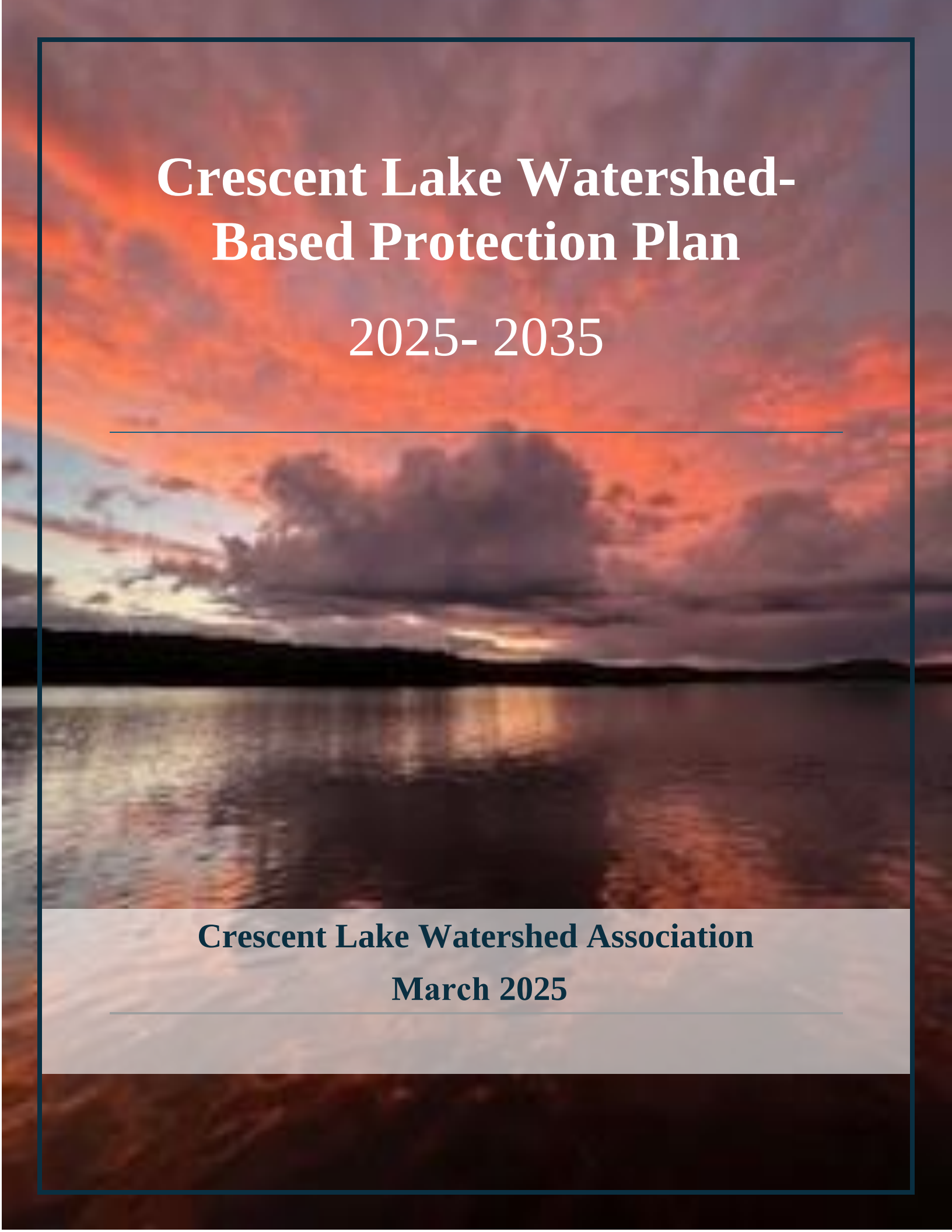

Crescent Lake Watershed-Based Protection Plan

2025- 2035

Crescent Lake Watershed Association

March 2025

Acknowledgements

Special thanks to volunteers from the Crescent Lake Watershed Association for providing input for the completion of this plan and their dedication to the protection of Crescent Lake's water quality for the enjoyment of future generations.

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1. Background Information

A. Purpose & Scope

The purpose of the Crescent Lake Watershed Based Plan, herein after referred to as the “plan”, is to lay out a strategy and schedule for Nonpoint Source (NPS) mitigation and water quality protection efforts for the Crescent Lake watershed over the next ten years (2025 to 2035). Crescent Lake Watershed Association (CLWA) prepared the plan with assistance and input from Maine Department of Environmental Protection (ME DEP), and United States Environmental Protection Agency (EPA).

The plan was developed to satisfy national watershed planning guidelines provided by the EPA. EPA requires nine-element plans for impaired watersheds but allows alternative plans in several cases including for protection of high quality or unimpaired waters. ME DEP accepts alternative plans for unimpaired lakes that have completed a recent watershed survey provided that the plans follow EPA and ME DEP guidance and include minimum planning elements. Crescent Lake meets these eligibility criteria.

Note: Information collected during the 2024 Crescent Lake watershed survey forms the basis for much of the plan. As such, the Crescent Lake Watershed Survey Report is attached to the plan in Appendix A.

B. Watershed Background

Situated in Maine’s scenic Lakes Region, the Crescent Lake watershed covers the towns of Raymond (74%), Casco (23%), and Poland (3%) in predominately Cumberland County with a small portion of Poland in the upper watershed in Androscoggin County, Maine. The lake drains into Panther Pond, and eventually Sebago Lake, which provides drinking water to one-sixth of Maine's population, including Portland. Watershed statistics are listed in Figure 1.

It plays a vital role in the local economy and serves as an important habitat for Maine’s wildlife. Its shores are developed with over 203 seasonal and year-round homes, a large commercial campground (Kokatosi), four private youth camps (Laurel South, Camp Crescent Cove, Camp Pinehurst, and Camp Agawam), two small public beaches (one in Raymond and one in Casco), the Raymond public boat launch, and an extensive network of unpaved camp roads. The lake is fed by Edwards (also referred to as Davis) Brook, Raymond Pond, the Tenny River, as well as several intermittent streams.

Crescent Lake is renowned for its picturesque landscape, rich wildlife, and year-round recreational activities, such as swimming, water skiing, boating, fishing (both warmwater and coldwater), birdwatching, kayaking, sailing, canoeing, ice skating, and snowmobiling. The Maine Department of Inland Fisheries and Wildlife manages the lake's fisheries and water levels (via the Mill St. dam), making it a popular destination for bass fishing. The water quality is above average and there are no known invasive aquatic plants.

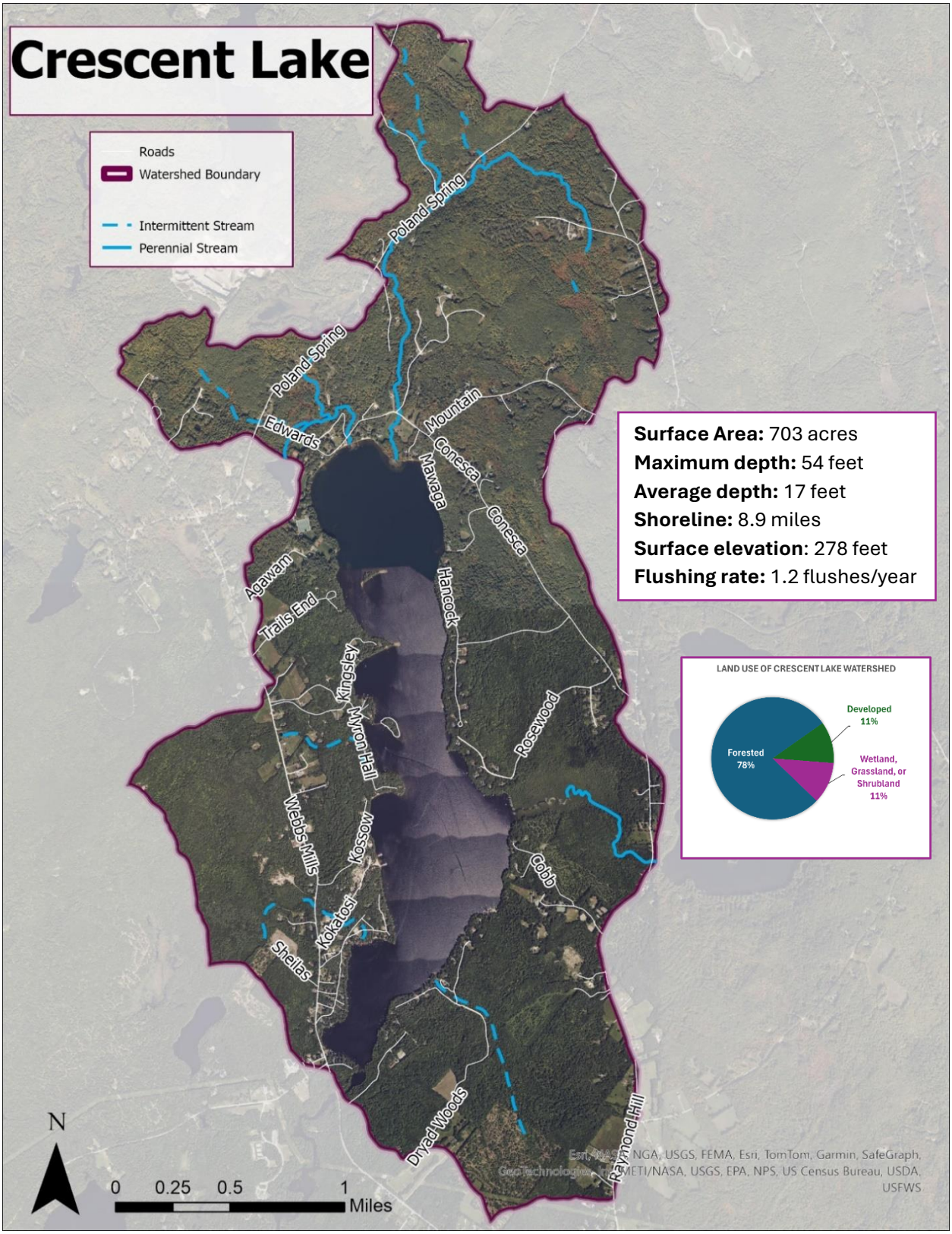


Figure 1 Crescent Lake Watershed

C. Summary of Prior Watershed Work

The Raymond Waterways Protection Association (RWPA) was established in the early 1970s to monitor and preserve the lake water quality of all Raymond lakes, including Crescent Lake. Crescent Lake Watershed Association (CLWA) was established in 2008 and works closely with RWPA on critical programs dedicated to protecting Crescent Lake. These objectives are accomplished through a variety of programs. The Water Quality Monitoring program on Crescent Lake dates to 1974 and is currently conducted by locally trained and certified volunteers through Lake Stewards of Maine. In its first year (2008), CLWA successfully ran the Maine DEP LakeSmart program, now part of Maine Lakes. This program offers free property evaluations and serves as an education and outreach program that rewards lakefront homeowners who manage their land to protect water quality. Landowners who receive an evaluation get individualized suggestions for their site to keep pollutants from stormwater out of the lake. Crescent Lake Invasive Plant Patrollers (CLIPPers) is the volunteer invasive plant patrol program on Crescent Lake that promotes prevention, early detection and rapid response to invasive aquatic plans. The lake gets divided into sections and volunteers patrol, survey and inventory sections each year, submitting reports annually to Lake Stewards of Maine. RWPA and CLWA collaborate to fund staff and organize volunteers to provide boat inspections at one public boat launch (Raymond Boat Launch) on Route 85 through the Courtesy Boat Inspections (CBIs). A group of CLWA volunteers have been addressing the problems of wakes on Crecent lake through the Wake Wise Education program, educating people on wakes and the impacts of large boat wakes on Crescent Lakes ecosystems, wildlife and human safety through distribution of pamphlets, and education materials at kiosks at the Raymond Boat Launch. CLWA also maintains a kiosk at Raymond and Casco beaches with information about loons; fish; CBIs, lake monitoring, additional watershed work, watershed history, and maps. In the past, they have worked in collaboration with summer camps in the watershed to host educational events such as “Look Out for Loons”, and Camp Agawam has collaborated with Lake Stewards of Maine’s Lakes Alive program.

The Raymond Conservation Commission organized the Cresent Lake Watershed Survey in 2000 in which volunteers identified 139 erosion sites. Following the survey in 2001, the Cumberland County Soil and Water Conservation District (CCSWCD) received $58,710 in Clean Water Act section 319 funding to implement the Raymond Pond and Crescent Lake Demonstration Project (#2001R-03). This project included the stabilization of nine identified NPS sites in the Crescent Lake watershed and six in the Raymond Pond watershed (indirect watershed of Crescent Lake) and provided technical assistance to nine landowners in the Crescent Lake watershed and 11 in the Raymond Pond watershed.

In 2008 FB Environmental conducted the Northern Crescent Lake Preliminary Feasibility Study[1] investigating increasing rates of sedimentation occurring in the northern portion of Crescent Lake at the outlets of Robinson and Edwards (Davis) brooks. This caused the formation of sand bars, a decline in water quality, and an increase in aquatic plant growth along the northern shoreline. Excess sediment loading and overland flow and erosion from the Robinson and Edwards Brook watersheds were identified to be the primary cause of these issues. In-lake recommendations to reduce these loads included in-lake data collection to obtain bathymetric, soft sediment thickness, sediment quality, water quality, and aquatic plant data. Watershed recommendations included reconnaissance surveys and field data collection in both watersheds to identify potential locations for Best Management Practice (BMPs) installments and to identify sources to sediment loading.

In the fall of 2009 RWPA staff and Crescent Lake residents conducted a shoreline survey to identify potential LakeSmart properties and candidate erosion sites from the 2000 watershed survey and identified 70 priority areas. In 2011, the Town of Raymond received $79,133 in CWA s. 319 funding implement the Crescent Lake NPS Watershed Protection Project, Phase I (#2011RR03). This project installed conservation practices at 21 of the priority erosion problems, and 11 residential sites were addressed through a small matching grant program. Additionally, the Town of Casco replaced three undersized culverts on Edwards Road with large concrete box culverts that were subject to chronic road washouts. CLWA also provided technical assistance to two camps and completed several projects at Camp Laurel South. The Town of Raymond has provided in-kind match to support conservation projects on many of the lakes and ponds in Raymond. As part of this grant, staff and volunteers conducted a watershed survey in May 2011 to check on the sites from the 2000 and 2009 surveys to determine which sites continued to impact the lake and identified 70 additional sites which were used to develop the *Crescent Lake Watershed-based Protection Plan (2013).*

In 2014 the Town of Raymond received $82,049 in CWA s. 319 funds to implement the Crescent Lake NPS Watershed Protection Project, Phase II (#2014RR03). The grant was implemented in partnership with CCSWCD, FB Environmental and the Town of Casco. This project successfully addressed 25 NPS sites in the watershed. This included 11 priority erosion sites, such as the Raymond Boat Launch, Camp Agawam, Camp Laurel South, public beach parking, private gravel roads and town roads. An additional 10 residential sites were addressed through a small matching grant program, and 28 landowners received free technical assistance to assess their properties.

Since 2007 there have been approximately 73 LakeSmart inspections resulting in 19 awards including 10 renewals and numerous letters of commendation. All inspections are followed up with an evaluation report and suggestions to address issues specific to the property. To encourage participation in the LakeSmart program and the implementation of shoreline best

[1] FB Environmental. Northern Crescent Lake Preliminary Restoration Feasibility Study, February 20, 2008.

management practices, CLWA has offered a grant program to those willing to implement suggestions made in the LakeSmart evaluation report. The grant is participatory and dependent on the availability of funding. CLWA anticipates continuing the program and perhaps extending eligibility to properties noted in the 2024 Watershed Survey report.

2. Identification of the Causes or Sources of the NPS Threat

A. Water Quality Summary

The Maine DEP and CLWA volunteers have been testing the water quality of Crescent Lake since 1974. CLWA's team of certified volunteer lake monitors collect scientific water quality data at two stations on Crescent Lake bimonthly from May to September. Monitors use a Secchi disk and view scopes to measure water clarity and a dissolved oxygen (DO) meter to record temperature and dissolved oxygen throughout the water column. Surface water is collected and sent to the state laboratory to determine total phosphorus levels. During the past three years (2022-2024) lake monitors have employed a Van Dorn water sampler at the deep station on the lake to determine total phosphorus (TP) within the water column and near the bottom.

The water quality data generated monthly during the summer (from 1974 to 2022) at Station 1 includes 42 years of Secchi Disk transparency (SDT) readings as well as; 35 years of dissolved oxygen profiles, 13 years of alkalinity, 15 years of total phosphorus – epilimnion core and 14 years of total phosphorus – bottom grabs, 12 years of total phosphorus – surface grabs, 14 years of chlorophyll-a (Chl-a) levels, 11 years of conductivity, 5 years of pH, and 3 years of color.

Phosphorus is often considered the limiting nutrient in lake ecosystems because it is typically less readily available than other nutrients, like nitrogen, meaning the amount of phosphorus available influences the growth rate of algae. Increasing concentrations of total phosphorus in lake water generally indicates a potential increase in biological productivity of the lake and can foretell potential problems. When combined with Secchi transparency readings and dissolved oxygen and thermal profiles, TP samples provide additional information about lake ecosystem dynamics and help in understanding how to improve the lakes water quality. The concentration of most indicators of lake water quality varies within individual seasons, and from one year to the next. Therefore, it is best to analyze long term trends to spot emerging issues and provide evidence of the cause of lake health degradation.

Crescent Lake has slightly above average water clarity, the Secchi disk is visible to an average depth of 6.4 meters (21 feet) compared to the mean average for Maine lakes of 5.3m (17.4 ft). Historical averages for additional water quality indicators include total phosphorus of 6.5ppb for epilimnion core samples and 15ppb for total phosphorus bottom grab samples, 3.1ppb for chlorophyll *a*, 8.3SPU for color, 12mg/L $CaCO_3$ of alkalinity, pH of 7.3, and 53 µS/cm for conductivity.

In Crescent Lake, some water quality trends have remained reasonably stable over time. Average Secchi disk transparency has remained predominately between six-and seven meters since 1974. Thirty-year and ten-year trends are shown in Figures 2 and 3. The thirty-year moving average

shows that the annual SDT became shallower from 2005-2015, while the past ten years (Figure 3) shows a moving average back to 7m.

Figure 2. Average Yearly Secchi Depths
30-year trend (1992-2022)

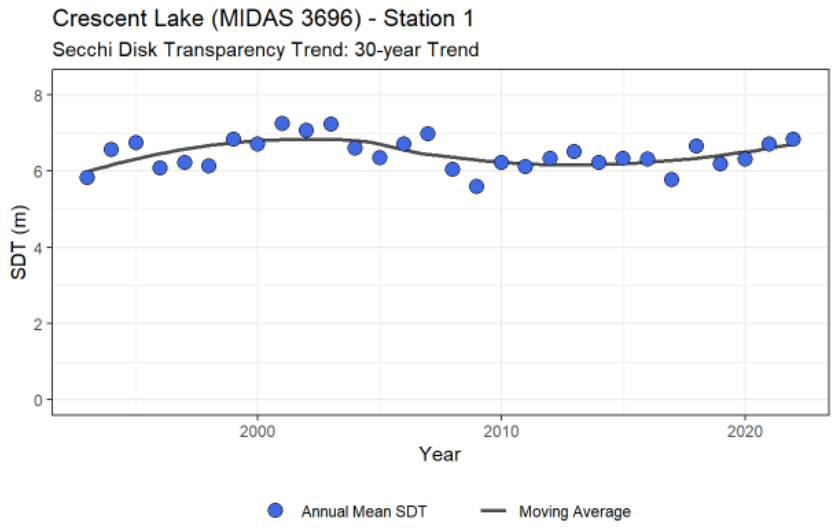
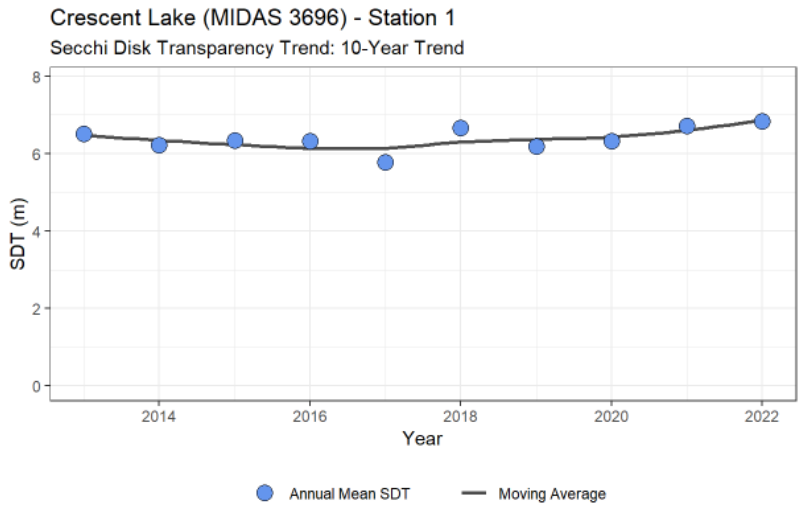


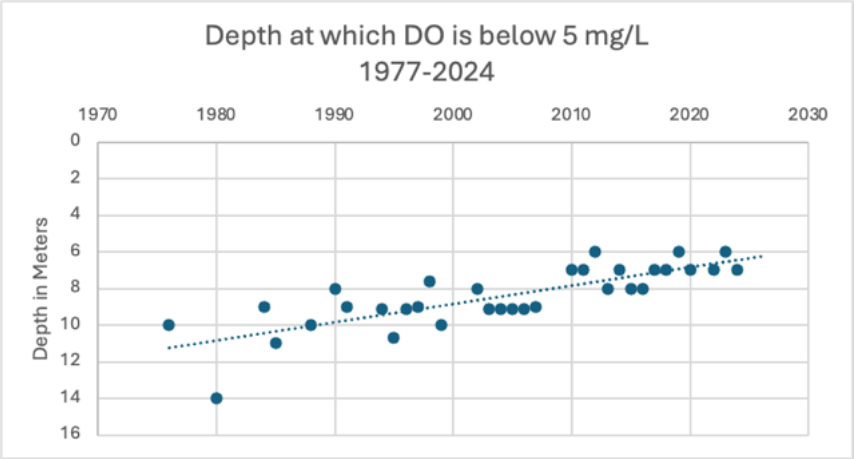
Figure 3. Average Yearly Secchi Depths
10-year trend (2012-2022)



However, the lake has shown a long-term trend of anoxic or near anoxic conditions higher in the water column thus threatening cold water fish requiring at least 5 mg/L of oxygen to survive (Figure 4). Lake temperatures have been warming by an average of about 1.4 degrees Fahrenheit per decade. Warmer waters have resulted in less ice coverage, with earlier ice-out and later ice-in dates. Less ice coverage and warmer waters has increased the period of summer lake

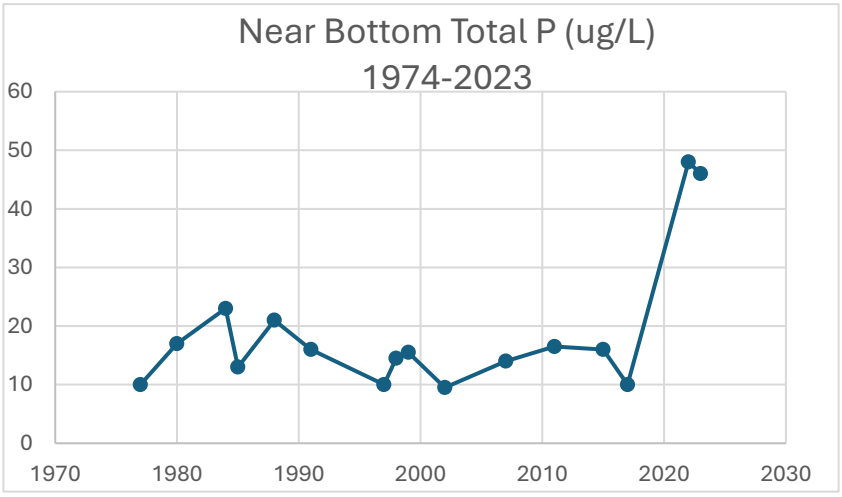
stratification, which impacts how long the bottom waters are deprived of oxygen. Not only are the bottom waters deprived of oxygen, but Figure 4 also demonstrates that the depth at which 5mg/L or less of oxygen is getting higher in the water column. Increasing the depth at which there is limited to no oxygen available. A persistent loss of oxygen may eliminate habitat for sensitive cold-water species.

Figure 4. Depth at which Dissolved Oxygen is below 5mg/L



A sediment analysis conducted on Crescent Lake sampled in 2011 and extracted and analyzed in 2013 measured the ratio of aluminum hydroxide $Al(OH)_3$ to iron hydroxide Fe(OH)3 (results were 5.15) and the ratio of $Al(OH)_3$ to reducible iron-bound phosphorus (results were 77.6) found in the sediment. An $Al(OH)_3$ to $Fe(OH)_3$ ratio of less than 3 and an $Al(OH)_3$ to P ratio of less than 25 indicates favorable conditions for phosphorus release from sediments under anoxic conditions. Crescent Lake is not considered vulnerable to internal loading based of this sediment chemistry data, however, TP recordings observed near the bottom increased drastically from 10µg/L in 1977 to 46µg/L observed in recent years (Figure 5**)**. This condition can occur from high external inputs of phosphorus from the watershed entering the lake from stormwater runoff and accumulating in the sediments that get released back in the water column when bottom oxygen levels drop, which allow for off gassing from the accumulated phosphorus in lake. Coupled with DO depletion at increasingly shallow depths, these trends are of increasing concern.

Figure 5. Total Phosphorus Bottom Grab Yearly Average



B. Threatened Status

Crescent Lake currently meets Maine state water quality standards. However, it is listed as threatened on Maine DEP's Nonpoint Source Priority Watersheds List[2] because it has been identified as being sensitive to additional phosphorus inputs. It is also listed in Maine Stormwater Law Chapter 502 as a "Lake Most at Risk from New Development"[3]. Any new development in the watershed is subject to the permitting requirements found in the Maine Stormwater Law (Chapter 500).

C. Watershed NPS Threats

Non-point source (NPS) pollution is the biggest threat to water quality in Crescent Lake. Twenty-three percent of the shoreline is developed, which creates conditions for up to 10 times more phosphorus to enter the lake in polluted stormwater runoff than would in a less developed area (Dennis, 1986)[4]. This is because impervious surfaces associated with development such as gravel and dirt roads, pavement, rooftops, and compacted soil allow water to flow faster and pick up more pollutants, where undeveloped areas have uneven, covered soil which allows water to pool and be filtered by surface debris and plants. Runoff carries phosphorus into the lake, which is a limiting nutrient for algae growth. Excess phosphorus can create ideal conditions for algae blooms to occur. These blooms reduce water clarity, can cause fish kills as decomposing algae depletes dissolved oxygen on the lake bottom, and can sometimes produce cyanotoxins which are harmful to humans and animals.

Roads and private residences are the largest source of polluted runoff to the lake. Issues such as poorly shaped roads or culverts can create conditions for large amounts of material to be washed into the lake during storm events. On private properties, areas of bare soil, limited buffer on the lake shore, and a lack of stormwater management practices around residences allows a smaller, but consistent flow of pollutants into the lake even during minor rain events.

To identify and address these problems, CLWA conducted a watershed survey and a shoreline vulnerability survey in 2024, with assistance from FB Environmental and ME DEP. The watershed survey surveyed non-shoreland properties and identified 23 erosion sites. Of these, seven were low impact erosion issues, nine were medium impact, and seven were high impact (Figure 6, Table 1). The most common land use associated with NPS sites was private roads (9) followed by driveways (6) and trails and paths (3). FB Environmental also conducted a shoreline vulnerability survey for shoreline properties which ranked disturbance to the shoreline by evaluating vegetated buffer, bare soil, extent of shoreline erosion, proximity of structures to the lake, and slope of the shoreline area. The sum of these scores generated a "Shoreline Disturbance

[2] Maine DEP Priority Watershed List: NPS Priority Watersheds List, Maine Department of Environmental Protection

[3] MAR list available at: Stormwater - Stormwater Management Law, Bur. of Land & Water Quality, Maine Department of Environmental Protection

[4] Dennis, Jeff. 1986. "Phosphorus Export from a Low-Density Residential Watershed and an Adjacent Forested Watershed." Lake and Reservoir Management Volume II.

Score" and a "Shoreline Vulnerability Score". Of the 203 shoreline parcels surveyed, 92 properties were identified as having conditions detrimental to water quality: a shoreline disturbance score above 7. Those 92 sites were then reviewed, and 31 are considered high priority and 61 are low priority. This data will be used to prioritize areas of shoreline for remediation. Figure 7 shows the location of NPS sites identified during the watershed survey, and the vulnerability and disturbance scores of every shoreline property assessed in the shoreline survey. A full report of both surveys is included in Appendix A of this plan.

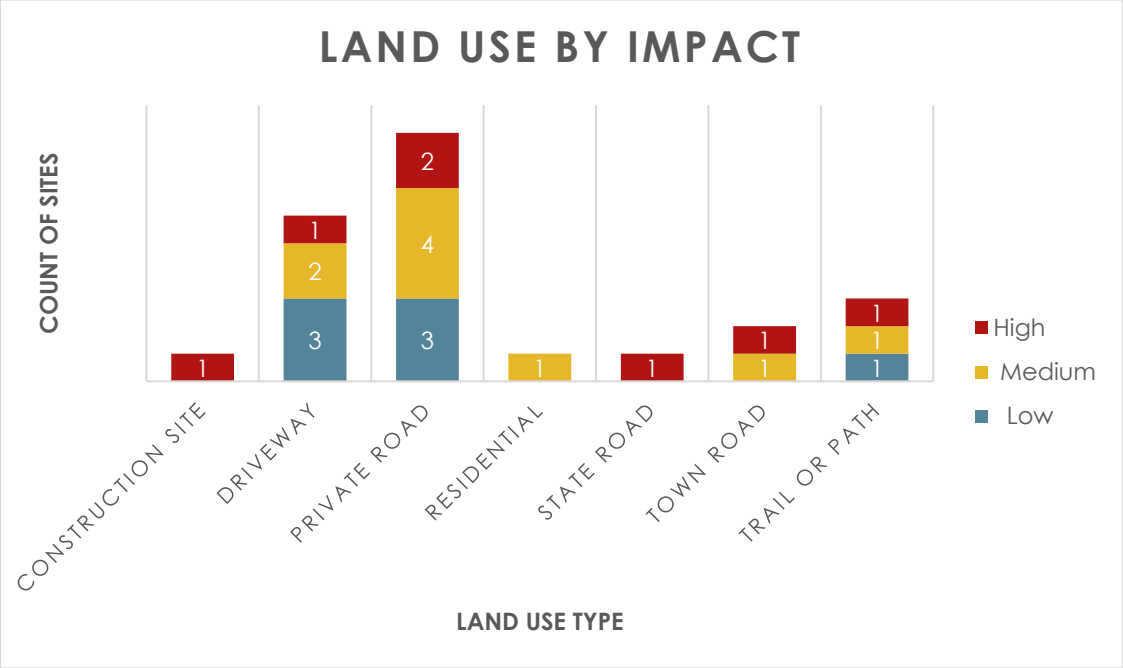


Figure 6. Land use by Site Impact

Table 1. NPS Sites Land Use and Impact

Land Use Type	High	Medium	Low	Grand Total	% of Total
Construction site	1			1	4.3%
Driveway	1	2	3	6	26.1%
Private road	2	4	3	9	39.1%
Residential		1		1	4.3%
State road	1			1	4.3%
Town road	1	1		2	8.7%
Trail or path	1	1	1	3	13.0%
Grand Total	7	9	7	23	100.0%

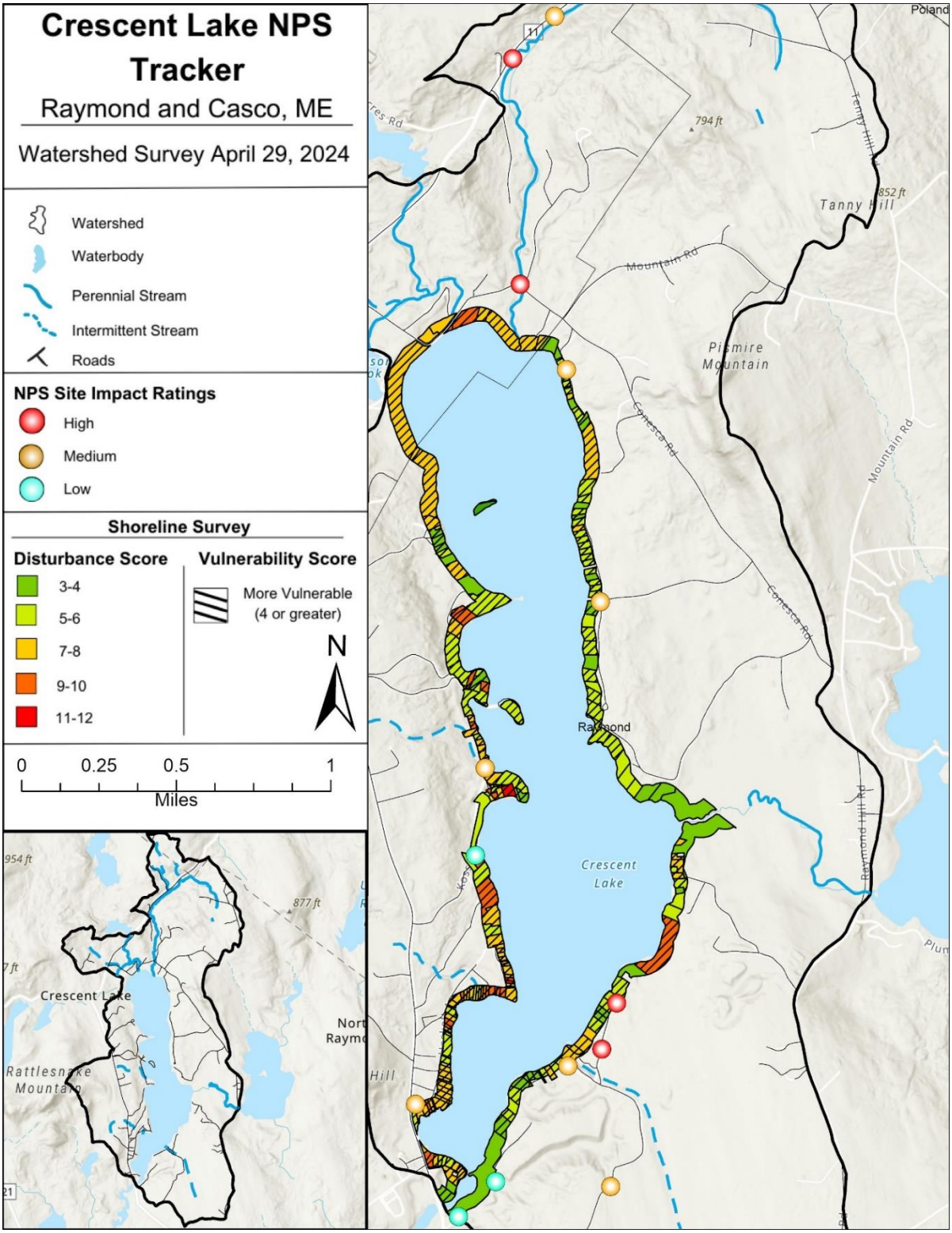


Figure 7. Crescent Lake NPS Tracker

3. Watershed Plan Goals and Objectives

The goal of this plan is to maintain or improve the Class GPA water quality standards in Crescent Lake by reducing the amount of phosphorus and sediment entering the lake. This will be achieved over the coming ten-year period (2025-2035) by implementing the following actions:

1. **Reduce existing sources of phosphorus** loading by fixing all 23 watershed survey sites identified in the watershed survey and addressing 31 residential shoreline sites identified in the shoreline vulnerability survey (those with scores above 7 *and* ranked as high priority). This will be achieved by providing targeted outreach, education, technical assistance, workshops, presentations, and cost-sharing assistance to install conservation practices at NPS sites identified. It is expected that sites will be addressed through a combination of grant cost sharing, and independent landowner initiative.

2. **Prevent new sources of phosphorus** by facilitating improved land use practices and ongoing maintenance activities. This objective will be met by conducting outreach, education, and providing technical assistance to residents, road associations, and municipal officials.

3. **Strengthen and maintain local capacity for watershed stewardship** by providing outreach and education; holding workshops and giving presentations; building CLWA supporters; and raising funds for mitigation work.

4. **Conduct ongoing assessment of lake and watershed condition** by monitoring lake water quality, patrolling and inspecting for invasive plants, and setting up and maintaining the NPS Site Tracker.

4. Schedule and Milestones to Guide Project Implementation

A. Action Plan and Schedule

Action items (Table 3) and an estimated implementation schedule with milestones (Table 2) were developed to prevent new NPS problems and address existing NPS sites, both within the watershed and along the shore to Crescent Lake over the next 10 years. The number and types of sites targeted in the plan is based on local knowledge about potential funding sources, landowner involvement, and other considerations. Other actions in the plan are included because they have proven to be cost-effective and successful in the region. The plan is designed to be implemented over a ten-year period, and an estimated schedule is provided for each action (Table 2). Potential funding sources and key partners are also identified for each action (Table 3). The plan will be carried out, in large part, with local funding and resources. However, state and federal funding, and grants will also be sought to help implement some actions in the plan.

Table 2. Implementation Schedule

2025-2026	• Mail notifications to all landowners (including the Towns of Casco and Raymond) in the watershed with the status of erosion on their property, suggested recommendations, and resources. • Apply for Clean Water Act section 319 fundsto address high and medium impact erosion sites. • Set up and maintain NPS Site Tracker.
2026-2029	• Implement USEPA CWA Section 319 funded project (pending approval of the grant). • Monitor and document projects. Track Pollutant Load reductions.
2025- 2035	• Conduct outreach and provide education on BMPs and lake-friendly living, including LakeSmart evaluations and Septic System outreach • Engage with Road Associations to offer Road BMP recommendations, Road Maintenance recommendations and Gravel Road workshops. • Apply for additional CWA s. 319 funding to address major NPS pollution in 2 additional phases (3 total) • Maintain, follow-up, and add new NPS sites to the NPS Site Tracker • Conduct annual monitoring – water quality monitoring, CLIPPers, CBI's

Table 3. Action Items

Action Items	Schedule[5]	Responsible Party	Cost[6]	Potential Funding Sources
Reduce existing sources of phosphorus (P) loading by addressing NPS pollution				
Notify landowners with identified NPS sites by mail – 50 mailings total (19 sites from the watershed survey, which include 1 residential site, 3 trail/path sites, 9 private road sites, and 6 private driveways. And 31 sites from the shoreline survey that ranked as high priority sites). Follow with onsite visits to interested landowners	2025	CLWA	$250	CLWA
Notify Towns of Casco and Raymond identified NPS sites.	2025	CLWA, Towns of Casco and Raymond	$750	Towns of Casco and Raymond, EPA (CWA 319)
Notify and provide recommendations to residential landowners whose properties had a disturbance score of 7 or greater in the Shoreline Survey but ranked as low priority- 61 sites	2025-2035	CLWA, Landowners	$1000	CLWA, EPA (CWA s.319) (, Landowners
Work with landowners to mitigate NPS pollution on residential sites (4 from the watershed survey, which	2025-2035	CLWA, Landowners with support from CCSWCD,	$42,000	CLWA, EPA (CWA s.319) Landowners

[5] Some actions are just a one time action that are aimed to happen in a specific year, others will happen at some point throughout the ten-year timeframe and therefore 2025-35 is included in this column, and some actions will happen annually, every year of the ten-year time frame and are included as “annual 2025-35”

[6] Costs are ten-year totals, with yearly totals provided in parenthesis where applicable. These costs include both cash and in-kind estimates.

includes trails and paths, and 31 from the shoreline survey) -35 sites		Portland Water District (PWD) and/or RWPA		
Work with road associations to mitigate NPS pollution on Private Road NPS Sites identified in the watershed survey- 9 Sites	2025-35	Road Associations, CLWA with support from CCSWCD, PWD and/or RWPA	$ 63,000	Road Associations, EPA (CWA s.319)
Work with Town of Raymond to mitigate NPS pollution on Town Road sites and public access points identified in the watershed survey – 2 Sites.	2025-35	CLWA, Town of Raymond	$20,000	Town of Raymond, EPA (CWA s.319)
Mitigate NPS pollution on State Road site identified in the watershed survey – 1 site	2025-35	ME DOT	$10,000	ME DOT
Work with private landowners to mitigate NPS pollution on Driveway NPS Sites identified in the watershed survey – 6 Sites	2025 -35	Homeowners, CLWA with support from CCSWCD, PWD and/or RWPA	$18,000	Homeowners, EPA (CWA s.319)
Prevent new sources of phosphorus				
Provide site visits for BMP recommendations and develop site specific BMP designs - 50 site visits	2025-35	CLWA, with support from CCSWCD, PWD and/or RWPA	$12,500	CLWA, EPA (CWA s.319) PWD
Septic System Maintenance outreach/education with pumping and maintenance schedules in digital and print newsletters. Advertise Maine Small Community Grant Program for cost-share opportunities.	Annual 2025-35	CLWA, with support from CCSWCD, PWD and/or RWPA	$1500	CLWA, EPA (CWA s.319) (for education and outreach)
Distribute BMPs and NPS	Annual	CLWA	$25,000	CLWA

pollution outreach and education via annual meetings, newsletters, training sessions, and website links.	2025-35		($2,500/yr)	
Continue to conduct LakeSmart Evaluations – with a goal of five per year. Continue to offer LakeSmart recommendations and implementation grants when funding is available.	Annual 2025-35	CLWA with support from Maine Lakes	$12,000	CLWA, EPA (CWA s.319)
Host Gravel Road Workshops led by ME DEP NPS Training Center – 3 workshops over 10 years	2025-35	CLWA, ME DEP NPS Training Center	$2,250	CLWA, EPA (CWA s.319), Towns of Casco and Raymond, Road Associations
Strengthen and maintain local capacity				
A plan implementation committee will meet annually to update NPS Site Tracker, plan grant phases, and check status of action items.	Annual 2025-35	CLWA, CCSWCD, Towns, PWD, RWPA, DEP	$10,000	CLWA, CCSWCD, Towns, PWD, RWPA, DEP (in-kind from all partners)
Apply for section EPA CWA. s319 funding.	2025-2035	CLWA, CCSWCD	$19,500	CLWA
Bolster CLWA supporters by keeping the community appraised of implementation projects, NPS sites, and water quality through outreach and education	2025-35	CLWA	$10,000	CLWA
Encourage volunteerism for continued water quality monitoring & invasive	Annual 2025-35	CLWA	$10,000	CLWA

plant (CLIPPer) program				
CLWA to continue holding annual meetings and provide updates on grants, erosion sites, and water quality issues.	Annual 2025-35	CLWA	$10,000 ($1000,yr)	CLWA
Review existing shoreland protection laws and provide resources for more robust enforcement.	2025	Towns of Casco and Raymond	$1,500	Towns of Casco and Raymond (in-kind)
Conduct outreach to Towns to ensure consideration of phosphorus loading and impacts to water quality when considering new development.	2025-35	CLWA, Towns of Casco and Raymond	$300 CLWA time for outreach N/A – Town Staff Time	Towns of Casco and Raymond
Conduct ongoing assessment of lake and watershed conditions				
Continue Water Quality monitoring	Annual 2025-35	CLWA with support from RWPA & LSM	$35,000 ($3,500/yr)	CLWA, Towns of Raymond and Casco
Conduct one & five-year BMP installation 2025-35 assessments to determine long-term effectiveness	Annual 2025-35	CLWA, CCSWCD, and/or third-party consultant	$10,000 ($1,000/yr)	CLWA
Contact Road Associations to encourage annual BMP maintenance and conduct assessments/follow-up.	2025-35	CLWA	$300	CLWA
Continue CBI inspection program to control invasive species.	Annual 2025-35	CLWA, RWPA	$53,500K ($5,350/yr)	CLWA, RWPA, Towns of Raymond and Casco

Create and Maintain NPS site tracker, follow-up, and add new sites	Annual 2025-35	CLWA	$10K	CLWA, EPA (CWA s.319)
Continue CLIPPer Program	Annual 2025-35	CLWA	$10K ($1,000/yr)	CLWA

B. Plan Oversight and Partner Roles

The CLWA will lead in directing and overseeing the actions necessary for implementing the Plan. Additionally, the CLWA will provide education /outreach, support, technical assistance through the LakeSmart program, submit grant applications, and manage and maintain the NPS Site Tracker. Below is a list of partners involved in executing the Plan, along with a summary of their key responsibilities.

Partners:

- **U.S. Environmental Protection Agency (EPA)** will provide guidance on grant programs, particularly Clean Water Act section 319, , workplan guidance, and selected project funding, pending acceptability of grant proposals, final workplans, and availability of federal funds.
- **Maine Department of Environmental Protection (ME DEP**) will conduct water quality monitoring and technical assistance and provide the opportunity for financial assistance through the NPS Grants Programs.
- **Raymond Waterways Protection Association (RWPA)** will help protect the water quality in our lakes, ponds, rivers, and streams, and promote good watershed stewardship; prevent and remove invasive aquatic species; conduct Courtesy Boat Inspections (CBIs); work with property owners in Raymond to survey their land, observe any erosion problems, and off offer suggestions for addressing those problems using best management practices (BMPs); and support water quality monitoring by loaning water quality monitoring equipment to lake associations.
- **Maine Department of Transportation (MDOT), Youth Camps**, **Campground**, **Road Associations**, and **private landowners** will address NPS issues on their properties.
- **The Towns of Raymond and Casco** may provide some funding support for the Plan, water quality monitoring, and work to address NPS problems on town road sites.
- **Portland Water District (PWD)** may provide technical assistance and likely cash match funding for grant projects.
- **Cumberland County Soil and Water Conservation District (CCSWCD)** will educate property owners on ways to improve drainage and decrease runoff through landscaping and green infrastructure like rain gardens, provide holistic and site-specific technical recommendations, and assist with proposal writing and implementation of State and federal grant funding.
- **Lake Stewards of Maine (LSM)** will train, certify, and provide technical support for monitoring a wide range of indicators for water quality, assessing watershed health and function, and screening lakes for invasive aquatic plants and animals.

- **Maine Lakes** will advocate on behalf of Maine's lakes at the statehouse; provide training for evaluators and coordinators for lake associations' LakeSmart personnel for keeping pollutants from stormwater out of the lake waters; and provide education on BMPs.
- **Loon Echo Land Trust (LELT)** will help preserve and protect land in the Lakes Region of Maine including the Crescent Lake Watershed to conserve natural resources and support the region's water resources and wildlife habitat for present and future generations.

C. Plan Outputs and Milestones

Outputs and outcomes to be accomplished over the ten-year period of this Plan.

Organizational Outputs

- Crescent Lake Watershed Association applies for Clean Water Act section 319 grants for three project phases over ten years
- NPS Tracker created and maintained; new sites added and follow-up on current sites
- Contact made with all property owners, road associations, and towns with identified NPS Sites

NPS Mitigation Outcomes

- 52 NPS sites addressed independently or with cost-sharing assistance
- 1 NPS site addressed by State agencies
- 61 Shoreline survey sites receiving education and reference materials provided by CLWA to improve site conditions by voluntary landowner initiative
- 50 LakeSmart evaluations (5 per year)

Water Quality Outcomes

- Meets lake Class GPA standards in ME DEP's biennial 303d reports
- Stable or improved trends for in-lake total phosphorus and chlorophyll-a

5. Proposed Management Measures

The Crescent Lake Watershed Survey Report (Appendix A) lists specific management measures recommended for each of the NPS erosion sites identified during the survey. The most common management measures recommended in the survey are described in the following section. Recommendations follow guidelines found in ME DEP publications including the Gravel Road Maintenance Manual, Conservation Practices for Homeowners fact sheet series, and the Erosion and Sediment Control Manual. The recommended BMPs accomplish this plan's goal of reducing phosphorus and sediment loading to the lake by stabilizing bare soil and erosion and diverting, infiltrating, or filtering polluted runoff before it reaches the lake.

In addition to structural BMPs recommended for each problem, public education and outreach efforts will also be needed to promote responsible stewardship and ongoing maintenance

activities. The NPS Site Tracker will be created and used by CLWA with support from ME DEP on an ongoing basis to identify new problems and to prompt maintenance on sites fixed through the plan.

A. Structural BMPs at NPS Sites identified in the 2024 Watershed Survey

Residential Sites (including trails and paths):

The watershed survey identified one residential erosion site and three trail or path sites on private residences. They are discussed here together since the management measures are similar. The shoreline survey identified 92 parcels with a disturbance score of seven or above indicating shoreline conditions at residential sites that may be detrimental to water quality, with 31 sites identified to pose a higher risk of impact to water quality.

Common problems included sheet erosion on bare soil, bare soil and/or gully erosion on walking paths, lack of vegetated buffers and erosion along roof driplines. Based on the survey results, the most common BMPs will include:

- Install Runoff diverters
- Install Infiltration steps
- Plant native buffers
- Use of Erosion Control Mulch
- Define access paths
- Meander Paths
- Install Infiltration trenches, rain barrels or raingardens

The one residential site identified in the Watershed Survey was a unique site, in which a stream or drainage channel had been daylit on a residential property without any filtration. This site should get a Stream Determination by the Maine DEP Land Bureau to determine whether it is a stream, which will dictate the BMPs appropriate. If it's determined to be a stream, consider restoring to a natural stream channel. If it's determined to be a drainage ditch, BMP recommendations are to install a sediment plunge pool or level lip-spreader at the culvert outlet into a vegetated buffer for proper filtration of stormwater runoff.

The plan aims to address all four of the erosion problems identified in the Watershed Survey and the 31 sites identified in the Shoreline Survey (that posed a higher risk of negative impact to water quality) in three phases. Depending on landowner interest each phase will aim to address 10-12 sites through remediation by the homeowners themselves or by providing cost sharing funds to landowners. In all phases, the emphasis will be on high impact sites. Targeted outreach, education, and technical assistance will be provided.

Private Roads and Driveways

The watershed survey identified nine private road sites, and six driveway sites. They are discussed here together since the management measures are similar. Common problems included undersized, crushed, or clogged culverts, ditch erosion or lack of ditching, road shoulder erosion, undersized sediment pools, and road and driveway surface erosion. The most common BMPs and recommendations in the survey included:

- Install or reshape ditch
- Armor or seed ditch
- Install runoff diverters
- Replace and enlarge culvert
- Remove culvert clog
- Install turnouts
- Install plunge pool
- Resurface, crown, or super elevate road or driveway
- Upgrade to Stream Smart Crossings
- Plant native plant buffers

The plan aims to address approximately five of the private road sites in each phase. They will be addressed by providing cost sharing funds to road associations and landowners. Like residential sites, targeted outreach, education, and technical assistance will be provided to landowners and road associations. It is anticipated that some of these problems will be fixed by property owner funded solutions, but further discussions with property owners are necessary for a better understanding of the extent of this option.

Ongoing maintenance (e.g., grading, removing accumulated sediment from sediment basins and turnouts) is critical to long term performance of these BMPs and prevention of new NPS problems. As a result, the plan calls for periodic inspections of implemented BMPs. Follow up contact will be made by CLWA to road associations and landowners for any maintenance needs.

Town Roads

There were two town road sites identified in the watershed survey. Common problems included road surface erosion and lack of ditching. The most common BMPs and recommendations in the survey included:

- Install ditch
- Install check dams
- Remove culvert clog
- Stabilize culvert inlet/ outlet
- Install turnouts

CLWA will work with the Towns of Casco and Raymond to address these sites. Speaking with the road commissioner will be the first step in addressing the problems. The town's willingness and capacity to address the issues will determine how and when the project gets addressed, funding may be a combination of CWA section 319 grant funding and town match. These areas will be resurveyed in the spring of 2030 to see if any sites have been addressed, or if any additional action is needed.

State Roads

The Crescent Lake Watershed Survey identified one site located on State of Maine roads.

ME DEP will inform MDOT of the site identified in the survey. These areas will be resurveyed in the spring of 2030 to see if any sites have been addressed, or if any additional action is

needed. The NPS Site Tracker can be used to prompt periodic inspections of the state road site and communication with the ME DEP and DOT about future maintenance needs.

B. Non-Structural BMPs

In addition to the actions to mitigate existing NPS sites, the plan includes a proactive strategy to prevent and identify emerging NPS sites. These actions include the use of the NPS Site Tracker to monitor existing and newly identified NPS sites and communication through CLWA outreach/educational efforts including annual meetings, mass-email messages, the CLWA website, Facebook, workshops, and the local media.

6. Pollutant Load Reductions

Pollutant load reductions will be estimated for many NPS sites to help demonstrate the value of BMPs to reduce the amount of sediment and phosphorus entering the lake. Pollutant load reductions will be estimated and reported to ME DEP for any work funded by CWA 319 grants. Pollutant load reduction will be made using methods approved and recommended by ME DEP and EPA.

7. Water Quality Monitoring

Maine water quality criteria require that lakes and ponds have a stable or improving trophic state and be free of culturally induced algal blooms. CLWA's monitoring team will continue its bimonthly monitoring program from May-September for Secchi disk transparency, temperature, and dissolved oxygen profiles for the foreseeable future. ME DEP also conducts baseline monitoring on Crescent Lake about every five years for these and additional parameters.

ME DEP conducts Secchi disk trend analysis every two years as part of their Integrated Water Quality Monitoring and Assessment report. Trend reporting (positive, negative or stable) will assist in determining whether the plan meets its goal of having stable or improving water quality over time.

Appendix A: Crescent Lake Watershed Survey Report, September 9, 2024

Crescent Lake

WATERSHED SURVEY REPORT

September 9, 2024

Prepared For:

Crescent Lake Watershed Association
PO Box 1298
Raymond, ME 04071
https://crescentlakemaine.org/

Prepared By:

FB Environmental Associates

97A Exchange Street, Suite 305
Portland, Maine 04101
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WATERSHED SURVEY RESULTS | MEMORANDUM

TO: Sallie Worcester & Russ Hutchinson, Crescent Lake Watershed Association

FROM: Mindee Goodrum & Tim Kirsten, FB Environmental Associates

SUBJECT: Crescent Lake Watershed Survey Results (Task 3)

DATE: August 28, 2024

CC: Forrest Bell, FB Environmental Associates

FB Environmental Associates (FBE) was contracted by the Crescent Lake Watershed Association (CLWA) to complete a watershed survey and shoreline survey that identifies and documents nonpoint source (NPS) sites in the Crescent Lake watershed in Raymond and Casco, ME. Nonpoint source pollution comes from stormwater runoff flowing over a wide area and picking up pollutants as it flows, such as sediment, phosphorus, nitrogen, and more. NPS sites require implementation of best management practices (BMPs) to address impacts from stormwater, erosion, inadequate infiltration due to impervious cover, culvert restrictions, and/or lack of vegetated riparian buffers. On 4/29/2024, FBE technical staff (Elliott Boardman) joined CLWA (Sallie Worcester and Russ Hutchinson) and Maine Department of Environment Protection (Addie Halligan and Carolina Swindel) staff to survey the watershed, following up on several sites already identified by CLWA members and documenting new sites for a total of 23 NPS sites (Figure 1). NPS sites were non-shoreline properties. Shoreline properties were evaluated via a shoreline survey, as described below. Only 0.2 inches of precipitation had fallen within the previous 72 hours in the area. Documentation included describing the problem, making recommendations for fixing the problem, rating the site's impact on water quality, logging the site's geoposition, and taking photographs.

In addition to the watershed survey, a shoreline survey was conducted on the same date by FBE technical staff (Mindee Goodrum, Luke Frankel, and Julia Maine), CLWA (Ray Bersch and Charlie Bradbury), and Maine DEP (Kristin Feindel). Two boats were used for surveying parcels with lake frontage. Technical staff documented the condition of the shoreline for each parcel using a scoring system that evaluates vegetated buffer, presence of bare soil, extent of shoreline erosion, distance of structures to the lake, and slope. These scores were summed up to generate an overall "Shoreline Disturbance Score" (scores ranging from 3-12) and "Shoreline Vulnerability Score" (scores ranging from 1-6) for each parcel, with high scores indicating poor or vulnerable shoreline conditions. Photos were taken at each parcel and were cataloged by tax map-lot number. These photos will provide project stakeholders with a valuable tool for assessing shoreline conditions over time. It is recommended that a shoreline survey be conducted every five years to evaluate changing conditions.

WATERSHED SURVEY RESULTS

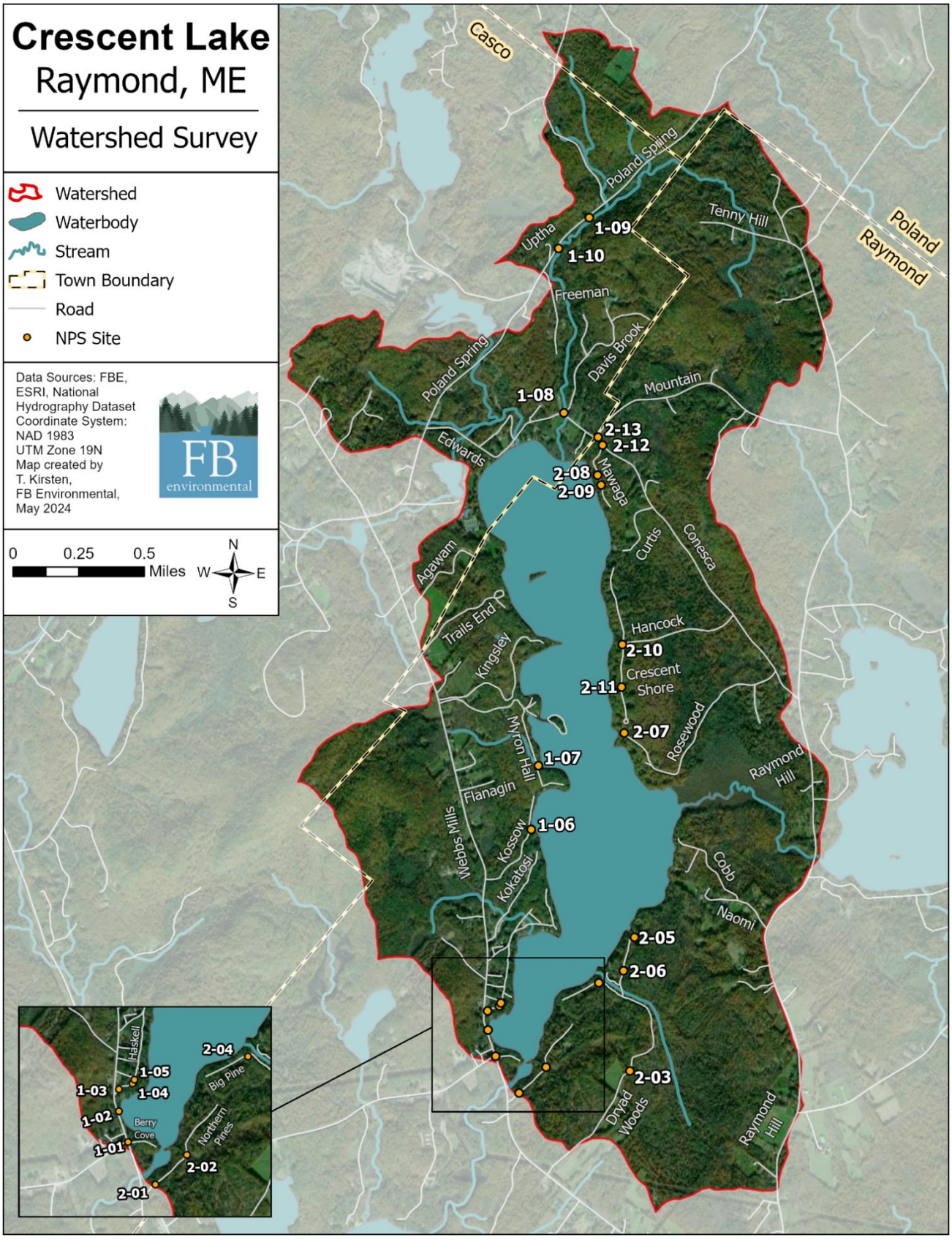


Figure 1. Location of identified nonpoint source sites from the watershed survey for the Crescent Lake watershed.

Table 1. Crescent Lake watershed survey sites and impact ratings.

Site #	Site Name	Impact Rating
1-01	Berry Cove Road	Medium
1-02	Route 85 ditch	High
1-03	South entrance of Haskell Ave	Medium
1-04	13 Haskell Ave, 31-31 on tax map	Low
1-05	17 Haskell Ave	Low
1-06	Kossow Lane	Low
1-07	Stream crossing next to 92 Myron Hall Road	Medium
1-08	Davis Brook Road culvert	High
1-09	Route 11, 9-40 parcel, 96 Poland Spring Road	Medium
1-10	Telephone pole 2021 north of Uptha Road	High
2-01	Culvert #1 under Northern Pines Road	Low
2-02	Culvert #2 under Northern Pines Road	Low
2-03	Culvert under Dryad Woods Road	Medium
2-04	Road erosion on private driveway and Big Pine Road	Medium
2-05	Steep paved area at end of Dryad Woods Road	High
2-06	New road off Dryad Woods Road	High
2-07	Rosewood Drive	High
2-08	“Culvert” along Mawaga Drive	Medium
2-09	21 Mawaga Road steps	Low
2-10	Water access at intersection of Hancock and Crescent Shore Road	Medium
2-11	20 Crescent Shore Road	Low
2-12	Side of Conesca Road	Medium
2-13	Erosion along Mountain Road	High

Table 2. Crescent Lake watershed survey sites and impact ratings by land use.

Land Use	Low	Medium	High	Total (#)	Total (%)
Residential	0	1	0	1	4%
Private Road	3	4	2	9	39%
Driveway	3	2	1	6	26%
Public Access	0	0	0	0	0%
Construction Site	0	0	1	1	4%
Town Road	0	1	1	2	9%
State Road	0	0	1	1	4%
Trail or Path	1	1	1	3	13%
Total	7	9	7	23	

NONPOINT SOURCE SITES

Site 1-01: Berry Cove Road

Location (latitude, longitude): 43.95176, -70.46389

Impact: Medium

Observations: There is gully ditch erosion on the lakeside of Berry Cove Road and its intersection with Route 85. In addition, the culvert below Berry Cove Road is clogged with debris and sediment.

Recommendations: A ditch should be installed on the side of Berry Cove Road. To address erosion from runoff on Route 85, the existing ditch should be reshaped and armored with riprap. The culvert should also be cleared of debris and sediment.

(Left) View of the northern corner where Berry Cove Road intersects with Route 85. Erosion within the gully ditch is evident. (Right) View up Berry Cove Road from Route 85. Signs of gully erosion on the lakeside of the road are present.

Site 1-02: Route 85 ditch

Location (latitude, longitude): 43.95344, -70.46461

Impact: High

Observations: Gully ditch erosion has occurred on the lakeside of Route 85. It is most severe just south of the intersection of Route 85 and Haskell Ave, but it extends southwards past the wooden fence of the property on Route 85, to the boat launch parking lot. The total length of the gully is 395 feet. At its end point the runoff overtops onto the paved road shoulder, where sediment has been deposited. The gully then continues in the direction of the lake, where it ends at an old detention basin.

Recommendations: The ditch should be enlarged so that its banks are less steep, making them less vulnerable to erosion in high rainfall events. Riprap or seed (grass or low-growing ground cover) should be planted to stabilize the soil in these ditches. Additionally, plunge pools should be established at culvert outlets within the ditch, except where the ledge makes this impossible.

(Left) View of the start of the gully on the lakeside of Route 85, just south of Haskell Ave. Steep banks indicate severe gully ditch erosion. (Right) View of where the gully overtops onto the paved road shoulder, before veering towards an old detention basin above the lake.

Site 1-03: South entrance of Haskell Ave

Location (latitude, longitude): 43.95467, -70.46466

Impact: Medium

Observations: There is erosion on the unpaved Haskell Ave, with at least one significant rill running down its center. The stretch of road affected is between the residences of 3 and 8 Haskell Ave.

Recommendations: Resurface, re-crown, or superelevate Haskell Ave so that it slopes towards the vegetated side of the road. The installation of roadside ditches is also recommended.

(Left) View down Haskell Ave, where a rill has formed within the unpaved road surface. (Right) View upslope of the rill.

Site 1-04: 13 Haskell Ave

Location (latitude, longitude): 43.95499, -70.46362

Impact: Low

Observations: Rill erosion has occurred in the driveway of the residential property at 13 Haskell Ave.

Recommendations: Reshape the driveway using gravel if possible. Runoff diverters such as rubber razors could also be installed as a low-cost solution.

View of the driveway at 13 Haskell Ave, which has signs of rill erosion.

Site 1-05: 17 Haskell Ave

Location (latitude, longitude): 43.955204, -70.463484

Impact: Low

Observations: There is minor erosion in the driveway of 17 Haskell Ave, forming a "W" shape. While it may not erode frequently, it has somewhat lost its shape.

Recommendations: Build up and crown the driveway, and/or install runoff diverters such as rubber razors. The team observed the driveway from Haskell Ave, and therefore could not recommend where runoff be diverted.

View down the driveway of 17 Haskell Ave, which has experienced erosion in a "W" shape.

Site 1-06: Kossow Lane

Location (latitude, longitude): 43.96638, -70.46106

Impact: Low

Observations: There is erosion on the shoulder of Kossow Lane. The road is crowned, but its steepness has caused runoff to erode both edges. There are no ditches in place to mitigate erosion impacts. It was noted that the runoff only causes erosion during heavier rainfall events.

Recommendations: Installing a road turn-out on the hill is recommended, to reduce the volume of stormwater runoff on the road surface. Alternatively, a ditch on the lakeside of the road would be a potential solution, although this would require a cross-culvert to be built beneath the driveway off this stretch of Kossow Lane. The outlet of the turn-out or ditch could be a plunge pool or apron, which directs water into a vegetated buffer area.

View down Kossow Lane. Erosion is occurring on both shoulders of the road.

Site 1-07: Stream crossing next to 92 Myron Hall Road

Location (latitude, longitude): 43.97047, -70.46053

Impact: Medium

Observations: A stream overtops onto Myron Hall Road during high rainfall events, which has caused the road and driveway opposite the stream to become washed out.

Recommendations: Install a berm on the stream side of Myron Hall Road and install a detention basin next to the stream. Pave the washed-out driveway to prevent future wash outs. Enlarge the culvert with a Stream Smart crossing.

(Left) View of the location where the stream overtops onto Myron Hall Road, causing erosion of the road. (Right) Driveway at 92 Myron Hall Road that is also eroding during storm events.

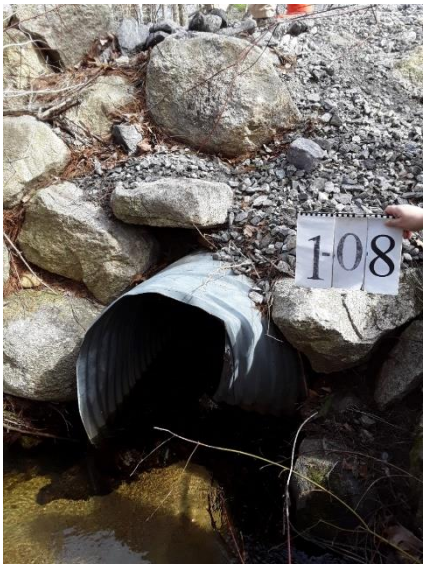
Site 1-08: Davis Brook Road culvert

Location (latitude, longitude): 43.99316, -70.45882

Impact: High

Observations: A crushed, rusting culvert is undercutting the bank below Davis Brook Road. This has caused the road to wash out and has led to significant amounts of sediment deposition in the stream as well as in the lake downstream of the site.

Recommendations: Replace and enlarge the culvert to align with Stream Smart standards.



(Left) The culvert beneath Davis Brook Road is rusting and undercutting the bank. (Right) Erosion has caused the road to wash out, and deposit sediment in the stream.

Site 1-09: Route 11, 96 Poland Spring Road

Location (latitude, longitude): 44.00573, -70.45688

Impact: Medium

Observations: There is erosion on the road shoulder at the intersection of Route 11 and the driveway of 96 Poland Spring Road. An old culvert beneath the driveway is also crushed. The driveway is very narrow at the culvert crossing, resulting in steep banks that are unstable.

Recommendations: The culvert should be replaced and possibly lengthened. A more permanent solution would be to construct a bridge for this driveway, which would be costly but would best protect the lake as well as make the driveway safer.

The culvert beneath the driveway, which is crushed.

Site 1-10: Telephone pole 2021 north of Uptha Road

Location (latitude, longitude): 44.00372, -70.45956

Impact: High

Observations: A stream has overtopped and washed out a small driveway off Route 11, just north of a telephone pole labeled 2021. Two culverts beneath this driveway have also been washed out, with their tops and sides exposed. An area around the culvert of about 15 x 8 ft and 1 ft deep has lost gravel and other sediment.

Recommendations: Replaced the twin culverts with a bridge. The driveway should be restabilized and reshaped.

(Top right) The driveway has been washed out, exposing the culverts. (Bottom right) A channel ~1 ft deep has formed around the culverts. (Bottom left) View of erosion around the culverts.

Site 2-01: Culvert #1 under Northern Pines Road

Location (latitude, longitude): 43.94944, -70.46175

Impact: Low

Observations: There is a potentially undersized, 4' corrugated metal culvert with a rusted-out bottom, which contains some blocked debris. The culvert transports water from an unnamed stream below Northern Pines Road.

Recommendations: The culvert should be cleared regularly, and potentially replaced and enlarged.

(Left) Debris blocking the inlet of the culvert. (Right) View of the outlet of the culvert, where sediment and debris have been deposited. The bottom of the culvert is rusted.

Site 2-02: Culvert #2 under Northern Pines Road

Location (latitude, longitude): 43.95111, -70.45937

Impact: Low

Observations: A corrugated metal culvert that transports water from an unnamed stream below Northern Pines Road (north of Site 2-01) has bottomed out, and has significant rust on its bottom. The culvert is perched on its outlet side. It is estimated to be 5-6 feet in diameter.

Recommendations: It is recommended that the culvert is eventually replaced.

View of the perched, rusted culvert outlet below Northern Pines Road.

Site 2-03: Culvert under Dryad Woods Road

Location (latitude, longitude): 43.95098, -70.45191

Impact: Medium

Observations: There is severe road erosion into a stream along Dryad Woods Road. A culvert is also perched, rusting out and clogged with debris. The surrounding area has been logged extensively, and Dryad Woods Road is eroding from the shoulder about 350 feet south of this site. The bank of the road down to the stream is steep.

Recommendations: Install a ditch along Dryad Woods Road, armored with vegetation and/or riprap and graded to reduce the steep cut of the bank. Revegetate the riparian buffer where it has been thinned. Clear the culvert and eventually replace and enlarge.

(Top left) View of the perched, rusted culvert outlet. (Top right) View of the steep bank surrounding the culvert outlet, where road erosion has occurred. (Botom) Shoulder erosion has occurred on both sides of Dryad Woods Road approximately 350 feet south of the culvert.

Site 2-04: Road erosion on private driveway and Big Pine Road

Location (latitude, longitude): 43.95659, -70.45482

Impact: Medium

Observations: The surface of Big Pine Road is moderately eroding down a residential driveway and the adjacent steep bank into the lake. Erosion rills were visible along the driveway.

Recommendations: Regrade driveway to restore crown or grade away from the lake. Add water diverters (such as rubber razors or turnouts) to the driveway to direct flow into the forested buffer. Add ditching or turnouts along Big Pine Road.

View from the driveway towards the private residence and lake.

Site 2-05: Steep paved area at end of Dryad Woods Road

Location (latitude, longitude): 43.95958, -70.45173

Impact: High

Observations: A steep paved area slopes towards a small basin. It is highly likely that sediment is entering the lake from this paved area and the driveway.

Recommendations: Install a vegetated settling basin beneath the steep paved area. In addition, infiltration steps along the steep private driveway should be installed.

(Top) The area below Dryad Woods Road and the driveway visible in the right of the photo slope steeply toward the lake.

(Bottom) A paved area near the end of Dryad Woods Road, where logged trees are visible in the bottom left photo, slopes steeply towards the road and the lake.

Site 2-06: New road off Dryad Woods Road

Location (latitude, longitude): 43.95740, -70.45264

Impact: High

Observations: A newly constructed road is surrounded by cleared land, with significant amounts of gravel and sand observed in ditches. Observers noted this sediment would certainly enter the lake via culverts and steep, paved driveways.

Recommendations: Ensure proper erosion controls are in place during logging activities to contain sediment on site. Install a vegetated swale along the road. Revegetate road shoulders or cover with erosion control mulch.

(Top) Clearing and logging has taken place along the newly constructed road. (Bottom left) Sediment can easily wash into the lake down the steep roads and driveways. (Bottom right) Sediment deposition around a small plastic culvert.

Site 2-07: Rosewood Drive

Location (latitude, longitude): 43.97266, -70.45296

Impact: High

Observations: Gravel and sediment from Rosewood Drive is being washed down access steps to the lake.

Recommendations: Replace existing path and steps with infiltration steps. Add erosion control mulch and plantings to the sides of the steps and paths. Install water diverters on the driveway to direct flow into forested areas and away from the path.

Sediment from Rosewood Drive washed down onto steps providing access to the lake.

Site 2-08: Culvert along Mawaga Drive

Location (latitude, longitude): 43.98920, -70.45572

Impact: Medium

Observations: A stream or drainage channel appears to have been daylit through a long plastic culvert that runs down from the road to the lake, through a residential property.

Recommendations: The outlet of the pipe should be checked to ensure sediment is not washing into the lake. Install a sediment plunge pool or level lip spreader to a vegetated buffer at the culvert outlet. Consider restoring a more natural stream channel or vegetated swale.

(Left) View looking down the plastic "culvert" towards the lake. (Right) The inlet of the culvert before it passes beneath Mawaga Drive.

Site 2-09: 21 Mawaga Road steps

Location (latitude, longitude): 43.98856, -70.45541

Impact: Low

Observations: A set of steps leading down from the road to the lake on a residential property displayed some signs of erosion at the bottom. The stairs are in two different sets.

Recommendations: These steps may be a good candidate for the installation of infiltration steps. A settling basin at the bottom would reduce sediment transported by sheet runoff from entering the lake. Add erosion control mulch and native plants to the sides of the stairs.

View looking down the top set of stairs from Mawaga Road. Signs of erosion are present at the staircase bottom.

Site 2-10: Water access at intersection of Hancock and Crescent Shore Road

Location (latitude, longitude): 43.97835, -70.45325

Impact: Medium

Observations: Sediment and water run off the paved Hancock Road down a small access path directly at the end of the road, where it intersects Crescent Shore Road. The access trail is approximately 215 feet long and outlets directly to the lake. Local residents reported that this area has been previously mulched, but no mulch was present on the survey date, indicating this may have run into the lake. Additionally, road runoff is not properly directed into a roadside swale at this intersection, causing washout of the road and sediment transport.

Recommendations: A small infiltration basin or sediment forebay is recommended to be installed at the end of Hancock Road, where the access trail begins. Add new erosion control mulch and/or water diverters to the access path. Regrade the road to direct road runoff into the existing swale.

(Left) View from the end of Hancock Road, looking down the access trail which is in the center of the photo. No mulch is present, and signs of erosion are visible. (Right) View north up Crescent Shore Road from the end of Hancock Road, showing signs of erosion.

Site 2-11: 20 Crescent Shore Road

Location (latitude, longitude): 43.97562, -70.45326

Impact: Low

Observations: Water and sediment run down a steep gravel driveway, into the lakeside neighbors' paved driveway and ultimately into the lake.

Recommendations: Install water diverters across the gravel driveway. Alternately, crown driveway and add ditches with turnouts to direct flow into existing road ditches. Clear ditches and culverts regularly.

(Left) View up the steep driveway where runoff occurs. (Center) One of the lakeside neighbor's driveways downslope of the steep driveway. (Right) View of a ditch along Crescent Shore Road that needs clearing.

Site 2-12: Side of Conesca Road

Location (latitude, longitude): 43.99114, -70.45531

Impact: Medium

Observations: Sand and gravel from the road are washing out to the side of the roadway, which is unditched, and then downslope and through a culvert.

Recommendations: Revisit to verify that runoff from this site reaches the lake. If so, install ditches along the side of Conesca Road and turnouts to infiltration basins. Unclog the culvert and stabilize the inlet and outlet.

(Left) View of the roadside, where sediment washes. (Center) View of the land downslope of the roadside, where sediment deposition is evident. (Right) View of the small culvert downslope of the road.

Site 2-13: Erosion along Mountain Road

Location (latitude, longitude): 43.99165, -70.45575

Impact: High

Observations: A highly eroded area along Mountain Road slopes towards a culvert that ultimately transports water into the lake.

Recommendations: Re-evaluate the site to verify if the runoff is making its way into the lake. If so, clean out the existing ditches and install stone check dams. Where possible, add turnouts into forested buffer areas or install an infiltration basin.

(Left) View up Mountain Road where roadside erosion is evident. (Center) View down Mountain Road towards the intersection with Conesca Road. (Right) View downslope of the intersection of Mountain Road and Conesca Road, where runoff has deposited sediment.

SHORELINE SURVEY RESULTS

A total of 203 parcels were evaluated along the shoreline of Crescent Lake in Raymond and Casco, ME. The average Shoreline Disturbance Score (Buffer, Bare Soil, and Shoreline Erosion) for the entire lake was 6.3 out of 12 (Table 3). About 45% of the shoreline (or 92 parcels) scored 7 or greater (Figure 2). A disturbance score of **7 or above** indicates shoreline conditions that may be detrimental to lake water quality. These shoreline properties tended to have inadequate buffers, evidence of bare soil, and shoreline erosion[1]. Two parcels scored high disturbance scores (11 out of 12).

The average Shoreline Vulnerability Score (Distance and Slope) was 4.2 out of 6 (Table 3). About 80% (or 162 parcels) scored 4 or greater (Figure 2). A vulnerability score of **4 or greater** indicates that the parcel may have a home less than 150 feet from the shoreline and a moderate or steep slope to the shoreline (>10 degrees). Parcels with a vulnerability score of 4 or greater are more prone to erosion issues whether or not adequate buffers and soil coverage are present.

In summary, the overall average shoreline condition of Crescent Lake is moderate-to-good for erosion issues (average disturbance score below 7), with 92 properties (45%) needing to address erosion issues that are impacting the lake. Crescent Lake is also generally more prone to erosion issues because many homes are located close to shore and on moderate to steep slopes (average vulnerability score is 4.2). Refer to the end of this document for a series of maps of the scores by parcel.

Note: When evaluating the shoreline condition of each parcel, we consider the entire length of each parcel's shoreline. Because of this approach, the same shorefront home would score better on a parcel with a long shoreline that was mostly natural buffer compared to a parcel with a short shoreline that consisted mostly of developed area. You will notice that many of the highest scoring parcels have short shorelines (refer to maps).

Table 3. Average scores for each evaluated condition criterion and the average Shoreline Disturbance Score and average Shoreline Vulnerability Score for Crescent Lake. Lower values indicate shoreline conditions that are effective at reducing erosion and keeping excess nutrients out of the lake. Note: the numbers in parentheses are the range of possible scores for that variable.

Evaluated Condition	Average Score
Buffer (1-5)	2.9
Bare Soil (1-4)	1.9
Shoreline Erosion (1-3)	1.4
Shoreline Disturbance Score (3-12)	**6.3**
Distance (0-3)	2.4
Slope (1-3)	1.8
Shoreline Vulnerability Score (1-6)	**4.2**

[1] Shoreline erosion can be from or exacerbated by natural phenomena or human-related activities. Natural phenomena typically include the orientation of the parcel to prevailing winds and subsequent greater wave action, composition of the shoreline bank (whether highly erodible soil material or hardened rocky or bedrock outcroppings), and winter ice damage. Human-related activities typically include motorboating (which generate wakes whose wave energy is dissipated by the shoreline) and shoreline development (which includes retaining walls, beaches, access points, etc.).

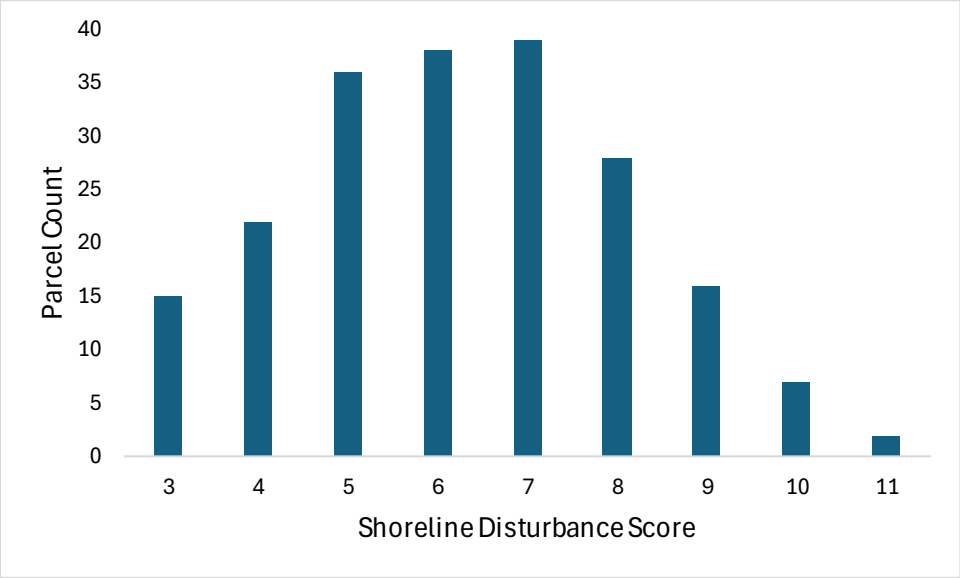


Figure 2. Histogram showing the number of parcels falling into each shoreline disturbance score category. The possible range of Shoreline Disturbance Scores is 3-12.

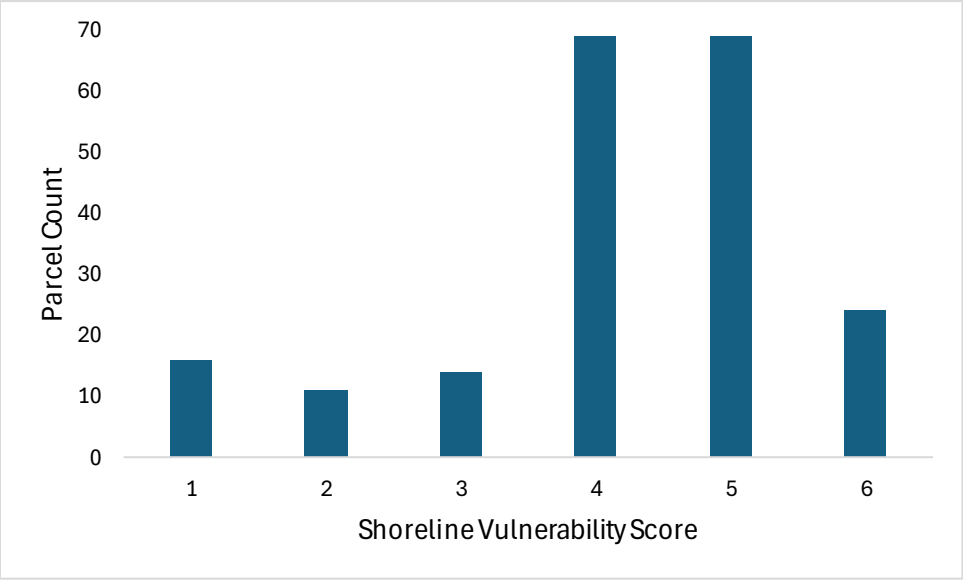


Figure 3. Histogram showing the number of parcels falling into each shoreline vulnerability score category. The possible range of Shoreline Vulnerability Scores is 1-6.

NEXT STEPS

The information obtained from this survey will be used to plan next steps for improving both the properties within the watershed and along the shoreline of Crescent Lake and further inform the watershed-based protection plan. The survey map and database highlight areas that are possibly contributing to polluted runoff, and the shoreline scores should be used to prioritize areas of the shoreline for remediation. Recommendations largely include improving shoreline vegetated buffers. Encouraging landowners to plant and/or maintain vegetated buffers as a BMP along their shoreline, particularly in areas of bare soil, will help mitigate erosion and reduce sediment and nutrient loading to the lake.

RECOMMENDATIONS

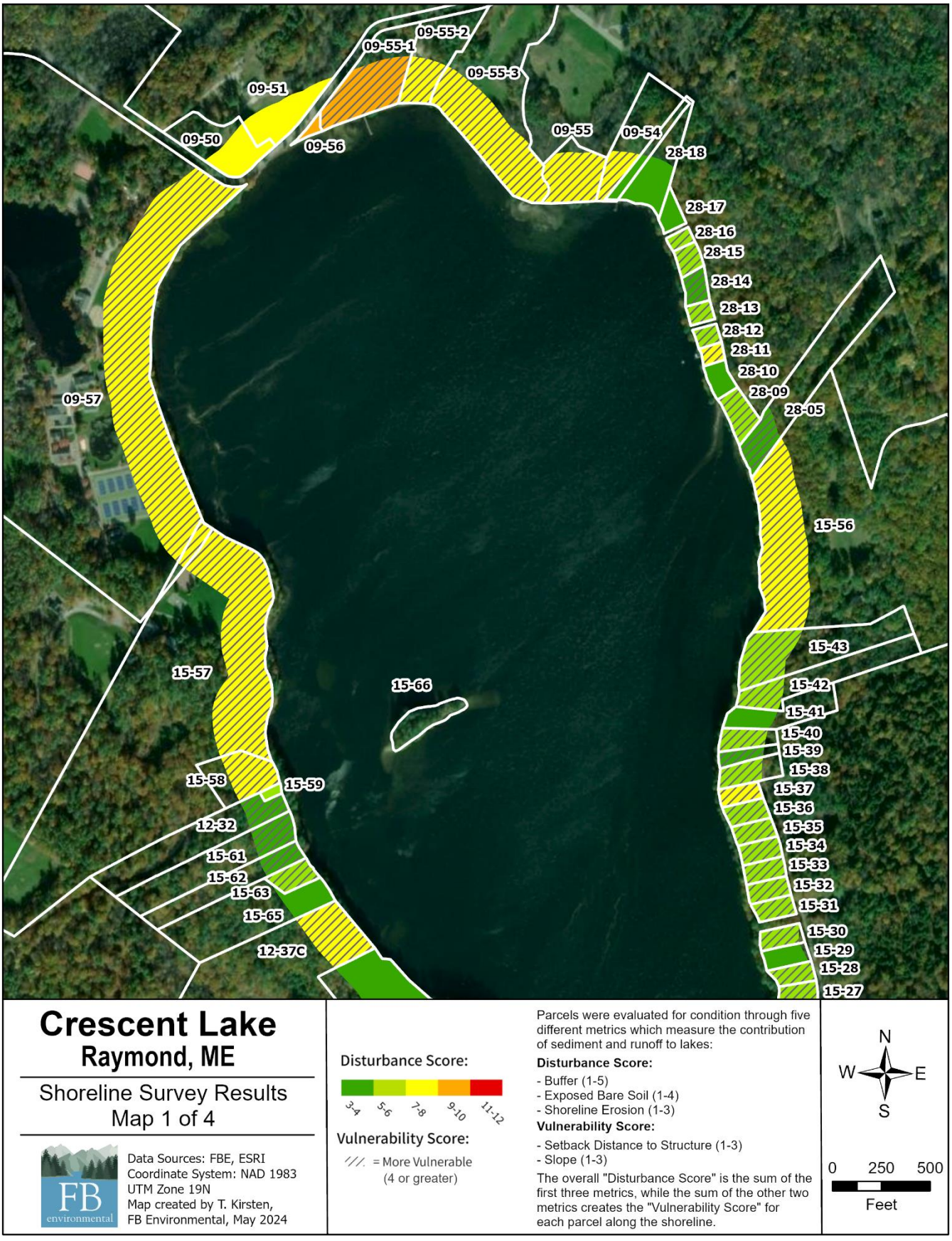
Generally, landowners should be encouraged to revegetate their shoreline buffers with native plants, avoid large grassy lawns, increase mower blade height to 4 inches, and avoid bringing in sand to replenish beaches. Woody vegetation with deep rooting structures stabilizes banks and intercepts water flow, allowing it to spread out, slow down, and be filtered by the soil. **These recommendations are applicable to both shoreline and non-shoreline properties.**

- Plant native shrubs along shoreline such as: blueberry, willows, elderberry, viburnums, dogwoods, winterberry, buttonbush, pepperbush, serviceberry, swamp azalea, and leatherleaf. Link for Native Plants of Maine: https://www.maine.gov/dep/land/watershed/bufa.html. Digging small holes for shrubs and plants along the shoreline represents minimal temporary impacts from exposed soil and is therefore consistent with Maine DEP guidelines for shorefront protection and management guidelines.
- Create defined access paths that use sustainable practices such as adding meanders to paths or infiltration steps.
- Locate willing volunteers to "demonstrate" what an ideal shoreline buffer looks like and how it functions.
- Direct roof runoff into dedicated receptacles such as rain barrels or vegetated areas such as rain gardens.
- Ensure stormwater is adequately directed to ditches or other practices to reduce erosion on private driveways and roads.
- Use survey results to target future implementation efforts on residential shoreline properties.
- Continue to monitor for bare soil, shoreline erosion, and slope conditions.
- Re-survey the lake in 5-10 years when updating the watershed-based protection plan.
- For future projects, site-specific recommendations should be made for each lot with engineered designs when needed.
- Seek LakeSmart certification for more properties within the watershed.

Examples of adequate vegetated shoreline buffers:

Crescent Lake parcel 15-62 receiving a final score of 3 due to a thickly vegetated buffer, which is comprised of natural vegetation of both trees and shrubs along the shore. It also has very little exposed soil present. This is a LakeSmart property.

Crescent Lake parcel 15-28 receiving a final score of 5 due to a vegetated buffer consisting of multi-story canopy (trees and shrubs), minimal exposed soil, and a defined access point.


09-55-2
09-55-1
09-55-3
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09-50
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09-55
09-54
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28-17
28-16
28-15
28-14
28-13
28-12
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28-05
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15-29
15-28
15-27
Crescent Lake
Raymond, ME
Shoreline Survey Results
Map 1 of 4
Data Sources: FBE, ESRI
Coordinate System: NAD 1983
UTM Zone 19N
Map created by T. Kirsten,
FB Environmental, May 2024
Disturbance Score:
3-4
5-6
7-8
9-10
11-12
Vulnerability Score:
/// = More Vulnerable
(4 or greater)
Parcels were evaluated for condition through five different metrics which measure the contribution of sediment and runoff to lakes:
Disturbance Score:
- Buffer (1-5)
- Exposed Bare Soil (1-4)
- Shoreline Erosion (1-3)
Vulnerability Score:
- Setback Distance to Structure (1-3)
- Slope (1-3)
The overall "Disturbance Score" is the sum of the first three metrics, while the sum of the other two metrics creates the "Vulnerability Score" for each parcel along the shoreline.
N
W
E
S
0
250
500
Feet

Crescent Lake
Raymond, ME

Shoreline Survey Results
Map 2 of 4

Data Sources: FBE, ESRI
Coordinate System: NAD 1983 UTM Zone 19N
Map created by T. Kirsten, FB Environmental, May 2024

Disturbance Score:

3-4 5-6 7-8 9-10 11-12

Vulnerability Score:

/// = More Vulnerable (4 or greater)

Parcels were evaluated for condition through five different metrics which measure the contribution of sediment and runoff to lakes:

Disturbance Score:
- Buffer (1-5)
- Exposed Bare Soil (1-4)
- Shoreline Erosion (1-3)

Vulnerability Score:
- Setback Distance to Structure (1-3)
- Slope (1-3)

The overall "Disturbance Score" is the sum of the first three metrics, while the sum of the other two metrics creates the "Vulnerability Score" for each parcel along the shoreline.

N
W E
S

0 250 500
Feet


12-51
12-52
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30-13
30-28
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30-30
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31-31
31-38
33-11
33-08
33-07A
33-05
33-04
12-64B
33-03
12-64C
12-64A
12-63
33-02A
33-02
33-01
32-20
32-19
32-18
32-17
32-16
32-15
32-13
32-12
32-11
32-09
32-08
32-06
32-05
32-02
32-01
12-56
12-81
12-82
12-83
Crescent Lake
Raymond, ME
Shoreline Survey Results
Map 3 of 4
Data Sources: FBE, ESRI
Coordinate System: NAD 1983
UTM Zone 19N
Map created by T. Kirsten,
FB Environmental, May 2024
Disturbance Score:
3-4
5-6
7-8
9-10
11-12
Vulnerability Score:
/// = More Vulnerable
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Parcels were evaluated for condition through five different metrics which measure the contribution of sediment and runoff to lakes:
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Vulnerability Score:
- Setback Distance to Structure (1-3)
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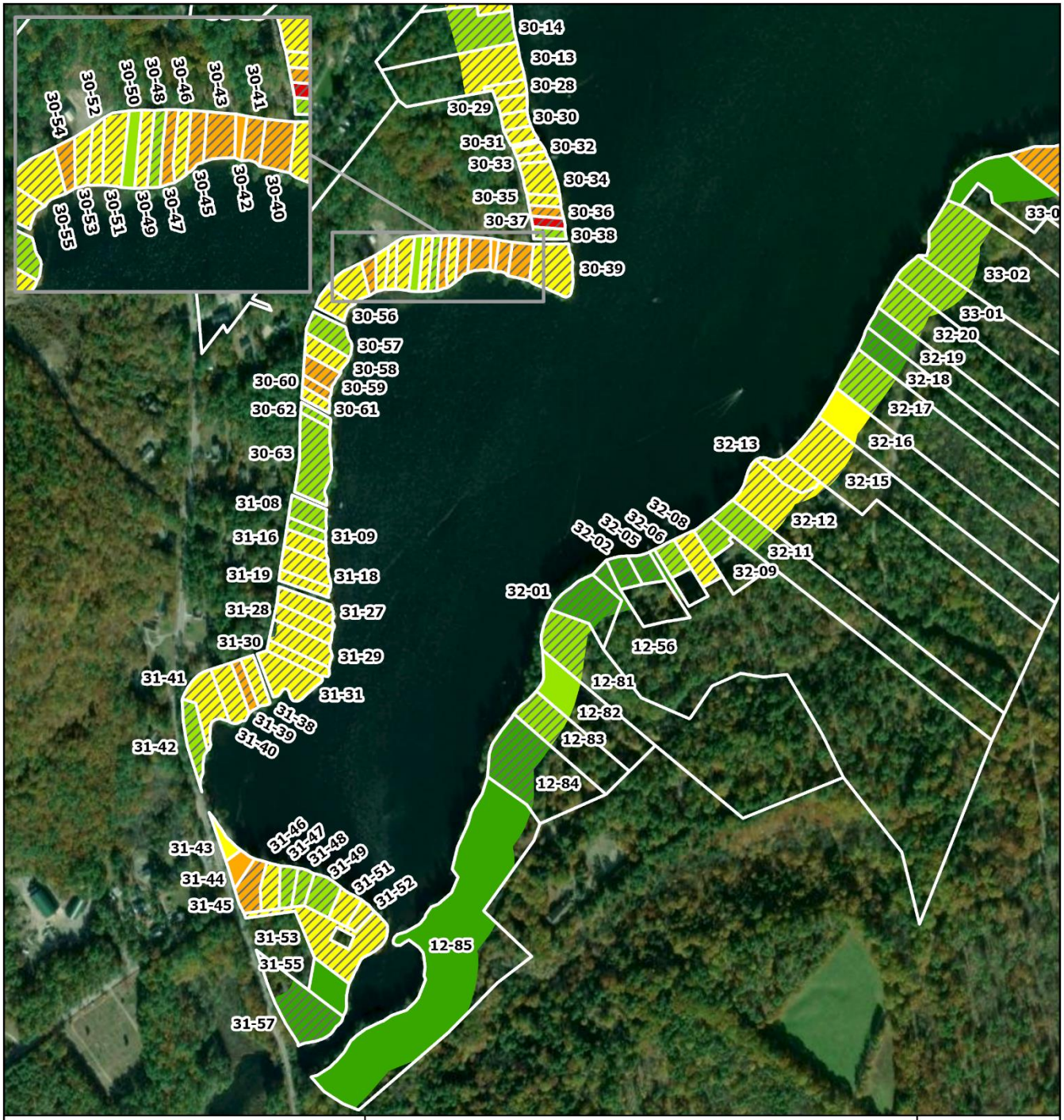
The overall "Disturbance Score" is the sum of the first three metrics, while the sum of the other two metrics creates the "Vulnerability Score" for each parcel along the shoreline.
N
W
E
S
0
250
500
Feet



Crescent Lake
Raymond, ME

Shoreline Survey Results
Map 4 of 4

Data Sources: FBE, ESRI
Coordinate System: NAD 1983
UTM Zone 19N
Map created by T. Kirsten,
FB Environmental, May 2024

Disturbance Score:

3-4 5-6 7-8 9-10 11-12

Vulnerability Score:

/// = More Vulnerable
(4 or greater)

Parcels were evaluated for condition through five different metrics which measure the contribution of sediment and runoff to lakes:

Disturbance Score:
- Buffer (1-5)
- Exposed Bare Soil (1-4)
- Shoreline Erosion (1-3)

Vulnerability Score:
- Setback Distance to Structure (1-3)
- Slope (1-3)

The overall "Disturbance Score" is the sum of the first three metrics, while the sum of the other two metrics creates the "Vulnerability Score" for each parcel along the shoreline.

N
W E
S

0 150 300
Feet