadow
Stream
SMITHFIELD
OAKLAND
BELGRADE
Station 4
Station 2
Station 1
Station 3
Great
Pond
ROME
BELGRADE
Bog
Brook
Legend
Public Wells
Municipal Boundary
Roads
ME DEP Monitoring Station
Aquifer (3 sq. mi.)
Waterbody (13.2 sq.mi.)
Riparian Habitat (8 sq.mi.)
Intermittent Streams (136 mi.)
Perennial Streams (46 mi.)
Wetlands >10 acres (3.5 sq.mi.)
Wetlands <10 acres (0.4 sq.mi.)
Drainage Area (32.2 sq.mi.)
0
0.5
1
2 Miles
N
ecological
instincts
Source: ME Geolibrary, NHD
Projection: NAD1983 UTM Zone 19N
Map Created By: W. Baker, Ecological Instincts
Dec. 2020

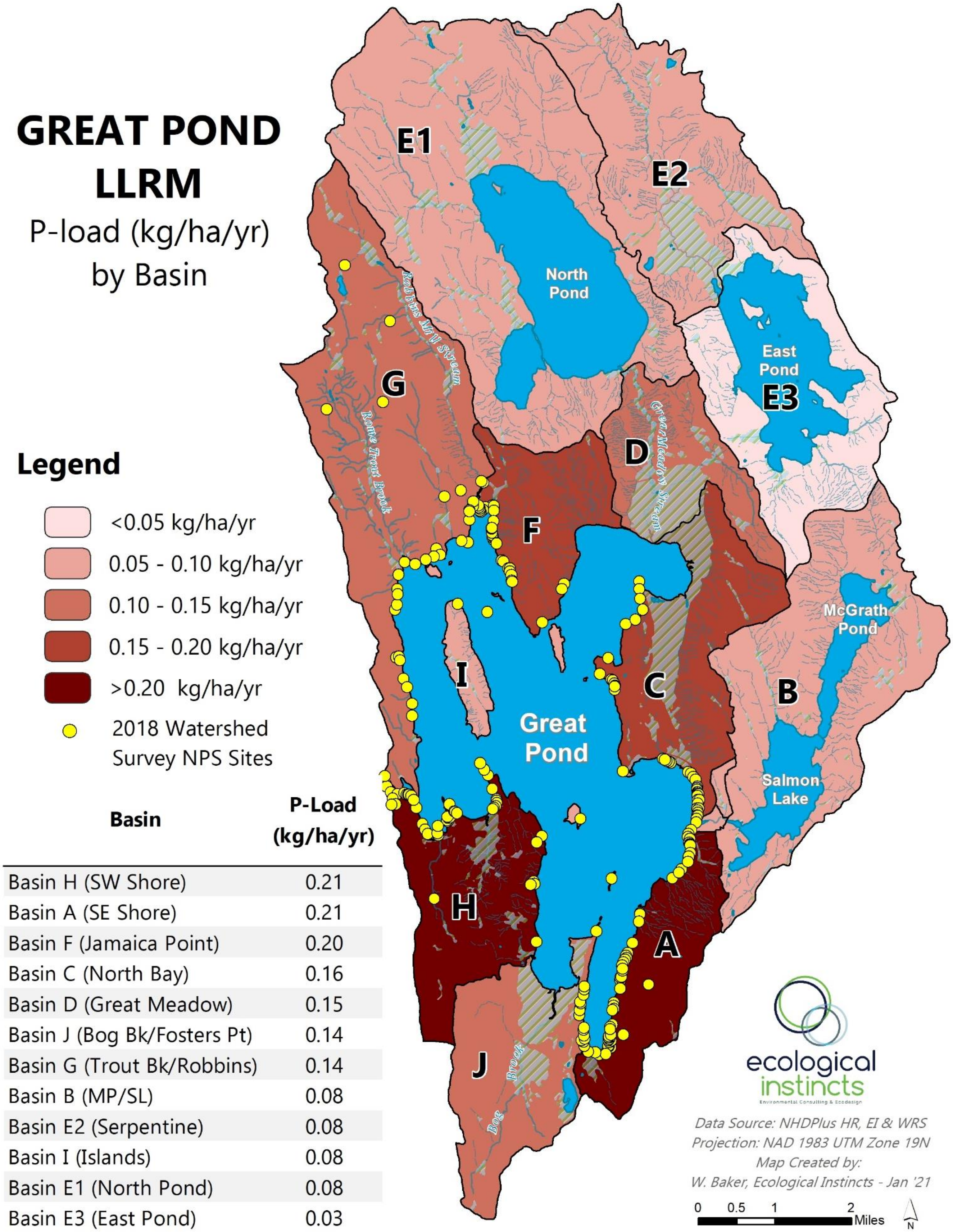


GREAT POND WATERSHED
WILDLIFE HABITAT
Great Blue Heron (A. herodias)
Species of Special Concern
Eastern Ribbon Snake (T. sauritus)
Species of Special Concern
Exemplary Natural Community:
Unpatterned Fen Ecosystem
BELGRADE
Rare Plant Species:
Threatened
State Rank:S2
Global Rank: G4
Great Pond
Legend
Barriers
Watershed Boundary
Roads
Focus Areas
Waterfowl & Wading Bird Habitat
Block Connectors (Roads)
Block Connectors (Riparian)
Deer Wintering Areas
Maine Wetlands
Undeveloped Blocks
Rare Plants & Exemplary Natural Communities
State Listed Animal Habitats
Exemplary Natural Community:
Kettlehole Bog-Pond System
Focus Area of Ecological Significance:
Belgrade Esker & Kettle Complex
ecological instincts
Source: ME Geolibrary, NHD
Projection: NAD1983 UTM Zone 19N
Map Created By: W. Baker, Ecological Instincts
Jan. 2021
0 0.5 1 2 Miles
N


Great Pond
LLRM Basins
Basin E
Basin D
Basin F
Basin G
Basin C
Basin I
Basin H
Basin B
Basin A
Basin J
North Pond
East Pond
McGrath Pond
Great Pond
Salmon Lake
Robbins Mill Stream
Great Meadow Stream
Bog Brook
E1
E2
E3
D1
D2
F1
F2
F3
F4
F5
F6
F7
F8
G1
G2
G3
G4
G5
G6
G7
G8
I1
I2
I3
I4
I5
I6
I7
I8
I9
I10
C1
C2
C3
C4
B1
B2
B3
A1
A2
A3
A4
A5
A6
A7
A8
A9
H1
H2
H3
H4
H5
H6
J1
J2
J3
Great Pond Watershed
Perennial Streams
Intermittent Streams
Waterbody
Wetlands
Town Boundary
Contours
Basin A (SE Shoreline Drainage)
Basin B (MP/SL Watershed)
Basin C (North Bay Wetland & Shoreline)
Basin D (Great Meadow Stream)
Basin E (North Pond/Serpentine/East Pond)
Basin F (Jamaica Point Shoreline)
Basin G (Trout Bk/Robbins Mill Stm/Shoreline)
Basin H (SW Shoreline Drainage)
Basin I (Islands)
Basin J (Bog Brook/Fosters Point)
ecological instincts
Data Source: NHDPlus HR
Projection: NAD 1983 UTM Zone 19N
Map Created by: Ecological Instincts - April 2020
0 0.5 1 2 Miles
N

GREAT POND LLRM

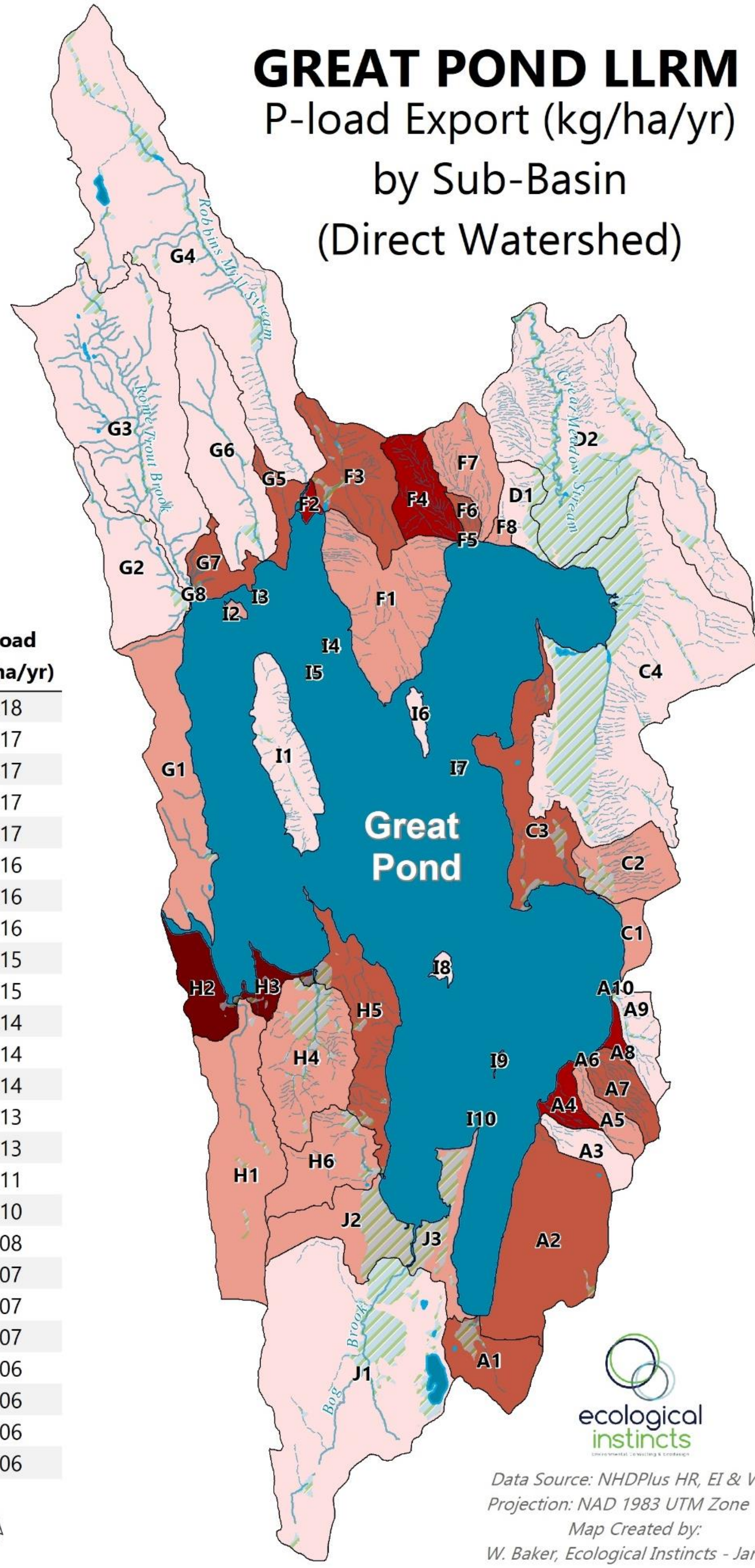
P-load (kg/ha/yr) by Basin



Basin	P-Load (kg/ha/yr)
Basin H (SW Shore)	0.21
Basin A (SE Shore)	0.21
Basin F (Jamaica Point)	0.20
Basin C (North Bay)	0.16
Basin D (Great Meadow)	0.15
Basin J (Bog Bk/Fosters Pt)	0.14
Basin G (Trout Bk/Robbins)	0.14
Basin B (MP/SL)	0.08
Basin E2 (Serpentine)	0.08
Basin I (Islands)	0.08
Basin E1 (North Pond)	0.08
Basin E3 (East Pond)	0.03

GREAT POND LLRM

P-load Export (kg/ha/yr) by Sub-Basin (Direct Watershed)



Legend

- < 0.15 kg/ha/yr
- 0.15 - 0.20 kg/ha/yr
- 0.20 - 0.25 kg/ha/yr
- 0.25 - 0.30 kg/ha/yr
- 0.30 - 0.40 kg/ha/yr
- > 0.40 kg/ha/yr

Sub-Basin	P-Load (kg/ha/yr)	Sub-Basin	P-Load (kg/ha/yr)
F5	0.57	J2	0.18
I9	0.46	A5	0.17
H2	0.37	F7	0.17
A10	0.35	H1	0.17
H3	0.32	G1	0.17
F2	0.29	F8	0.16
A4	0.29	I2	0.16
A6	0.28	H4	0.16
A8	0.26	D1	0.15
F4	0.26	G3	0.15
A1	0.25	C4	0.14
G5	0.24	G4	0.14
H5	0.24	G2	0.14
A2	0.24	J1	0.13
C3	0.23	A9	0.13
A7	0.22	I3	0.11
F6	0.21	G6	0.10
G7	0.21	A3	0.08
F3	0.21	I1	0.07
C2	0.20	I6	0.07
C1	0.20	I8	0.07
H6	0.20	I4	0.06
G8	0.18	I5	0.06
F1	0.18	I7	0.06
J3	0.18	I10	0.06

APPENDIX C. STEERING COMMITTEE & TECHNICAL ADIVOSORY COMMITTEE MEETING SUMMARY

STEERING COMMITTEE MEETINGS

The Great Pond WBMP Steering Committee was convened early on to help guide the plan development process by providing local input, assisting with public outreach activities, reviewing scientific recommendations, and helping prepare the watershed action plan. The committee also reviewed and provided feedback on the draft plan.

Steering Committee Meeting #1 - The first meeting was held on August 23, 2019 at the 7 Lakes Alliance offices in Belgrade Lakes Village. The purpose of the meeting was to review the work plan and schedule, the current monitoring schedule, available water quality data, and identify data gaps. The committee discussed known information about the extent of anoxia in the lake and possible treatment options should they be needed. The meeting wrapped up with a discussion about public outreach for the plan.

Steering Committee Meeting #2 - The second Steering Committee meeting was held remotely via Zoom on June 17, 2020. The purpose of this meeting was to provide a Technical Advisory Committee update to the committee. This included a presentation of the preliminary water quality analysis and watershed modeling, and an update on current monitoring efforts. 7 Lakes reviewed the project schedule, and a communications subcommittee was formed to set a date and agenda for the public meeting. A significant finding from the science report was that several water quality parameters appear to have improved over the ten years or leveled off. This includes a leveling off of the size of the area of low oxygen at the bottom of the lake that leads to phosphorus release from sediments. The reason for these changes is not well understood but may be tied to changes in weather (less rain means less runoff), watershed improvement efforts over the past decade (YCC, LakeSmart, land conservation), and/or other factors.

Steering Committee Meeting #3 - The final Steering Committee was held remotely via Zoom on January 27, 2021. The purpose of this meeting was to provide input on the draft WBMP.

TECHNICAL ADVISORY COMMITTEE (TAC) MEETINGS

The purpose of the Technical Advisory Committee (TAC) was to provide input on the technical aspects of the watershed planning process. This includes review and feedback on key project materials such as the water quality analysis and watershed modeling, as well as helping identify water quality thresholds and water quality goals. The TAC reviewed and provided feedback on the draft WBMP. The TAC met as a group three times during the project period.

TAC Meeting #1 - The first meeting of the TAC was held at the 7 Lakes office in Belgrade Lakes Village on November 18, 2019. Fifteen people attended this meeting. The purpose of the meeting was to review available water quality data and discuss planned monitoring activities for 2019/2020 as well as identify data gaps. Colby provided an update on the sediment analysis, and the committee reviewed planned methods for the watershed modeling task. Notable points from this meeting include: 1) the two monitoring stations in Great Pond exhibit different characteristics and turn-over times, with waters in the larger portion of the lake turning over earlier (likely due to increased exposure to wind); 2) Anoxia is prevalent in summer below the thermocline, yet migration of P into the upper water column is also limited by that same thermocline.

TAC Meeting #2 - The second TAC meeting was held remotely via Zoom on April 22, 2020. Eleven people attended the meeting. The purpose of the meeting was to get feedback on the preliminary water quality analysis, sediment analysis, and watershed modeling as well as discuss the approach for the public meeting. A few notable points from this meeting include: 1) the highest levels of phosphorus in the bottom of the lake occur in September just before the lake mixes; 2) an abrupt climate event resulting in a significant increase in phosphorus from the watershed, and/or changing surface water temperatures could be enough to shift the oxygen demand at the bottom of the lake so that internal loading becomes a concern, thus long-term monitoring efforts are needed to document any changes in anoxia occurring at the bottom of the lake; 3) more data is needed to better understand the impacts from septic systems in the watershed.

TAC Meeting #3 - The final TAC meeting was held remotely via Zoom on November 6, 2020. The purpose of the meeting was to review the 2020 monitoring results and updated water quality trend analyses, provide input on the future monitoring plan; provide an update on the sediment analysis; review watershed modeling results; and discuss water quality goal setting and the process for reviewing the WBMP. A couple notable points from this meeting include: 1) a septic vulnerability analysis conducted by DEP for the project indicates that 25% of the parcels in the direct watershed are located on at-risk soils with 206 located in the shoreland zone; and 2) the long-term water clarity trend (1970 – present) does not appear to be declining, but the 10-year trend shows a significant decline in water clarity.

APPENDIX D. GREAT POND PUBLIC MEETING Q&A

Great Pond Watershed-Based Management Plan Meeting Q & A

December 10, 2020 held via Zoom

Q1: How can we help stop erosion if we are not allowed to add dirt and lawn seed near the lake?

A1: The best defense on the shoreline is to plant hardy woody vegetation (ideally a mix of trees and shrubs of various heights) that will withstand the impacts of wave and ice action and stabilize the soil with their deep roots. A combination of native plantings and erosion control mulch to keep the soil in place is recommended. Allowing your shoreline to naturalize by not cutting vegetation, replacing lawns with native vegetation, and establishing a minimum buffer width of 10 ft will help filter runoff from your property. Buffer guides and planting fact sheets from the Maine DEP can be found here:

https://www.maine.gov/dep/land/watershed/materials.html

Q2: How many properties are on Great Pond shores*?*

A2: There are 866 lots in the shoreland zone (within 250 feet) of Great Pond, and 2,226 lots within the entire watershed.

Q3: Someone said NOW phosphorus is below level that causes algal blooms. Is that NOW as in Dec, or was that this past summer when a lot of occupancy and activity on lake?

A3: The average phosphorus level in the lake, over the course of the ice-free season when 7 Lakes/Colby/DEP do their monitoring, is below the level that causes algal blooms.

Q4: What is the current cottage count on Great Pond?

A4: Refer to #2 above. There is no known current house count available at this time.

Q5: How often do you update the land and watershed info to generate the land cover maps used as part of the Watershed Based Management Plan?

A5: The Watershed Management Plan and the Watershed Survey are updated every 10 years. Some information is updated more often. Erosion control and LakeSmart project sites are updated continuously.

Q6: Some woods have been removed on Brook Drive off of Horse Point and the land razed. This is causing water from Horse Point Road and the nearby bogs to head toward low areas and I get a lot of water on my camp lawn. Could the water be redirected to flow on the other side of Horse Point Road down past the hill past Brook Drive and then though a culvert into the other bog?

A6: Please contact 7 Lakes to set up a site visit in spring 2021. As a town road is involved, contacting the town manager and/or road commissioner may also be helpful.

Q7: Do we have knowledge of bad/old septic systems? What can we do to generate an action plan for the landowners? Is there agreement that this is a controllable that we should be attempting to drive down to zero?

A7: There is currently little data on bad septic systems. There is a database of septic systems in the towns and at the State that are available to identify old septic systems. The Steering Committee plans to do education and outreach with landowners and the real estate community as part of the Management Plan. The State has recently changed the law to require septic system testing when properties are transferred. There is debate among scientists about the size of the effect of septic systems on lake water quality. There will be additional testing to better determine septic system impacts on Great Pond.

Q8: In Fairfield, there is a huge problem with "forever chemicals" from farm sludge polluting drinking water wells. Is there any use of that same polluting sludge in the Belgrade area?

A8: The Steering Committee is not aware of municipal sludge being used in Belgrade or in Rome. We will make those inquiries with the towns and/or other entities this winter. NOTE: please provide us with any contacts in Fairfield that may help provide information about this problem.

Q9: What data do you have on changes in the water temperature in the last 50 years.

A9: The DEP maintains a dataset of this as well. Surface water temperatures have increased across the Belgrades over the period we have data for.

Q10: What is an NPS site?

A10: Non-point source (NPS) pollution. Diffuse sources of pollution such as soil erosion that add up to a whole lot of impact.

Q11: What was the phosphorus PPB reading in North Pond before the algae bloom this past summer?

A11: 30 ppb

Q12: If we have a concern about an issue on a lake that feeds into Great- who can we contact to get it checked out?

A12: 7 Lakes Alliance
137 Main Street
PO Box 250
Belgrade Lakes, ME 04918
(207) 495-6039

info@7 Lakesalliance.org
www.7 Lakesalliance.org

Q13: If an alum treatment would nullify the negative effects of internal loading, why wouldn't we do this as we continue to work runoff issues as this feeds the internal loading over time?

A13: The effect of internal loading is small (10%), so it doesn't have as much of an impact on water quality as the watershed load. Until the watershed loading issue is reduced significantly, any sediments treated with alum will become buried by new sediments entering the lake annually from the watershed, reducing the efficacy and longevity of an in-lake treatment.

Q14: Would it be better to have a paved road or blue stone surfaced road along the lake?

A14: There are situations in which paving may be more beneficial than gravel and vice versa. Paving is typically recommended on steep roads and driveways that continually erode every year. If paving is recommended, then any water flowing off the pavement should be designed to be captured and infiltrated into the ground rather than running off into a nearby ditch or waterbody.

Q15: What form of bank stabilization is allowed? Rock gabions and riprap or just plantings?

A15: Please contact Maine DEP and your town's Code Enforcement Officer if you are concerned about an eroding shoreline or bank and be sure to obtain the proper permits. Vegetation is the best solution for most shoreline erosion. Riprap will only be permitted if the eroded slope is steeper than 3:1. Rock gabions are not typically used for residential or small-scale bank stabilization projects. Sites with shoreline undercutting (caused by ice and wave action) do not need to be actively managed unless a structure is threatened, or significant soil loss is occurring.

Q16: How does one know if their property was one of the 237 NPS areas identified? This would be good for those properties to know.

A16: If their property was one of the 237, they would have been sent a letter directly. Some letters were returned undeliverable, however. They can contact Art Grindle (the Erosion Control Coordinator at 7 Lakes, who is partially funded by BLA) at art.grindle@7 Lakesalliance.org if they suspect they are on that site list or should be or have erosion issues.

Q17: When lawns are mowed should clippings be removed

A17: Lawns are healthiest when the grass mulch is left in place. If you use a mower that collects grass clippings, these should be composted away from the shoreline in an area that will not result in runoff. Since lakes are healthiest with less lawn, we encourage replacing large lawn areas with natural vegetation, especially at the immediate shoreline.

Q18: What can we do about all the grass clippings that appear to be coming from the south end of Great Pond?

A18: Public awareness is a vital tool in improving the lake water quality. There will be a communications committee going forward to help spread the word about such issues.

Q19: Lake smart revisits? How to get properties that do not have buffers to address the issue?

A19: BLA has an incentive program to help with buffers. It's a rebate for plant purchases. If a property owner would like a LakeSmart revisit they can contact Art Grindle at art.grindle@7 Lakesalliance.org. He has been following up with owners to arrange revisits too. Neighbors helping neighbors goes a long way too!

Q20: Anyone ever consider tax abatements/reductions for effective buffers?

A20: The Steering Committee wants to consider ideas like this to provide incentives to landowners. Conversely, we have also discussed a stormwater or impervious surface fee for properties that are in the Shoreland Zone with a reduction in the fee for the kind of buffer BMP you suggest. These fees would be used to fund water quality improvement programs.

Q21: What percentage of the external load is coming into Great Pond from North Pond/East Pond and from McGrath Pond/Salmon Lake? Is this of significant concern?

A21: The revised watershed model indicates that the phosphorus load from direct watershed load accounts for 48% of the total watershed load compared to 11% from North Pond, 7% from McGrath Pond/Salmon Lake, 5% from the Serpentine, and 2% from East Pond.

Q22: Is there any way that municipalities can provide a land tax incentive to be LakeSmart or a disincentive if they are not?

A22: See 20 above: The Steering Committee wants to consider ideas like this to provide incentives to landowners. The City of Auburn, Maine, for example, has a stormwater fee. Lake Tahoe has an impervious surface fee. Both fees are used to fund water quality improvement programs. Landowner fees are reduced for reducing stormwater runoff and for installing erosion control projects (BMPs).

Q23: How is the Great Pond dissolved oxygen trend?

A23: The dissolved oxygen trend has stabilized, although the lake is still going anoxic in late summer. But the relative impact of this anoxia on phosphorus release from the sediments (the internal load) appears to be minor, based on the detailed measurements taken by Colby/7 Lakes since 2015.

Q24: How are new homeowners educated about shorefront regulations?

A24: This will be part of the outreach portion of the action plan.

APPENDIX E. GREAT POND WATERSHED NRCS SOILS

Sym	Soil Unit	Area (acres)	% Watershed		Hydro. Soil Group	Parent Material
BkB	Berkshire fine sandy loam, 0-8% slopes, v. stony	1,515	7%	29%	B	loamy supraglacial meltout till derived from phyllite and/or loamy supraglacial meltout till derived from granite and gneiss and/or loamy supraglacial meltout till derived from mica schist
BkD	Berkshire fine sandy loam, 15-35% slopes, v. stony	976	5%			
BkE	Berkshire fine sandy loam, 20-45% slopes, v. stony	55	0.3%			
BhB	Berkshire fine sandy loam, 3-8% slopes	75	0.4%			
BhC	Berkshire fine sandy loam, 8-15% slopes	4	0.02%			
BkC	Berkshire fine sandy loam, 8-15% slopes, v. stony	3,394	16%			
PdB	Paxton-Charlton fine sandy loams, 3-8% slopes	375	2%	11%	C/D	coarse-loamy lodgment till derived from mica schist
PeB	Paxton-Charlton v. stony fine sandy loams, 3-8% slopes	616	3%			
PeC	Paxton-Charlton v. stony fine sandy loams, 8-15% slopes	623	3%			
PbB	Paxton fine sandy loam, 3-8 % slopes	57	0.3%			
PbC	Paxton fine sandy loam, 8-15% slopes	8	0.04%			
PcD	Paxton v. stony fine sandy loam, 15-25% slopes	26	0.1%			
PcB	Paxton v. stony fine sandy loam, 3-8% slopes	218	1%			
PcC	Paxton very stony fine sandy loam, 8-15% slopes	365	2%			
WrB	Woodbridge fine sandy loam, 3 to 8 percent slopes	110	1%	10%	C/D	coarse-loamy lodgment till derived from mica schist
WrC	Woodbridge fine sandy loam, 8 to 15 percent slopes	7	0.04%			
WsB	Woodbridge v. stony fine sandy loam, 3-8% slopes	2,029	10%			
WsC	Woodbridge v. stony fine sandy loam, 8-15% slopes	18	0.1%			
PkB	Peru fine sandy loam, 0-8% slopes, v. stony	1,435	7%	8%	C/D	loamy lodgment till derived from granite and/or loamy lodgment till derived from mica schist and/or loamy lodgment till derived from phyllite
PfB	Peru fine sandy loam, 3-8% slopes	21	0.1%			
PkC	Peru fine sandy loam, 8-15% slopes, v. stony	140	1%			
PdC	Peru fine sandy loam, 8-15% slopes, v. stony	33	0.2%			
HkD	**Hinckley gravelly sandy loam, 15-30% slopes**	**594**	**3%**	**7%**	**A**	**sandy-skeletal glaciofluvial deposits derived from granite and gneiss**
HkB	**Hinckley gravelly sandy loam, 3-8% slopes**	**186**	**1%**			
HkC	**Hinckley gravelly sandy loam, 8-15% slopes**	**592**	**3%**			

RcA	Ridgebury fine sandy loam	4	0.02%	5%	C/D	coarse-loamy lodgment till derived from mica schist
RdA	Ridgebury v. stony fine sandy loam	966	5%			
SkB	Scio v. fine sandy loam, 3-8% slopes	658	3%	4%	C	very fine sand glaciolacustrine deposits
SkC2	Scio v. fine sandy loam, 8-15% slopes, eroded	186	1%			
HfD	Hartland v. fine sandy loam, 15- 25% slopes	12	0.1%	4%	B	coarse-silty glaciolacustrine deposits
HfC	Hartland v. fine sandy loam, 8-15% slopes	717	3%			
ScA	Scantic silt loam, 0-3% slopes	502	2%	3%	D	glaciomarine deposits
Sc	Scantic silt loam, 0-3% slopes	213	1%			
LyD	**Lyman loam, 15-25% slopes, rocky**	**287**	**1%**	**3%**		**loamy supraglacial till derived from granite and gneiss and/or loamy supraglacial till derived from phyllite and/or loamy supraglacial till derived from mica schist**
LyB	**Lyman loam, 3-8% slopes, rocky**	**20**	**0.1%**		**D**	
LyC	**Lyman loam, 8-15% slopes, rocky**	**15**	**0.1%**			
LzC	**Lyman-Rock outcrop complex, 8-15% slopes**	**22**	**0.1%**		**D**	
HrB	**Lyman-Tunbridge complex, 0-8% slopes, rocky**	**123**	**1%**		**D**	
HrC	**Lyman-Tunbridge complex, 8-15% slopes, rocky**	**179**	**1%**			
RF	Rifle mucky peat	548	3%	3%	A/D	organic material
Bo	Biddeford mucky peat, 0-3% slopes	420	2%	2%	D	organic material over glaciomarine deposits
TO	Togus fibrous peat	411	2%	2%	A/D	organic material
Lc	Leicester v. stony loam	311	2%	2%	A/D	coarse-loamy supraglacial meltout till derived from mica schist
BuB	Lamoine-Buxton complex, 0-8% slopes	229	1%	2%	C/D	fine glaciomarine deposits
BuB2	Lamoine silt loam, 3-8% slopes	210	1%			
Pa	Peat and Muck	244	1%	1%	A/D	organic material
SuD2	Suffield silt loam, 15-25% slopes, eroded	46	0.2%	1%	C	fine glaciolacustrine deposits
SuC2	Suffield silt loam, 8-15% slopes, eroded	144	1%			
SA	Saco soils	123	1%	1%	B/D	coarse-silty alluvium
WmD	**Windsor loamy sand, 15-30% slopes**	**14**	**0.1%**	**1%**	**A**	**sandy glaciofluvial deposits derived from granite and gneiss**
WmB	**Windsor loamy sand, 3-8% slopes**	**64**	**0.3%**			
WmC	**Windsor loamy sand, 8-15% percent slopes**	**42**	**0.2%**			
Lk	Charles silt loam, 0-2% slopes, frequently flooded	104	1%	1%	B/D	coarse-silty alluvium derived from metasedimentary rock
Sd	Scarboro mucky peat	102	0.5%	0.5%	A/D	sandy glaciofluvial deposits derived from granite and gneiss

W	Water*	102	0.5%	0.5%	--	--
BuC2	Buxton silt loam, 8-15% slopes	47	0.2%	0.2%	C/D	fine glaciomarine deposits
VA	Vassalboro fibrous peat	30	0.1%	0.1%	A/D	organic material
GP	Gravel pits	29	0.1%	0.1%	--	--
DeB	**Deerfield loamy fine sand, 0-8% slopes**	**16**	**0.1%**	**0.1%**	**A**	**sandy glaciofluvial deposits derived from granite and gneiss**
AaB	**Adams loamy sand, 0-8% slopes**	**14**	**0.1%**	**0.1%**	**A**	**sandy glaciofluvial deposits**
AaC	**Adams loamy sand, 8-15% slopes**	**4**	**0.0%**			
CF	Cut and fill land	8	0.0%	0.0%	--	--
HtC	**Lyman-Abram-Rock outcrop complex, 8-15% slopes**	**3**	**0.0%**	**0.0%**	**D**	**loamy subglacial till**
CnE	**Colton gravelly sandy loam, 25-45% slopes**	**2**	**0.0%**	**0.0%**	**A**	**sandy-skeletal glaciofluvial deposits**
CnC	**Colton gravelly sandy loam, 8-15% percent slopes**	**1**	**0.0%**			
Mn	Mixed alluvial land	1	0.0%	0.0%	--	coarse-silty alluvium derived from slate
	TOTAL	**20,642**		**100%**		
	*Lake area removed from total					

Soil Series are grouped by common soil unit and parent material and are listed in order of largest to smallest area within the watershed. Soils highlighted by **bold red text** are considered coarse soils at risk for short-circuiting if an improperly designed or installed leach field were to be sited here. These soil units may be at risk for short-circuiting or export nutrients to groundwater and adjacent natural resources because of rapid permeability.

APPENDIX F. STATISTICAL ANALYSIS OF 2015-2020 WATER QUALITY DATA

Great Pond Water Quality Summary Memo

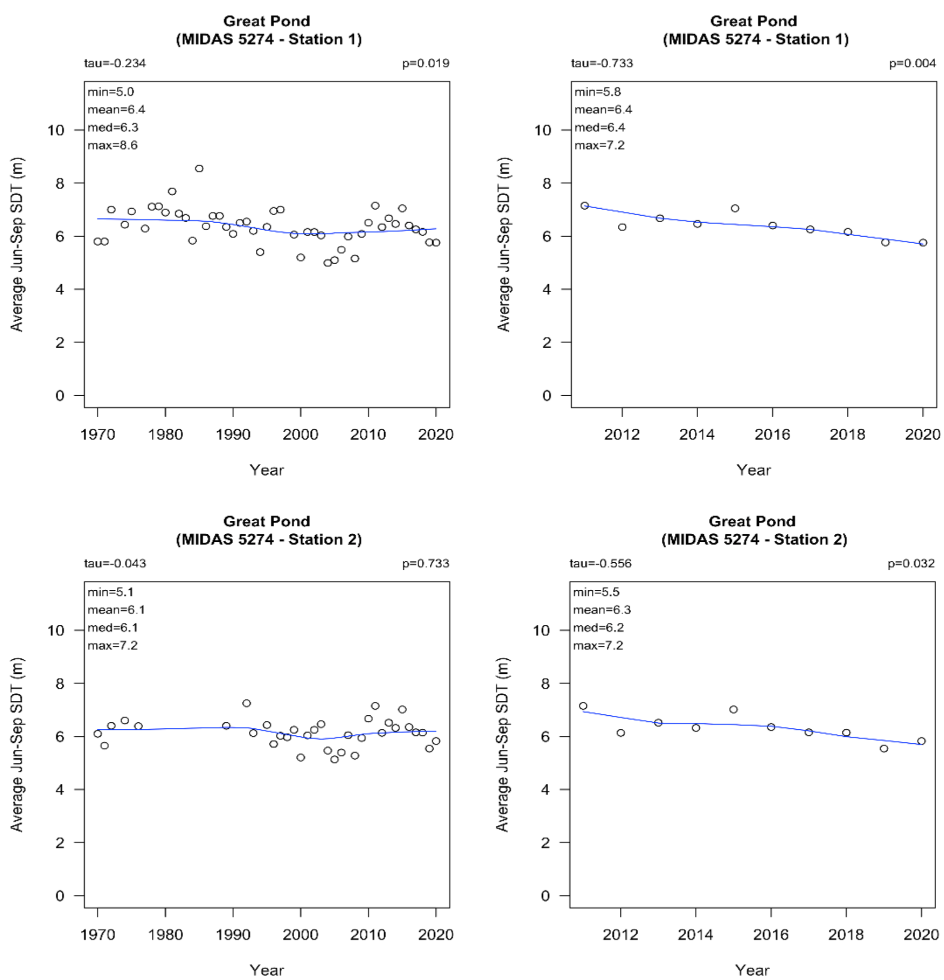
Dr. Danielle Wain, Lake Science Director, 7 Lakes Alliance

December 23, 2020

Secchi Trends

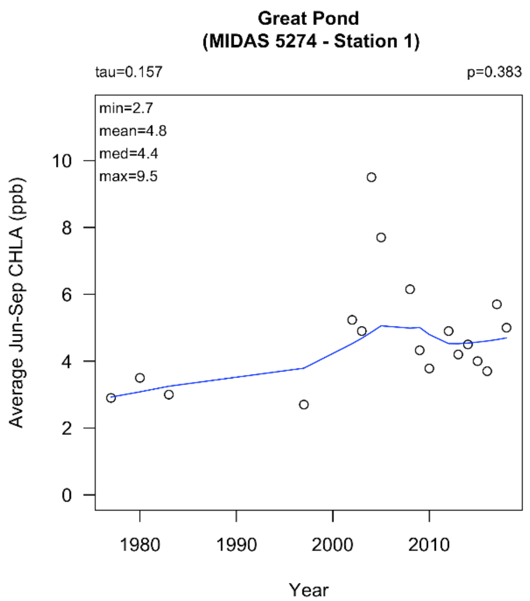
The data range for Secchi Disk Transparency (SDT) measurements in Great Pond is 1970-2020. Data from 1970 to 2015 was collected by certified lake monitors from Lake Stewards of (LSM) (formerly the Volunteer Lake Monitoring Program) and the Maine Dept. of Environmental Protection (DEP). From 2015-2020, most measurements on Great Pond were conducted by the 7 Lakes Alliance and Colby College, and most data was collected at Stations 1 and 2 between June and September. For this analysis, all data from a given month and year was averaged together, and all months from that year were averaged to generate the annual average. A Mann-Kendall trend analysis was conducted on the full time series as well as the last 10 years to determine if there was any significant trends in the data.

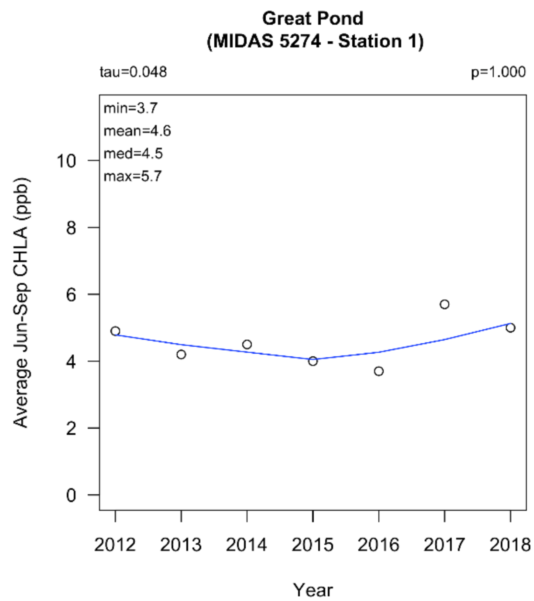
The **Station 1 SDT trend is significant for both time series, indicating a decrease in water clarity over time.** At Station 2, the trend in SDT over the past 50 years is not significant, likely due to gaps in the time series that are not present at Station 1. However, the short-term **SDT trend at Station 2 is significant and indicates a decrease in water clarity over the last 10 years.**

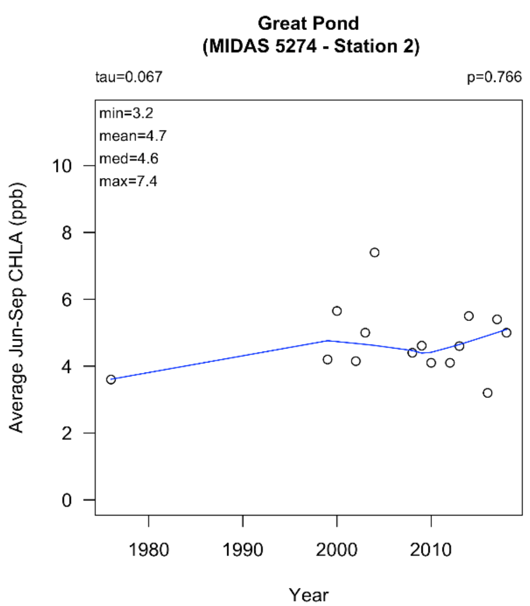


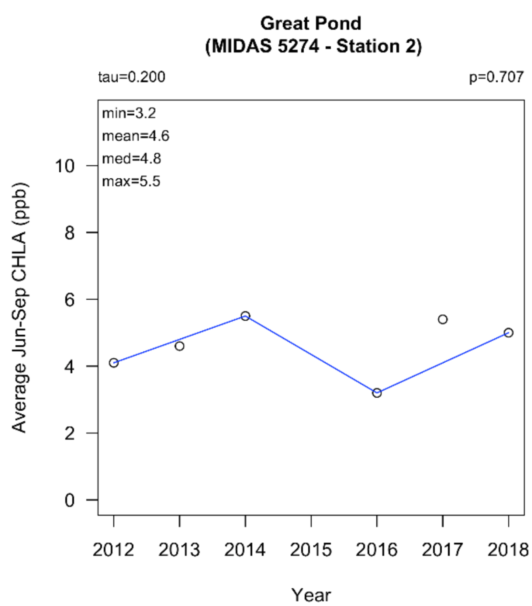
Chlorophyll Trends

The data range for Chlorophyll-a (Chl-a) is 1976-2018. Samples were taken from epilimnetic cores collected by DEP and certified lake monitors from LSM. Most data was collected at Stations 1 and 2 between June and September. For this analysis, all data from a given month and year were averaged together, and all months from that year were averaged to generate the annual average. A Mann-Kendall trend analysis was conducted on the full time series and the last 10 years to determine if there was any significant trends in the data. **There are no significant trends in Chl-a** at either station or for either time period.



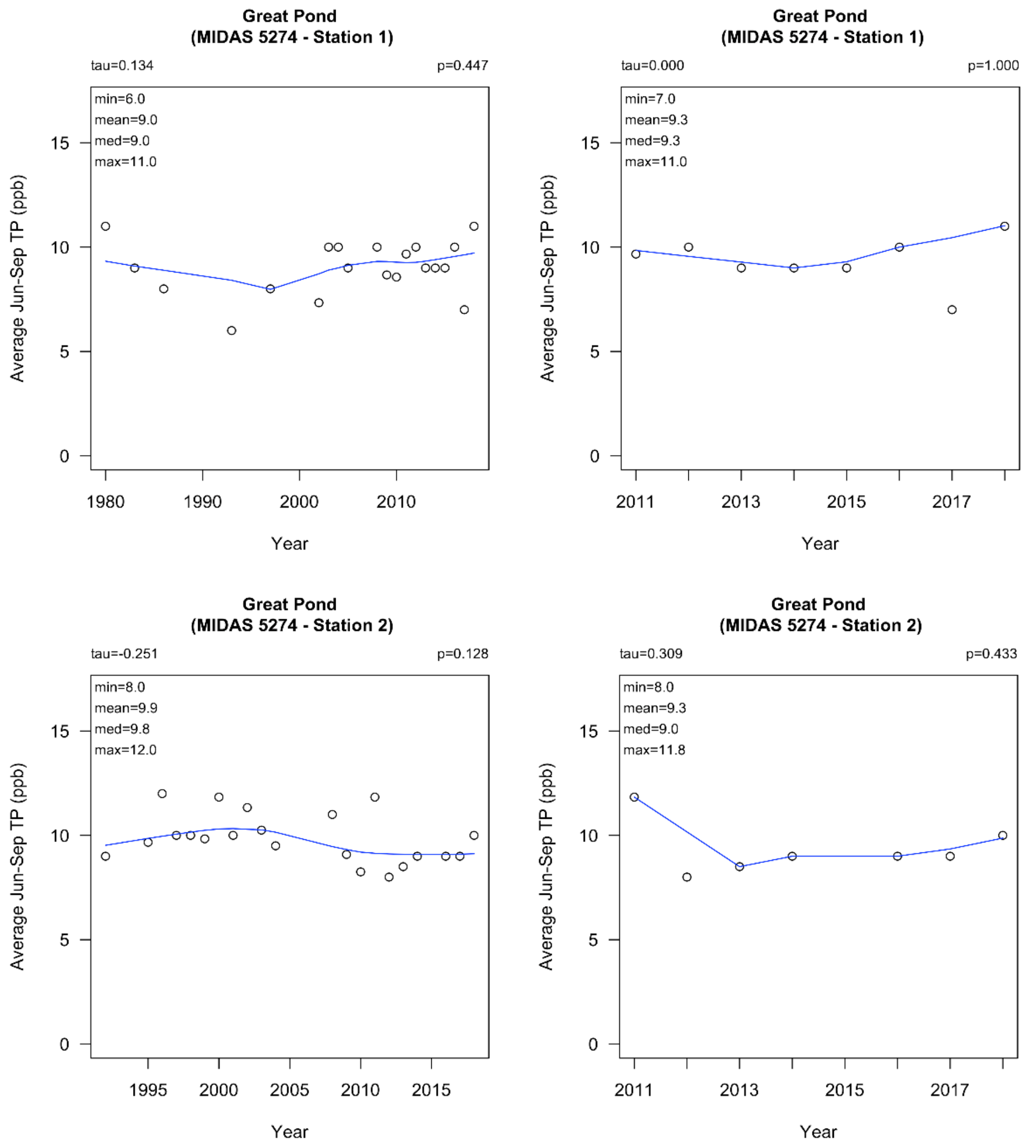






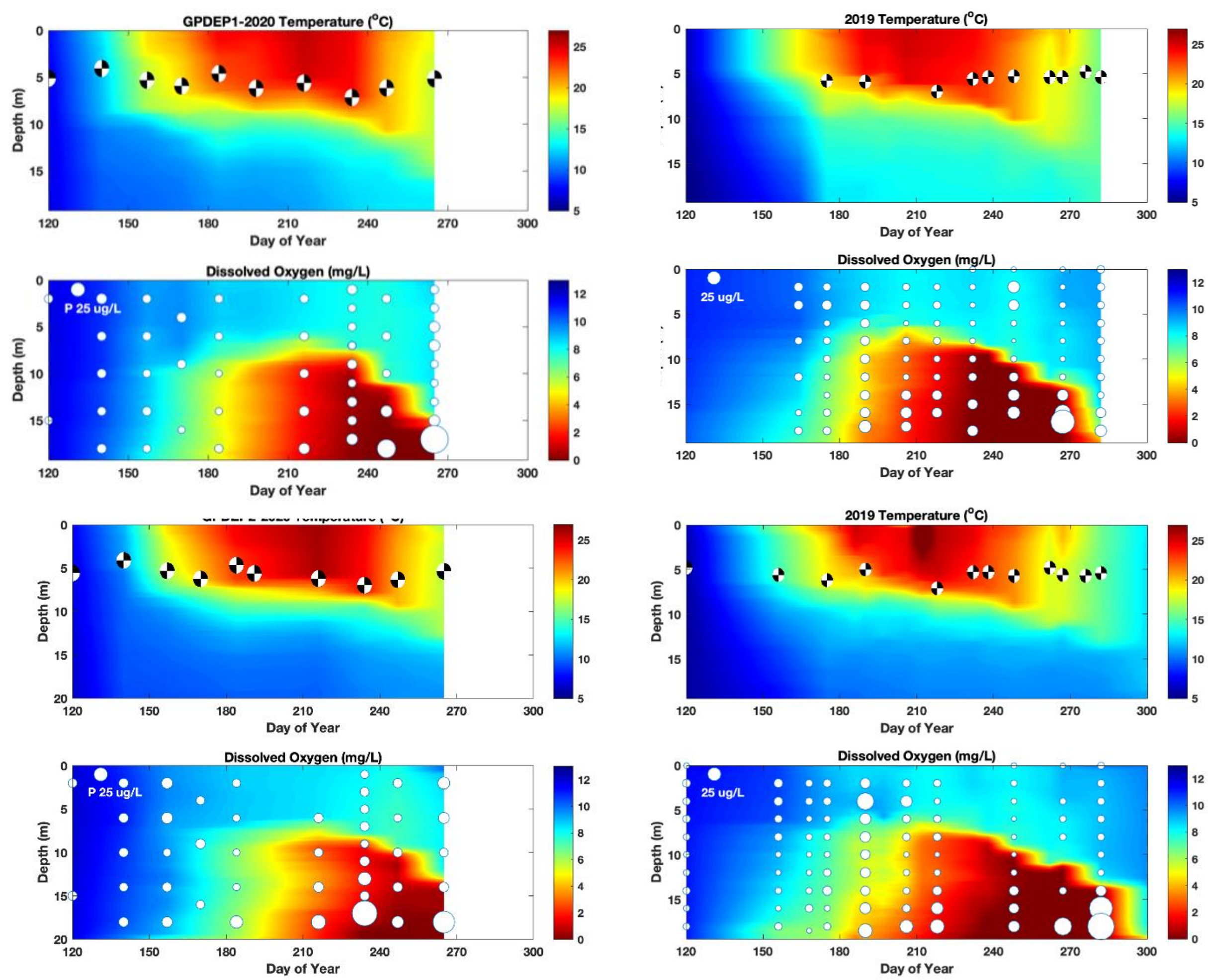
Phosphorus Trends

The data range for core measurements of Total Phosphorus (TP) measurements is 1980-2018. This data was collected by the DEP and certified lake monitors from Lake Stewards of Maine. Most data was collected at Stations 1 and 2 between June and September. For this analysis, all data from a given month and year was averaged, and all months from that year were averaged to generate the annual average. A Mann-Kendall trend analysis was conducted on the full time series and the last 10 years to determine if there were any significant trends in the data. **There are no significant trends in total phosphorus** at either station or for either time period.



Seasonal Patterns

Water quality profiles are documented in Great Pond by the 7 Lakes Alliance-Colby College Water Quality Initiative. During a typical summer, when Colby interns are available, SDT and profiles of temperature and oxygen are taken every week at the two stations using an In Situ multiparameter water quality sonde. Every two weeks, water samples are collected every 2 m with a Van Dorn sampler for total phosphorus and analyzed at Colby. When interns are not available, SDT and profiles are taken every two weeks and water samples are collected once per month at 4 m intervals.



The figures above show the patterns from 2019 and 2020, although data from all six summers of the Water Quality Initiative show similar results. The following patterns were observed in Great Pond over the course of the summer (June – September) between 2015 and 2020:

- **SDT** typically varies at both stations between 6 and 7 m, with the lowest values occurring in September and the highest values in July.
- **Surface temperature** at both stations typically ranges between 21 and 24 C, reaching its peak in July.
- **Bottom temperature** ranges between 13-14 C at Station 1 and 9-11 C at Station 2, both warming as the summer progresses.
- The **top of the thermocline** varies between 6-9 m at Station 1 and 5-7 m at Station 2, both getting deeper through the summer.
- **Dissolved oxygen** (DO) at the bottom of the lake at both stations ranges between 0 and 5 mg/L, with the lowest values occurring at the end of August.
- **Onset of hypoxia** (when the DO first drops below 5 mg/L at any depth) typically occurs in July.
- **Hypoxic depth** (below which the DO is < 5 mg/L) ranges between 9-11 m at Station 1 and 8-13 m at Station 2; much of the water below the thermocline is hypoxic, so the hypoxic depth gets deeper through the summer along with the thermocline.
- **Onset of anoxia** (when the DO first drops below 2 mg/L at any depth) is typically in late August.
- **Anoxic depth** (below which the DO < 2 mg/L) at both sites typically ranges between 10 and 14 m, increasing in area with the thermocline as the summer progresses.
- **Phosphorus in the surface water** at both sites typically ranges between 6 and 12 ppb and is quite variable with no particular seasonal trend.
- **Phosphorus near the bottom** typically ranges between 8-18 ppb at Station 1 and 11-26 ppb at Station 2, with values increasing through the summer with a maximum near the end of September.

Future Monitoring Plans

With a hopeful return to regular operations with Colby interns, in 2021, the 7 Lakes Alliance plans to continue the baseline monitoring that is presented in this summary. Based on the gaps in the data observed during the watershed management planning process, we would like to expand that monitoring to include:

- Regular sampling at Station 3 (in approximately 10 m of water) to monitor ephemeral stratification and anoxia, and potential release of phosphorus at shallower depths;
- Expand lake monitoring program to include nitrate, silicate, and chlorophyll concentrations;
- Expand plankton quantification to include zooplankton abundance;
- Complete sediment geochemistry inventories at multiple sites across the lake;
- Begin a stream sampling program documenting flows and nutrient fluxes;
- Establish a harmful algal toxin monitoring program.

APPENDIX G. RELATIONAL METHOD FOR ESTIMATING PHOSPHORUS REDUCTION

GREAT POND (DIRECT & INDIRECT)						
Source Type	Sub-type	Fraction of total load	Fraction Addressed	Expected BMP Efficiency	Load Fraction Reduced	
Agriculture						
	Cultivated Land	0.000	0.2	0.37	0.0%	
	Hayland/Grassland/Hobby Far	0.089	0.2	0.5	0.9%	
	Operated Forest	0.097	0.2	0.78	1.5%	2%
			0.2			
Urban Development						
	Low Density Development	0.064	0.2	0.42	0.5%	
	Medium Density Development/	0.028	0.2	0.4	0.2%	
	Developed Open Space	0.036	0.15	0.4	0.2%	
	Paved Roads	0.063	0.2	0.4	0.5%	
	Gravel Roads	0.051	0.2	0.4	0.4%	
	Gravel Pits	0.020	0	0.25	0.0%	2%
Non-Developed Land						
	Unmanaged Forest	0.172	0	0	0.0%	
	Open Water	0.048	0	0	0.0%	
	Scrub/Shrub	0.002	0	0	0.0%	
	Emergent Wetlands	0.008	0	0	0.0%	
	Forested Wetlands	0.040	0	0	0.0%	0%
Atmospheric		0.118	0	0	0.0%	
Internal		0.096	0	0	0.0%	
WaterFowl		0.035	0	0	0.0%	
Septics		0.034	0.1	0.75	0.3%	0.3%
	Total	1.00				

Expected Load Reduction	**5%**
TP Export Load kg TP	**2864**
TP Export Loading Target	**2734**
TP Reduction Needed	**130**
% Reduction Required	**n/a**
% Reduction Possible	**5%**

Indirect Watershed Load (kg/yr)
29

GREAT POND (DIRECT ONLY)						
Source Type	Sub-type	Fraction of total load	Fraction Addressed	Expected BMP Efficiency	Load Fraction Reduced	
Agriculture						
	Cultivated Land	0.000	0.2	0.37	0.0%	
	Hayland/Grassland/Hobby Far	0.063	0.2	0.5	0.6%	
	Operated Forest	0.115	0.2	0.78	1.8%	2%
			0.2			
Urban Development						
	Low Density Development	0.061	0.2	0.42	0.5%	
	Medium Density Development/	0.015	0.2	0.4	0.1%	
	Developed Open Space	0.038	0.2	0.4	0.3%	
	Paved Roads	0.036	0.2	0.4	0.3%	
	Gravel Roads	0.069	0.2	0.4	0.5%	
	Gravel Pits	0.024	0.2	0.25	0.1%	2%
Non-Developed Land						
	Unmanaged Forest	0.152	0	0	0.0%	
	Open Water	0.005	0	0	0.0%	
	Scrub/Shrub	0.001	0	0	0.0%	
	Emergent Wetlands	0.011	0	0	0.0%	
	Forested Wetlands	0.041	0	0	0.0%	0%
Internal		0.156		0		
Atmospheric		0.127	0	0	0.0%	
WaterFowl		0.046	0	0	0.0%	
Septics		0.045	0.1	0.75	0.3%	0.3%
	Total	1.00				

Expected Load Reduction	**5%**
TP Export Load kg TP	**2175**
TP Export Loading Target	**2074**
TP Reduction Needed	**101**
% Reduction Required	**n/a**
% Reduction Possible	**5%**