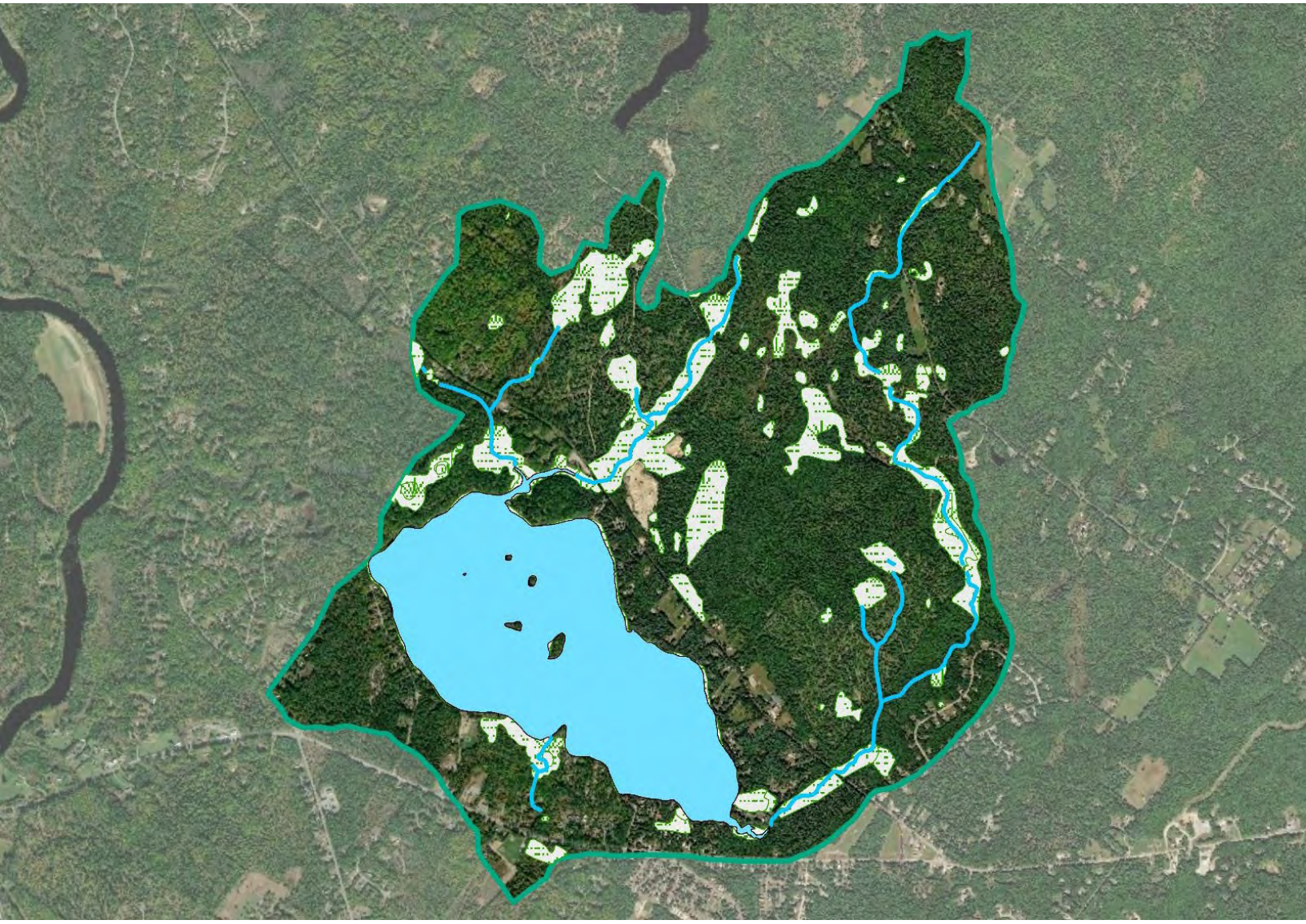
WATCHIC LAKE

WATERSHED-BASED PROTECTION PLAN

2020-2030



March 2020 - WLA Member Version Including Grant Opportunities

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DOCUMENT PURPOSE AND SCOPE

The purpose of this watershed-based protection plan is to provide a guide for protecting the water quality of Watchic Lake by addressing non-point source (NPS) pollution in the watershed over the next ten years (2020-2030). The plan provides recommended adaptive management strategies, as well as recommended action items to ensure successful implementation of the plan. The plan allows for flexibility and adjustments of priorities as additional data are acquired.

This plan was developed to satisfy national watershed planning guidelines provided by the U.S. Environmental Protection Agency (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. The Maine Department of Environmental Protection (MEDEP) accepts alternative plans for unimpaired lakes that have completed a recent watershed survey provided that the plans follow EPA and MEDEP guidance and include minimum planning elements. The Watchic Lake plan meets these eligibility criteria, and was written to include the EPA and MEDEP required planning elements (the remaining sections in this plan cover EPA's five elements for alternative watershed-based plans).

The overall goals of this plan are to (1) maintain or improve Class GPA water quality standards in Watchic Lake, (2) reduce and prevent phosphorus and sediment loading from NPS pollution, (3) continue to monitor water quality and track watershed conditions in the Watchic Lake watershed, and (4) continue to build local involvement and participation in watershed protection efforts. FB Environmental Associates (FBE) prepared this plan with assistance and input from the Watchic Lake Association (WLA) and MEDEP. This plan builds on the 2016 Risk Assessment, written by FBE for the WLA.

WATERSHED BACKGROUND

The Watchic Lake watershed, located in Standish, Maine, encompasses 4.3 square miles (Figure 1). The surface area of the lake itself is approximately 448 acres, with two tributaries entering the lake – Page Brook and Paine Brook – and a dam-controlled outlet – Watchic Brook, which drains to the Saco River. The dam was built in 1850 and deeded to WLA in 1956 from Central Maine Power. It was rebuilt in 2010. The deepest section of the lake, located on the southeastern end, is 41 feet, and the average lake depth is 18 feet. Watchic Lake is managed for warm water fisheries by the Maine Department of Fisheries and Wildlife, including small and largemouth bass (introduced in 1956), chain pickerel, white and yellow perch, and pumpkinseed sunfish.[1] The lake was managed for brown trout until the 1980s. Coldwater fishery habitat in the lake has been depleted over the last several decades from deteriorating water quality.

Watchic Lake has approximately 5.5 miles of shoreline, with moderately dense development on 175 parcels with shoreline frontage. Most shorefront landowners were initially seasonal residents, though in recent years, year-round residency has increased to about half of the shorefront properties. There are no public motorized boat launches, though public access and non-motorized craft launch is available at Kiwanis Beach. There are two state highways bordering the lake, Route 113 and Route 25, as well as numerous town roads and private roads to access shorefront properties. Other land use within the watershed potentially impacting water quality includes new development, aging septic systems, gravel pits, logging operations, and agricultural areas.

[1] https://www.maine.gov/ifw/docs/lake-survey-maps/cumberland/watchic_pond.pdf

Figure 1. Map of the Watchic Lake watershed.

PRIOR WATERSHED WORK

The WLA has been active since 1956, working to increase community involvement, monitor lake and tributary water quality, and reduce NPS pollution (Table 1).

Table 1. Timeline of prior watershed accomplishments. Updated and adapted from the 2016 Risk Assessment by FBE.

Year	Prior Work
1956	WLA founded.
1974	State and WLA volunteers begin water quality monitoring program.
1998	WLA, Cumberland County Soil and Water Conservation District (CCSWCD), and MEDEP completed a NPS Pollution Survey[2] and 12 technical assistance visits to shorefront properties; 31 volunteers assisted project staff to identify and prioritize existing sources of polluted runoff, particularly soil erosion sites, in the watershed; identified 135 sites impacting water quality (55% residential, 15% private roads, 15% driveways, 8% State roads, 4% boat access, 2% beach, and 2% town roads).
2000-2004	Watchic Lake Demonstration Project[3], sponsored by the CCSWCD; installed 13 Best Management Practices (BMPs) (Kiwanis Beach, 1 State road, 2 private roads, 2 driveways, 1 boat launch, 6 residential sites); one site on Watchic Terrace Road included the installation of several catch basins, curbing, a settling pool, and paving of the entire road; success of this project was achieved only through strong local commitment of lake association members and landowners; another site at Kiwanis Beach included the installation of water-bars, retaining walls, stairs, and plantings by 38 volunteers; Bonny Eagle High School students helped plant buffers around multiple residences; all projects estimated to reduce 38 tons/yr of sediment from reaching the lake; public presentations were made; watershed boundary and demonstration project signs were installed.
2002	Aquatic Invasive Plant (AIP) survey completed by volunteers.
2003	AIP Rapid Assessment Survey conducted by Maine DEP.
2004-2016	WLA and shorefront residents have actively participated in the LakeSmart Program and received the Gold Award by the Maine Lakes Society in 2016 once 30 LakeSmart awards were achieved. The lake currently has 35 LakeSmart properties.
2005	WLA recognized the need to redo the 1955 Association Articles of Incorporation and Bylaws, as well as establish operational strategy and measurable goals. Chemical analyses of lake water stopped; Secchi disk transparency readings continued by volunteers.
2006	WLA developed Mission and Vision Statements and set forth strategic initiatives with goals and action plans. From direction provided, WLA developed Articles of Incorporation and Bylaws in conjunction with an outside law firm, received approval by Association membership, and filed.
2007	WLA applied for and received 501(c)(3) status.

[2] Funding for this project, in part, was provided by the U.S. Environmental Protection Agency under Section 604(b) of the Clean Water Act. The funding is administered by the Maine Department of Environmental Protection in partnership with EPA. EPA does not endorse any commercial products or services mentioned.

[3] Funding for this project, in part, was provided by the U.S. Environmental Protection Agency under Section 319 of the Clean Water Act. The funding is administered by the Maine Department of Environmental Protection in partnership with EPA. EPA does not endorse any commercial products or services mentioned.

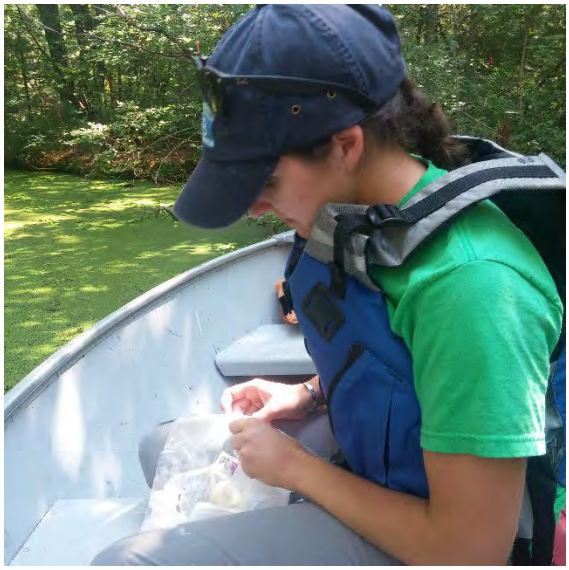
Year	Prior Work
2008	WLA revised Articles of Incorporation and Bylaws and approved. This was required for better alignment with long term objectives.
2009	Initial evaluation of dam indicated structural issues; significantly higher risk of dam failure than originally believed. Chemical analyses of lake water at multiple lake sites began again to assess the potential impact of runoff from a horse farm near the lake. Monitoring completed by volunteer.
2010	WLA set forth Capital Fund Drive from membership and prepared to implement a dam rebuild. WLA secured financing and completed the dam work and Phase I of the Capital Fund Drive.
2011	WLA continued Capital Fund Drive Phase II. WLA and the Town of Standish worked together to plan, engineer, and raise funds to address erosion issues coming from the Paine Neighborhood. In fall 2011, project staff retrofitted horse farm runoff that was impacting water quality in the lake, diverted water and added riprap to runoff point to lake, installed overflow measures, and added a settling pond at the outfall.
2012	Some adjustments to construction work on Paine Neighborhood project addressed and completed by WLA and the Town of Standish.
2013	WLA added fencing and other safety measures around the dam. Capital Fund Drive pledges totaled $240,000.
2015	WLA surveyed 230 property owners to determine what they view as key concerns, issues, and activities in the watershed. Received 81 responses (35%). Top five concerns were (1) invasive species infestation, (2) water clarity, (3) loon populations, (4) nutrient runoff pollution, and (5) septic system maintenance. Survey showed that most members understand WLA activities, but non-members do not fully understand the work or the importance of the work that WLA carries out. Once people understand what WLA does, then they are more apt to become a member. WLA installed a new dam gate that will be easier to operate and achieve a consistent water level in the lake. Six association board members received Maine VLMP Invasive Plant Patrol training. Volunteer(s) received Maine VLMP Secchi certification.
2015	FBE technical staff conducted a targeted NPS pollution survey around the shoreline of the lake to identify hotspot sources of sediment and phosphorus.
2016	FBE developed the Watchic Lake Risk Assessment Report. This assessment identified risks to the lake that currently or may in the future impact the water quality of the lake and provided recommendations to address those issues. WLA launched continuous monitoring program at the deep spot of Watchic Lake. FBE provided technical support to deploy continuous data loggers at each meter in the profile to log dissolved oxygen concentrations and temperature. (Dissolved oxygen loggers at 2 meters, 5 meters, and 11 meters. Temperature loggers at each additional meter interval.) Epilimnetic core sampling occurred monthly (June – Sept) as well as tributary grab sampling at Page and Paine Brooks. FBE developed annual report synthesizing data.
2017	WLA and FBE continued continuous monitoring program. Temperature loggers remained deployed over winter to capture under-ice conditions.
2018	WLA and FBE continued continuous monitoring program. FBE trains WLA volunteers to assume all fieldwork and logger maintenance. Volunteer received certification from VLMP to assume field work. WLA and FBE sign contract to complete a Watershed-Based Protection Plan.
2019	91% of the Capital Fund Drive pledges has been reached.

Year	Prior Work
2019	FBE conducted a comprehensive watershed survey to update the 1998 survey and created an NPS Site Tracker. The survey identified 23 sites with NPS pollution potential (44% town road, 22% private road, 13% residential and commercial, 13% state road, 4% logging operation, and 4% boat or beach access).
2019	FBE and WLA volunteers conducted a shoreline survey and 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. The overall shoreline score for each parcel was mapped and compiled into a database which prioritizes areas possibly contributing to polluted runoff.

IDENTIFICATION OF THE CAUSES OF NPS THREAT

WATER QUALITY SUMMARY

WLA, Lakes Stewards of Maine volunteers, and MEDEP began water quality monitoring in 1974. Secchi disk transparency readings have been taken continually since 1974. Water quality parameters, including temperature, dissolved oxygen, color, alkalinity, specific conductance, pH, phosphorus, and chlorophyll-a were taken intermittently starting in 1974 and ceased in 2006[4]. Chemical analyses started again in 2009. In addition, from 2016-2018, WLA deployed a monitoring buoy at the deep spot of Watchic Lake to for continuous temperature and dissolved oxygen monitoring and performed chemical analyses at Paine and Page Brook. Refer to Appendix A Figure A1 for lake deep spot monitoring buoy and tributary sampling locations.



Watchic Lake water quality has remained overall good from 2016-2018. Trophic indicators were within the acceptable range for water quality of a mesotrophic lake for all three years (Appendix A, Figure A2). Consistent with historical observations of lakes across Maine, water quality data in Watchic Lake from 2016 – 2018 suggests that the lake is susceptible to changes in total annual precipitation. While surface temperature and oxygen are relatively similar across the three years, inter-annual differences are noticed from the thermocline to the lake bottom. The wettest year (2017) experienced low oxygen shallower in the lake profile compared to the driest year (2016).

Despite changes in the onset of spring and fall stratification, the duration of stratification remained relatively stable across the three years of sampling. Fall wind events can play a critical role in the timing of fall turnover, and fall turnover often occurs rapidly over just a few hours. Furthermore, subsequent years of winter temperature data may allow us to draw connections between winter data and summer data. In addition, persistent oxygen depletion in bottom waters throughout 2016-2018 can stress organisms and release phosphorus from bottom sediments (Appendix A, Figure A3).

THREATENED STATUS

Watchic Lake is listed in Chapter 502 of the Maine Stormwater Law as a *Nonpoint Source Priority Watershed Most at Risk from New Development*. MEDEP lists Watchic Lake and other unimpaired lakes on the NPS Priority list because they are sensitive to eutrophication[5] based on one or more of the following; (1) their current water quality, (2) an increased

[4] https://www.lakesofmaine.org/data/2018_Lake_Reports/5040_1.html

[5] Eutrophication is the process by which lakes become more productive over time. Lakes with high productivity have high levels of phosphorus and chlorophyll-a, low water clarity, and abundant biomass with significant accumulation of organic matter on lake bottom. Eutrophic lakes are susceptible to algae blooms and severe oxygen depletion in the hypolimnion. Lakes naturally become more productive or "age" over thousands of years. In recent geologic time, however, humans have enhanced the rate of enrichment and lake productivity, speeding up this natural process to tens or hundreds of years.

potential for internal recycling of phosphorus, (3) the potential to be a cold water fishery, (4) the volume of water and/or flushing rate, or (5) the projected growth rate in the watershed.[6] The greatest concern for Watchic Lake is the current and future contribution of phosphorus from both internal loading within the lake and input from stormwater runoff associated with development in the watershed.

WATERSHED NPS THREATS

Watchic Lake is threatened by polluted runoff from both existing and new development. Developed land interrupts the natural water flowpaths in a watershed, with impervious surfaces limiting the infiltration of water and often causing concentrated flow that incises channels and increases erosion of soils. Eroding soils carry sediment and nutrients, including phosphorus, into surrounding surface waters. Densely developed and unbuffered lake shorelines increase the threat of polluted runoff. In addition to the threat caused by erosion, aging or malfunctioning septic systems are a common contributor to nutrient and pathogen delivery to lake systems. Agriculture and livestock areas can also be a threat through nutrient transport in stormwater runoff. Other threats posed by existing and new development are commercial operations such as construction sites, logging, and gravel operations.

Phosphorus is the most common limiting nutrient for algae and plant growth, controlling the level of algae production in the lake. Increased algae and plant growth decreases water clarity, and ultimately causes low oxygen in bottom waters as respiration by decomposers consumes oxygen. Low oxygen can cause the release of phosphorus back into the water column, creating a positive feedback loop and leading to eutrophication. Low oxygen is harmful to aquatic life, especially cold-water species that dwell in cooler, bottom waters. Watchic Lake undergoes oxygen depletion in the bottom waters from June through October, with low oxygen levels occurring frequently below seven meters (Appendix A, Figure A4). Both Page and Paine Brook have elevated nitrogen and phosphorus, which may be caused by NPS pollution from surrounding development. Additionally, the tributaries have low oxygen and low pH levels which have adverse effects on aquatic life.

2019 Watershed Survey

WLA completed a locally funded update to the 1999 watershed survey in April 2019 to identify, document, and prioritize sources of NPS pollution in the Watchic Lake watershed. In total, 23 erosion sites were identified in the watershed, of which 44% were town road, 22% private road, 13% residential/commercial, 13% state road, 4% logging, and 4% boat or beach access (Figure 2). NPS pollution threats identified during the survey were 59% erosion issues (soil, surface, road shoulder, or ditch erosion, and sediment transport), 21% culvert issues (clogged, damaged, unable to handle water volume, or undercut stream banks), 8% buffer issues (poor or lack of buffer), 5% roadside plow/grader berm, 3% new development, and 3% animal/nutrients input (Figure 3). NPS sites identified and recommended BMPs are further specified in the MEDEP "NPS Site Tracker" (Appendix C). The full results of the watershed survey, including specific recommended actions, are included in Appendix B as a Memorandum of Watershed Survey Results. Watershed survey data in table form is included as Appendix C to this plan. FBE managed the project and provided technical staff to complete the survey, following MEDEP watershed survey guidance documentation.[7] All developed portions of the watershed were surveyed, and NPS pollution sites were documented for location, extent of erosion, runoff problems, and impacts to the lake. In addition, each site was analyzed for recommended maintenance and potential best management practice (BMP) installations. All sites identified in the 2016 survey completed for the Risk Assessment Report were revisited and updated. The NPS Site Tracker was used to document the current condition of the sites.

[6] https://www.maine.gov/dep/land/stormwater/storm.html

[7] https://www.maine.gov/dep/land/watershed/materials/lakewsurveyguide.pdf

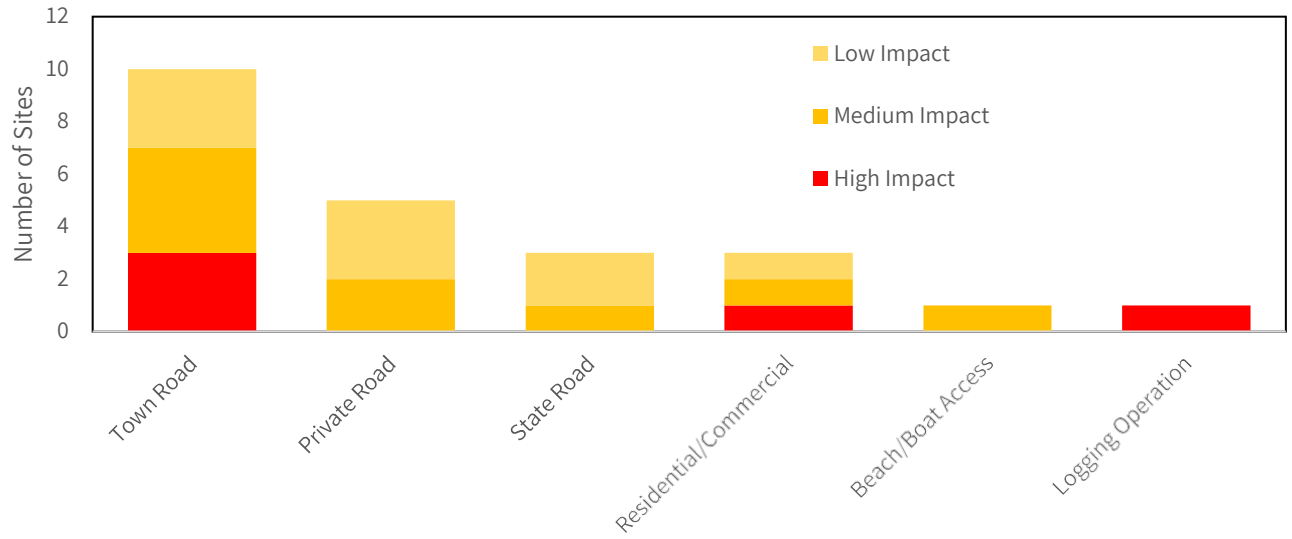


Figure 2. Land use of NPS sites identified during the watershed survey.

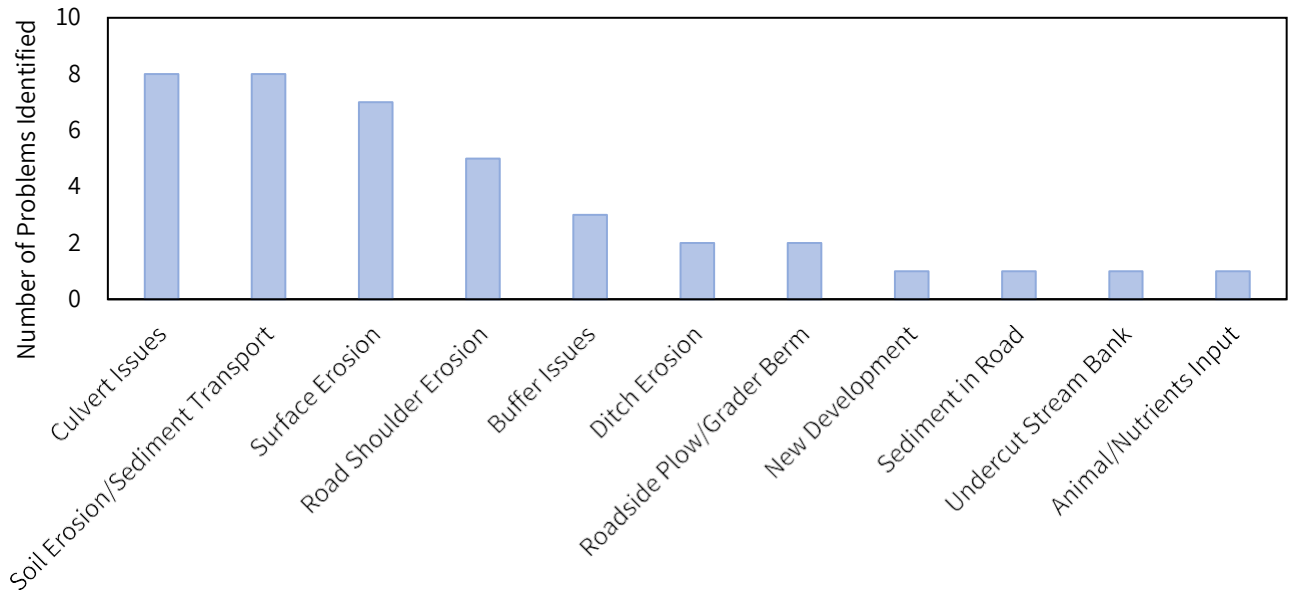


Figure 3. Sources of NPS pollution identified during the watershed survey.

Shoreline Survey

WLA, along with technical leaders from FBE and MEDEP, completed a locally funded shoreline survey in June 2019 to assess shoreline condition, using a scoring system that evaluates vegetated buffer, presence of bare soil, extent of shoreline erosion, distance of structures to the lake, and slope (refer to Appendix D for scoring methodology, Table D1). Most parcels scored in the category of developed parcels with moderate erosion issues, indicating a level of human disturbance that is detrimental to water quality (Appendix D, Table D2, Figure D1). While distance from shore and slope are potentially unchangeable factors for shorefront property owners, higher scores indicate a property is more vulnerable to negatively affecting lake quality. These scores for each parcel were summed to create individual parcel shoreline disturbance scores and entered into a database (Appendix D, Table D3). On average, LakeSmart parcels scored 14% higher than non-LakeSmart properties. Half of the 30 LakeSmart properties scored within the minimal erosion issues category e and half scored in the moderate erosion issues category, with none scoring in the significant erosion issues category. The spatial distribution of parcel scores highlights areas possibly contributing to polluted runoff and priority areas for remediation (Appendix D, Figure D2).

WATERSHED PROTECTION PLAN GOALS & OBJECTIVES

The overall goal of the Watchic Lake Watershed-Based Protection Plan is to maintain or improve Class GPA water quality standards in Watchic Lake. This will be accomplished by reducing phosphorus and sediment loading to the lake by implementing (or continuing) the following actions from 2020-2030:

- Fix 23 identified sources of NPS pollution in the 2019 Watershed Survey and 2019 Shoreline Survey via two phases of 319 grant funding through targeted outreach, technical assistance for designing, selecting and implementing BMPs, and cost-sharing assistance with property owners, the Town of Standish, and the State of Maine.
- Prevent new sources of NPS pollution by continuing to do outreach and provide technical assistance and BMP advice to property owners. In addition, prevent new sources of NPS pollution by developing more stringent development standards through ordinance revisions.
- Monitor water quality and track watershed conditions in Watchic Lake by continuing long-term water quality sampling and parameter analysis.
- Continue to build local watershed stewardship through outreach and involvement in watershed protection efforts.

SCHEDULE & MILESTONES TO GUIDE IMPLEMENTATION

ACTION PLAN AND SCHEDULE

The action plan, estimated implementation schedule, and milestones provided in this section will help address existing NPS sites and phosphorus and sediment loading to Watchic Lake and reduce additional NPS problems. The plan is designed to be implemented from 2020-2030 and is flexible to allow for new priorities throughout the ten-year implementation period. An estimated schedule is provided in Table 2. The action plan also identifies key partners and potential funding sources in Table 3.

Grant Opportunities

Grant opportunities can be used to target specific action items. The following grant opportunities are examples of potential funding opportunities to achieve the goals of this plan.

- The **Nonpoint Source Water Pollution Control Grants ('319")**, funded by EPA under Section 319(h) or Section 604(b) of the Clean Water Act**,** is a MEDEP administered grant to help communities make progress restoring or protecting waters named as NPS Priority Watersheds. A Watershed Protection Plan is a prerequisite to be eligible to submit a proposal. The annual request for proposals occurs in the spring on the MEDEP website: https://www.maine.gov/dep/rfp/index.html.
- The **Watchic Lake Stormwater Compensation Fund** is held the Cumberland Country Soil and Water Conservation District. Funds come through compensation fees from developers in certain impaired watersheds in lieu of the developers conducting full on-site phosphorus reduction efforts.
  Specifically, within the Watchic Lake Watershed, the Watchic Lake Stormwater Compensation Fund may be used to implement stormwater compensation projects that reduce phosphorus export from existing high phosphorus export land uses in the watershed. This may include addressing priority sites from the 2019 watershed and shoreline surveys.
- The **New England Forests and Rivers Grant** is a National Fish and Wildlife Foundation grant designed for projects that restore and sustain healthy forest and river systems, especially those that improve the quality of river and stream systems through targeted riparian and stream restoration, reduce barriers to fish passage, and increase fish access to high quality habitat. Proposals are typically requested in the spring. More information and application information can be found at https://www.nfwf.org/newengland/Pages/2019rfp.aspx.
  Specifically, within the Watchic Lake watershed, stream restoration projects and technical assistance are applicable to the New England Forests and Rivers Grant. For stream restoration, this may include replacing under-sized or perched culverts to restore fish passage at road crossings with Page and Paine Brook, and replanting riparian areas with native vegetation to reduce stream temperature, enhance reciprocal exchanges

between aquatic-terrestrial habitats, and to reduce sediment delivery through bank stabilization. For providing technical support, this may include providing outreach and technical assistance to engage private landowners and local governments in restoration and conservation on their land.

- The **Five Star and Urban Waters Restoration Grant Program** provides grant funds for projects that seek to address water quality issues in priority watersheds, such as erosion due to unstable streambanks, pollution from stormwater runoff, and degraded shorelines caused by development. Funding comes National Fish and Wildlife partners. The request for proposals happens annually in January. More information can be found at https://www.nfwf.org/fivestar/Pages/home.aspx.
  Specifically, within the Watchic Lake watershed, community outreach and stream restoration projects are applicable to the Five Star and Urban Waters Restoration Grant Program. For community outreach, projects may include meaningful education and training activities and integrationwith K-12 environmental curriculum. For stream restoration, projects may include riparian or in-stream habitat restoration in areas of Page and Paine Brook.
- The **Urban Waters Small Grants** are provided by EPA biannually to fund projects that address local water quality issues related to urban runoff pollution, provide additional community benefits, and foster partnership. Additional information is available at https://www.epa.gov/urbanwaterspartners/urban-waters-small-grants-101.
  Specifically, within the Watchic Lake watershed, projects addressing local water quality issues related to runoff pollution and providingcommunity benefits is applicable to the Urban Waters Small Grants. This may include projects such as community involvement and education surrounding buffer plantings, and fostering partnerships within the community.
- The **Small Community Grant Program** provides financial assistance for problems polluting a public water supply, a shellfishing area, water protection projects, or public nuisance condition. Funds, provided by MEDEP, cover 25% to 100% cost to replace malfunctioning septic systems. Additional information is available at https://www.maine.gov/dep/water/grants/scgp.html.
  This grant program is designed for residential owners whose federal taxable income is $40,000 or less, or commercial establishments whose gross profit is $100,000 or less. The pollution problem must be documented. Within the Watchic Lake watershed, malfunctioning septic systems may be eligible. The municipality applies on behalf of the property owner.

Table 2. An estimated schedule for plan implementation over a ten-year period.

Timeframe	General Accomplishments
2020-2030	Apply for an EPA Section 319 Clean Water Act grant through MEDEP. Plan to complete work in two phases with two application rounds.
	Continue to conduct water quality monitoring at Paine and Page Brook and Watchic Lake.
	Continue to conduct annual meetings, as well as raise funds for ongoing stewardship.
	Continue to do community outreach to educate and engage the public in the Watchic lake watershed protection efforts.
2020-2022	Conduct EPA 319 project (if funded) with targeted cost sharing and matching grants for high priority sites.
	Notify landowners about NPS problem sites on their property and potential courses of action (technical assistance options, cost-sharing, impacts).
	Notify the Town of Standish about NPS problem sites on town roads and potential courses of action (implementing road maintenance programs for street sweeping, cost-sharing, impacts).
	Begin using the NPS Site Tracker to track progress on sites identified in 2019 Watchic Lake Watershed Survey and to track new sites as they are identified.
2022-2025	Apply for second phase of EPA Section 319 funding and continue to implement activities described in the Action Plan.
	WLA continues to use the NPS Site Tracker for tracking ongoing progress at known sites and identifying new sites.

Table 3. Action table for the plan including milestones, timeframe, key partners, and potential funding sources.

Action Recommendation	Timeframe	Milestone	Responsible Party	Funding Source
Reduce polluted runoff from new and existing development by addressing identified NPS sites				
Review 2019 Watershed Survey sites and work with the WLA Board to identify feasibility of implementation at high priority sites. Identify sites suitable for inclusion in MEDEP 319 application in Spring of 2020.	Winter 2020	Identify 3-4 high priority sites.	WLA Board	Not Applicable.
Communicate with private landowners, the Town of Standish, and the State (if applicable) of high priority sites identified for spring 2020 application.	2020	Individual meetings with 4-5 landowners.	WLA	EPA (319), Private, Town
Follow-up on NPS sites identified during 2019 surveys, using specific BMP recommendations found in Proposed Management Measures**.**	2020-2030	Complete 100% of BMP installations, reducing phosphorus loading by a total of up to 11 lbs./yr.	WLA, Town, Landowners	EPA (319), Private, Stormwater Compensation Fund
Work with road associations, the Town of Standish, and MEDOT to identify NPS sites on roadways eligible for cost sharing assistance.				
Private Road (5 sites)	2020-2030	Technical assistance and BMP installation provided for 3-5 sites by 2022 and for 12-18 sites by 2025-2030.	WLA, Landowners	EPA (319), Private, Urban Waters Small Grants, New England Forests and Rivers Grant
Town Road (10 sites)	2020-2030		Town	EPA (319), Private, Town, New England Forests and Rivers Grant
State Road (3 sites)	2020-2030		MEDOT	EPA (319), MEDOT
Work with local landowners to identify self-funded BMP installations at NPS sites on private land.				
Residential and Commercial Sites (Watershed survey: 3 sites. Shoreline Survey, 17 high priority sites and 113 medium priority sites)	2020-2030	Technical assistance meetings for 3-10 sites provided. Informational materials on technical assistance material for all sites by 2025.BMPs installed at 10-30 sites by 2025-2030.	WLA, Landowners	EPA (319), Urban Waters Small Grants New England Forests and Rivers Grant, Private
Boat or Beach Access (1 sites)	2020-2030		WLA, Landowners	EPA (319), Urban Waters Small Grants, Private
Logging Operation(s) (1 site)	2020-2030		Landowners	EPA (319), New England Forests and Rivers Grant, Private

Action Recommendation	Timeframe	Milestone	Responsible Party	Funding Source
Follow up on previous BMP stormwater remediation system installed with NRCS on agricultural property off Route 113. Meet with landowners to ensure proper manure storage. Fund covered manure storage system if needed.	2020-2025	Meet with landowner to ensure continued BMP maintenance at site.	WLA	WLA, EPA (319), NRCS
Identify agricultural property owners in watershed and establish partnership for potential BMP installation.	2020-2030	Identify all property owners, implement BMPs as needed	WLA	WLA, EPA (319), NRCS
Train WLA to use NPS Site Tracker for required site maintenance and updates and set up NPS Site Tracker to act as accessible database for WLA and volunteers.	2020	Site Tracker is used and up to date.	FBE, WLA	WLA, MEDEP
Continue using NPS Site Tracker created with 2019 watershed survey.	2020-2030	Site Tracker is used and up to date.	WLA	WLA, EPA (319)
Repeat watershed survey every ten years to assess and document changing conditions and priorities; update NPS Site Tracker.	2030	Watershed survey repeated.	WLA	WLA, MEDEP
Repeat Shoreline Survey every ten years to assess and document change in shoreline condition over time.	2030	Shoreline survey is repeated.	WLA	WLA, MEDEP
Assess condition of BMP sites installed from 2000-2019; prioritize for any maintenance needed.	2020-2025	BMP sites re-surveyed.	WLA	WLA, MEDEP
Re-survey all implemented BMP sites every 5 years to assess functionality; update NPS Site Tracker.	2020-2030	BMP sites re-surveyed.	WLA	WLA, MEDEP
Advertise and provide clean lake checks via property walks and technical assistance for BMP installations as landowners request.	2020-2030	2 clean lake checks completed each year.	WLA	WLA, EPA (319)
Increase Property Owner Involvement				
Continue Lake Smart Program for shoreline owners.	2020-2030	Goal: increase to 25% of shorefront properties.	WLA	WLA
Collaborate with the Kiwanis executive board to understand and address stormwater runoff at Kiwanis Beach.	2020-2030	Establish partnership with executive board and implement BMPs at the property.	WLA	Private, EPA (319)
Continue to update the WLA website with information for property owners on self BMP installation. Consider adding a "Self-Assessment Quiz" to the WLA website that helps homeowners determine whether they have a stormwater runoff or buffer problem on their property.	2020-2030	Increase engagement by 2-10 new property owners each year, potentially measured by LakeSmart Applications.	WLA	Private

Action Recommendation	Timeframe	Milestone	Responsible Party	Funding Source
Provide lake residents with incentives, such as LakeSmart Awards, for planting locally sourced, native plants for shoreline buffers.	2020-2030	Increase engagement by 2-10 new property owners each year, potentially measured by LakeSmart Applications.	WLA	Private
Improve Road Maintenance Methods				
Continue to work with road associations, road agents, the town, and landowners to manage sediment and salt runoff from roads.	2020-2030	Winter sand removal programs implemented.	WLA, Road Associations, Town	WLA, MEDEP, Town, Private
Require training for road agents on proper salt, sand, and equipment use to minimize water quality impact.	2020-2030	Training implemented.	WLA, Road Associations, Town	Private, Town
Improve Septic System Maintenance				
Work with the Town to enforce the new State of Maine law (LD 216) that requires buyers to complete a septic system inspection before the purchase of shorefront property. (Beginning on 01/01/2020).	2020-2030	Meet with Town enforcement to ensure law is recognized and supported.	WLA	Not Applicable
Investigate septic systems in sensitive soil areas. Use the Maine Septic System Permit Search to research parcels overlaying sensitive soils to identify septic systems at-risk for failure/contamination and follow-up with site visits at high risk parcels. (https://www1.maine.gov/cgi-bin/online/mecdc/septicplans/index.pl)	2020-2030	Follow up with site-visits at high risk parcels.	WLA, Town	WLA, Town
Consider an incentive for replacing old failing septic systems.	2020-2030	Incentive program developed.	WLA	WLA, Private
Consider developing an ordinance that requires regular septic system pump-outs.	2020-2030	Ordinance developed and implemented.	WLA	WLA, Town
Improve Regulatory Protection of Land Development				
Review and revise local ordinances to include better site design, low impact development, and green infrastructure principles that limit the amount of phosphorus, nitrogen, sediment, and acidic waters from reaching waterbodies. Consultant can provide technical review of local ordinances and provide suggestions for improvement.	By 2022	Report on ordinance review findings.	WLA, Consultant	WLA

Action Recommendation	Timeframe	Milestone	Responsible Party	Funding Source
Fund tools, such as build-out scenario programs, GIS based natural resource inventories/critical area habitat assessments, to help target critical land for protection or where current zoning may threaten forested areas.	By 2022	Natural resources inventory report for watershed.	WLA, Consultant	WLA
Permanently protect undeveloped parcels to increase watershed resiliency to extreme weather events and prevent potential polluted runoff.	Ongoing	Identify and protect highest priority parcels.	WLA	WLA, Town of Standish

PLAN OVERSIGHT AND PARTNER ROLES

Partner Roles

The Watchic Lake Watershed-Based Protection Plan will be carried out by the WLA. Other partners include MEDEP, the Town of Standish, Maine Department of Transportation (MEDOT), private road associations, and landowners.

- **Watchic Lake Association (WLA)** will be responsible for plan oversite and implementation. WLA will conduct water quality monitoring, facilitate outreach activities and watershed stewardship, and raise funds for further stewardship work. They will use the NPS Site Tracker for continued implementation of BMP practices, maintenance, and identifying new sites.
- The **Town of Standish** will work to address NPS problems including conducting regular maintenance on town road sites and using best practices for winter sand/salt application and removal.
- **Maine Department of Transportation (MEDOT), private road associations, and landowners** will address NPS issues on their properties and maintain BMPs.
- **Maine Department of Environmental Protection (MEDEP)** will provide technical assistance and the opportunity for financial assistance through the NPS Grants Program.
- **Natural Resources Conservation Service (NRCS)** can provide technical assistance to implement BMPs to address agricultural issues.
- **Environmental Protection Agency (EPA)** may provide CWA Section 319 funds and guidance.

PLAN OUTPUTS & MILESTONES

The plan will provide organizational outputs, NPS mitigation outputs, and water quality outcomes (Table 5).

Table 4. Plan outputs and outcomes.

Plan Outputs	
Organizational Outputs	Proposal for EPA 319 funds and/or other grant sources.
	NPS Site Tracker – updated and maintained throughout plan implementation by WLA. This NPS site tracker is required for projects implemented using EPA funding.
	Documentation of landowner notification and outreach for sites with recommended BMPs.
NPS Mitigation Outputs	10-30 NPS sites fixed by voluntary landowner initiative.
	12-18 high and medium impact NPS sites fixed with cost sharing assistance.
	20-30 technical assistance visits.
	Estimated pollutant load reductions from BMP implementation.
Water Quality Outcomes	Watchic Lake continues to meet GPA standards set by MEDEP.
	Stable or improving trend for dissolved oxygen levels in bottom waters of Watchic Lake.

PROPOSED MANAGEMENT MEASURES

STRUCTURAL BEST MANAGEMENT PRACTICES

Common NPS pollution problems identified in the 2019 Watchic Lake Watershed and Shoreline Surveys are described in the sections below. The watershed survey memorandum can be found in Appendix B and the full data in table form, in Appendix C. Problems are categorized as residential sites and boat/beach access, private roads and driveways, state and town roads, or gravel/logging operations. General recommended BMPs and maintenance requirements for these common problems are provided in Table 5. The recommended BMPs accomplish the plan goal of reducing phosphorus, nutrient, and sediment input to Page and Paine Brook and Watchic Lake by stabilizing bare soil and erosion, as well as diverting, infiltrating, or filtering polluted runoff before it enters a surface water.

Residential Sites & Boat/Beach Access

The 2019 Watchic Lake Watershed Survey identified one high impact, three medium impact, and three low impact residential properties. Common problems included steep driveways and developed land, and shoreline destabilization (see Appendix B). Many residential site BMPs will require low cost installations and minimal maintenance, which landowners can install with targeted outreach or technical assistance from WLA.

In addition to the Watershed Survey, residential sites were also evaluated via water in the 2019 Watchic Lake Shoreline Survey, which identified 17 high priority and 113 medium priority residential shoreline properties.[8] Common problems included poor or lacking shoreline buffer, large areas of bare soil or sand, shoreline and bank erosion, and dense development close to the shore.

Private Roads & Driveways

The watershed survey identified five private road sites, of which two are low impact and three are medium impact, and one residential site with a high impact driveway issue. Common problems included surface, ditch, and road shoulder erosion, soil and sediment transport, inadequate culvert or stream crossing, and steep roads or driveways (Appendix C, Table C1). Targeted outreach and technical assistance will help road associations and landowners with BMP installation or repair. Cost-sharing may be appropriate in high priority areas. Road and driveway BMPs require ongoing maintenance and inspection to ensure proper BMP performance and prevent new NPS problems.

Town Roads

The watershed survey identified 10 town road sites, of which three are high impact, four are medium impact, and three are low impact. Common problems include road shoulder, surface, and ditch erosion, inadequate or damaged culverts, steep slopes, sediment transport, and winter sand and salt buildup and transport. One high impact site – Watchic Terrace Road – has been a consistent high severity site due to steep slopes, heavy residential development, and inadequately sized BMPs and maintenance. These sites require involvement and support from the Town of Standish. High impact sites may require technical assistance and cost-sharing for BMP implementation. Road BMPs require ongoing maintenance and inspection to ensure proper BMP performance and prevent new NPS problems (Appendix C, Table C1).

State Roads

The watershed survey identified three state road sites, of which one is medium impact and two are low impact. Common problems include road shoulder, surface, and ditch erosion, inadequate or damaged culverts, steep slopes, sediment transport, and winter sand and salt buildup and transport. These sites require the involvement of MEDOT. One medium impact site – the Page Brook stream crossing of Route 113 – is scheduled to be repaired by MEDOT in 2019-2020. Road BMPs require ongoing maintenance and inspection to ensure proper BMP performance and prevent new NPS problems (Appendix C, Table C1).

Gravel & Logging Operations

The watershed survey identified one high priority logging site and one medium impact gravel site. The logging site lacked a shoreline buffer and had exposed bare soil. The gravel site had exposed bare soil but had installed BMP practices. Both sites will require continuous BMP installation and maintenance to prevent new NPS problems (Appendix C,Table C1).

[8] Includes the Kiwanis Club, a private beach open to the public, as a high priority site.

Table 5. General recommendations for best management practices (BMPs) to address common nonpoint source (NPS) site issues seen in the Watchic Lake watershed. For specific site recommendations, see Appendix B.

	NPS Site Issue	Recommended Best Management Practice (BMP)	Maintenance Requirements	Who Does the Maintenance?
Residential Sites & Boat/Beach Access	Inadequate buffer	Plant vegetated buffers with native plants.	Low maintenance: periodic inspection, weeding, potential replanting	Landowners
	Bare soil	Plant rain gardens, mulch or seed open areas, remove artificial sand.		Landowners
	Shoreline and bank erosion and destabilization	Filter path and driveway runoff into ground, install runoff diverters on path, stabilize shoreline/bank with a combination of fabric, rip rap, and plantings, remove artificial sand.		Landowners
	Development close to shore	Ensure septic system is fully functioning, install driplines/infiltration trenches along roofedges.		Landowners
	Steep slope with development	Stabilize with rip rap and plantings.		Landowners
Private Roads & Driveways	Road surface erosion	Reshape (crown) the road surface, removing berms that trap runoff on road surface. Install or improve waterbars or turnouts to divert water off road.	Periodic inspection, regrading of road surface.	Road Association, Landowner
	Ditch and road shoulder erosion	Clean, enlarge, and stabilize ditches, install turnouts to push water away from the road and road edges.	Periodic inspection and cleaning of ditches	Road Association, Landowner
	Soil and sediment transport	Install catch basins and turnouts to filter and settle sediment, especially during storm events.	Periodic inspection and cleaning of catch basins	Road Association, Landowner
	Inadequate culvert: undersized, clogged, or broken	Armor culvert inlets and outlets, install plunge pool, enlarge and size for flow volumes.	Periodic inspection	Road Association, Landowner
	Steep road or driveway	Install armored ditches and turnouts to control and slow water.	Periodic inspection	Road Association, Landowner
State & Town Roads	Road surface erosion	Reshape (crown) the road surface, removing berms that trap runoff on road surface, Install or improve water bars to divert water off road	Periodic inspection, regrading of road surface.	Town, State
	Ditch and road shoulder erosion	Clean, enlarge, and stabilize ditches, install turnouts to push water away from the road and road edges	Periodic inspection and cleaning of ditches	Town, State
	Winter sand and salt buildup and transport	Implement winter sand removal practices.	Periodic sand removal.	Town, State
	Soil and sediment transport	Install catch basins and turnouts to filter and settle sediment, especially during storm events.	Periodic inspection and cleaning of catch basins	Town, State
	Inadequate culvert: undersized, clogged, or broken	Armor culvert inlets and outlets, install plunge pool, enlarge	Periodic inspection	Town, State

	NPS Site Issue	Recommended Best Management Practice (BMP)	Maintenance Requirements	Who Does the Maintenance?
	Steep road or driveway	Install armored ditches and turnouts to control and slow water.	Periodic inspection	Town, State
Gravel Operation or Logging	Bare soil	Vegetate landscape, practice sustainable logging operations.	Low maintenance	Responsible private company
	Inadequate buffer	Plant vegetated buffer, install rip rap and armor bank adjacent to construction.	Periodic inspection	Responsible private company
	Lack of stream shading	Improve buffer, leave large trees adjacent to stream.	Low maintenance	Responsible private company
Agriculture Operations	Uncovered manure storage	Install a covered manure storage area and locate manure piles away from watercourse drainages.	Periodic inspection	Landowner
	Nutrient transport	Install and maintain armored ditches and turnouts to control runoff.	Low maintenance	Landowner
		Maintain vegetated buffers to filter runoff.	Low maintenance	Landowner

NON-STRUCTURAL BEST MANAGEMENT PRACTICES

Public education and outreach and increased local involvement in lake protection efforts are also important tools for lake stewardship. The NPS Site Tracker will be used by WLA to identify new problems and prompt maintenance of corrected sites and installed BMPs.

Educational awareness of landowners in the Watchic Lake watershed includes education on septic system maintenance, boat pollution, and shoreline buffer improvement. Further education on the causes and impacts of nonpoint source pollution, how to identify problem areas, and what BMPs are appropriate to fix problem areas, are all important tools for community engagement. Encouraging WLA membership, surveying watershed citizens, and creating informational pamphlets all increase local awareness of lake protection efforts.

Using the regulatory framework for managing pollutants also implements watershed protection measures. Strong stormwater management, development, and land use regulations can reduce polluted runoff.

POLLUTANT LOAD REDUCTIONS

SHORELINE SURVEY

The pollutant loading estimates are based on the shoreline survey disturbance scores (Appendix D, Table D2). The eight parcels with a score of 15 or greater generate an estimated 11.2 lbs. of phosphorus load to Watchic Lake annually. The 123 parcels with a mid-range score of 10-14 are estimated to deliver approximately 8.6 lbs/yr of phosphorus load to the lake. If shoreline landowners were to create adequate buffers and install other shoreline BMPs on all properties (at a 50% BMP efficiency rate), the annual reduction would be 9.9 lbs. of phosphorus per year in total (Figure 4)[9].

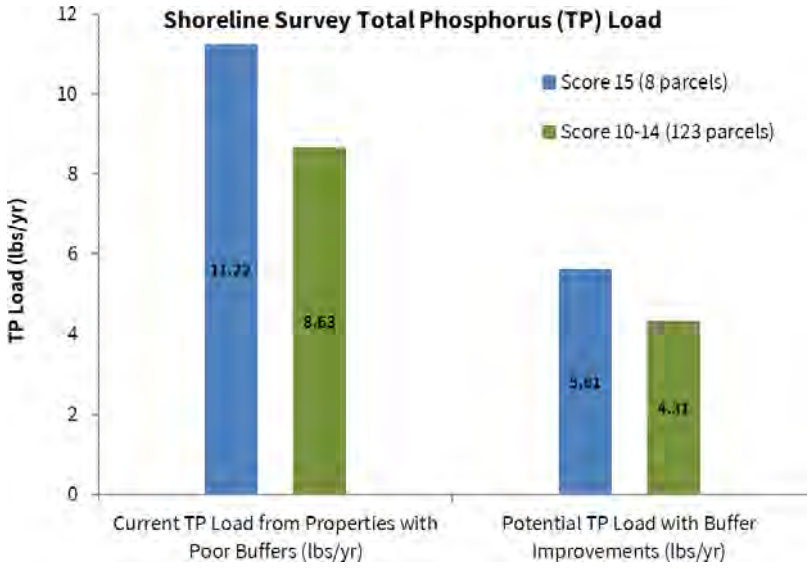


Figure 4. Pollutant load estimates for parcels surveyed during the shoreline survey.

[9] Estimates calculated using the USEPA Region 5 Model. All properties with a score of 15 or greater were given standard model inputs as follows: Soil Type = Loamy Sand, Model Type = Bank Stabilization, Length of Bank = 100 ft, Height of Bank = 5 ft, Lateral Recession Rate of 0.06 ft/yr (Moderate). Properties scoring between 10 and 14 were given the above inputs with the following adjustments: Length of Bank = 50 ft, Height of Bank = 3 ft, Lateral Recession Rate of 0.01 ft/yr (Slight).

WATERSHED SURVEY

We estimated pollutant load reductions from 23 sites (with three additional sites documented to track maintenance) with nonpoint source pollution problems identified during the watershed survey using the USEPA Region 5 Model. For sites utilizing the Region 5 model for bank or gully stabilization, the dimensions of the bank or gully were measured either in the field by observers initially and verified if needed by using aerial imagery and ArcGIS measuring tools. For sites utilizing the Region 5 model for Urban Runoff Loading Rate, the acreage of the contributing/drainage area was measured using ArcGIS measuring tools. The dominant soil type at each site location was identified using the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS) Web Soil Survey program. This tool allows the user to input the textural class of the soil (e.g., sand, loamy sand, fine sandy loam) and the estimated lateral recession rate (ft/yr; for bank stabilization) or years of formation (for gully stabilization) of the erosion site using best professional judgment and/or anecdotes from local residents. The model then calculates the sediment, phosphorus, and nitrogen load reductions (lbs./yr) as a result of implementing a BMP at that site. Total pollutant load reduction calculations are shown in Table 6, below. Note that pollutant load reductions are preliminary and for planning purposes only. Pollutant load reductions will be estimated and reported to MEDEP for any work funded by 319 grants using methods approved and recommended by the MEDEP and EPA. Refer to Appendix B for site specific pollutant load estimates.

Table 6. Preliminary pollutant load reductions for total suspended solids (TSS), total phosphorus (TP), and total nitrogen (TN), if all 23 watershed survey sites were addressed. Pollutant load reduction numbers for each site were estimated with desktop analysis using site measurements from field and/or verified with aerial imagery and ArcGIS measuring tools.

PRELIMINARY POLLUTANT LOAD REDUCTIONS		
TSS (tons/yr)	**TP (lbs./yr)**	**TN (lbs./yr)**
11.2	10.5	23.5

WATER QUALITY MONITORING PLAN

The WLA will continue to monitor Watchic Lake and Page and Paine Brook annually with the goal of maintaining lake GPA standards set by MEDEP, as well as continue to track changes in phosphorus and sediment loading to the lake. Maine water quality criteria require that lakes and ponds have a stable or improving trophic state and be free of culturally induced algal blooms. MEDEP also conducts baseline monitoring on Watchic Lake about every five years for these and other parameters. MEDEP 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.

The water quality monitoring program presented below began in 2016 and builds on historical water quality monitoring starting in 1974. Watchic Lake has one of the most robust water quality monitoring programs in the state. Therefore, our recommendations are to continue the existing water quality monitoring program. Continued monitoring will allow for long term data trend analysis, allowing Watchic Lake to better understand lake dynamics and response to the surrounding environment (Table 7).

Table 7. Recommended actions to continue water quality monitoring in the Watchic Lake watershed.

Recommended Action	Timeframe
Monitoring at the Deep Spot	
Continue to fund a lake monitoring program that includes four summer epilimnion samplings (June, July, August, September) of total phosphorus, chlorophyll-a, alkalinity, pH and color.	2020-2030
Continue collecting bottom grab samples for total phosphorus. Increase frequency to monthly, if funds allow.	2020-2030

Recommended Action	Timeframe
Continue to take Secchi disk transparency readings every two weeks at the deep spot from at least June to September, and potentially ice-out to ice-in.	2020-2030
Continue to deploy Onset HOBO® loggers at the deep spot. Maintain winter record with temperature pendants and re-deploy dissolved oxygen loggers each summer at 2, 5, and 11-meters.	Review after 10 yrs of continuous monitoring (2026)
Complete a water quality analysis of yearly and historical Watchic Lake water quality data to track trends.	Annually
Continue to increase the number of certified Secchi and DO volunteer monitors to increase local involvement and ensure future continuation of the monitoring program.	2020-2030
Conduct sediment chemistry testing to better understand internal phosphorus loading.	2020-2030
Tributary Monitoring	
Continue to monitor Page Brook, specifically during Route 113 culvert replacement. If funds allow, re-instate monitoring at Paine Brook for baseline data.	2020-2030
Consider deploying data loggers in Page and Paine Brook to gather continuous water quality information on specific conductivity, dissolved oxygen, temperature, and water level.	2020-2030
Conduct bracket sampling on the Page Brook tributary to identify any hotspot areas of total phosphorus and total nitrogen input(s) to the streams.	By 2022
Invasive Species Monitoring	
Currently, no invasive aquatic plant species exist in Watchic Lake. We recommend continuing to conduct an annual plant inventory in order to detect if an invasive species becomes present.	Ongoing
Work with the Kiwanis Club to establish an invasive species plant patroller at the boat launch to reduce the possibility for invasive species entry into the lake. Consider launching the MEDEP Courtesy Boat Inspection program for Watchic Lake. More information is available at https://www.maine.gov/dep/water/invasives/inspect.html.	Establish May 2020

RESOURCES

Maine Courtesy Boat Inspection Program: https://www.maine.gov/dep/water/invasives/inspect.html

This is avoluntary inspection program is to reducethe spreadofinvasive aquaticplants (IAP) byboats, trailers, and associated equipment to Maine waters, run by trained volunteers at boat launches.

Maine Erosion and Sediment Control Practices Field Guide for Contractors. MEDEP. 2015.

This manual provides information on Best Management Practice installation and maintenance.

New Hampshire Stormwater Manual: https://www.des.nh.gov/organization/divisions/water/stormwater/manual.htm

This manual provides information relevant to New England stormwater management.

UNH Stormwater Center: https://www.unh.edu/unhsc/

TheUNHStormwater Centerprovides annualreports relevant to protectingwaterresources through effective stormwater management.

APPENDIX A: WATER QUALITY

Water Quality Monitoring Methodology 2016-2018

From 2016-2018, WLA deployed a monitoring buoy at the deep spot of Watchic Lake, with Onset HOBO® loggers recording dissolved oxygen at 2, 5, and 11 meters below the surface and Onset HOBO® temperature pendants at 1, 3, 4, 6, 7, 8, 9, and 10 meters below the surface (Figure A1). Data are recorded at 15-minute intervals continuously from May to October at these depths from the surface. Beginning in 2017, temperature pendants remained deployed over the winter to monitor under-ice conditions. The buoy is affixed to the bottom of the lake, and pendant locations are adjusted to account for lowered water level in the winter and the removal of the three dissolved oxygen loggers. In addition to continuous data logging at the deep spot, FBE and WLA volunteers collect temperature and dissolved oxygen profiles, Secchi disk transparency readings, and integrated epilimnetic core samples monthly at the deep spot. Water samples are analyzed for trophic state indicators (total phosphorus and chlorophyll-a), and chemical parameters (total alkalinity, pH, color, total nitrogen, and dissolved organic carbon).

Page Brook and Paine Brook were sampled monthly (June-September) from 2016-2018 for dissolved oxygen, temperature, total phosphorus, pH, *E. coli*, and total nitrogen.

In 2019, total nitrogen and dissolved organic carbon were removed from sampling at the deep spot. The WLA added bottom grab samples for total phosphorus at the deep spot in August and September. In addition, WLA reduced monitoring at the two tributaries, conducting sampling at Page Brook in August and September for field parameters and total phosphorus analysis only. Sampling at Paine Brook was ceased in 2019.

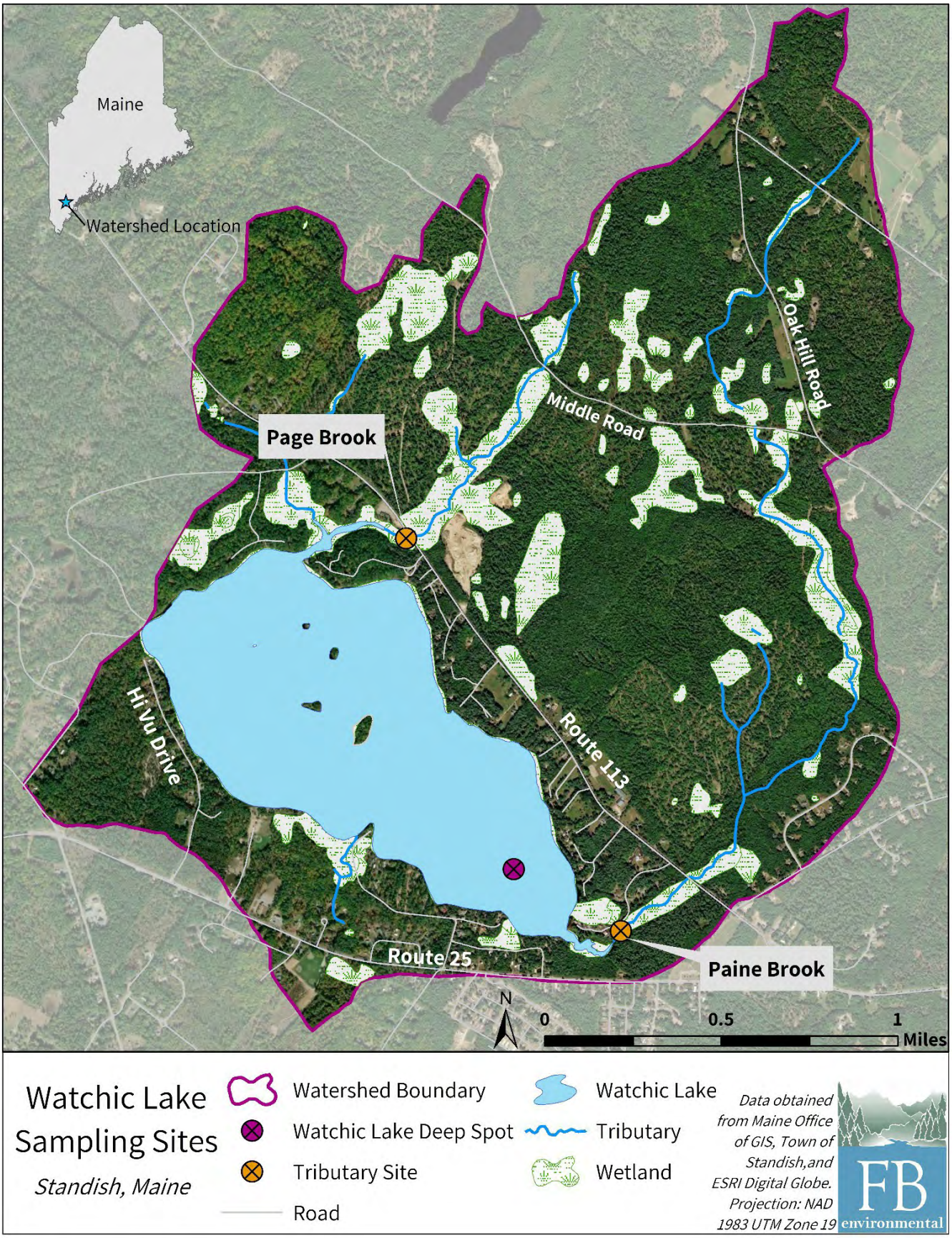


Figure A1. Map of Watchic Lake, including two tributary sites (orange) and the deep spot sampling location (magenta).

Trophic State Indicators

Historical total phosphorus levels averaging 9.8 ppb and chlorophyll-a levels averaging 5.4 ppb, place Watchic Lake in the category of a *mesotrophic*, or moderately productive lake (Figure A2). Epilimnetic core sampling from 2016 to 2018 show that trophic state indicators have remained within the acceptable range for water quality for a mesotrophic lake (Figure A3). Historical water clarity data in the lake beginning in 1974 show variability between 4 and 7 meters.[10] Across the three most recent years of deep spot monitoring (2016-2018), years with increased precipitation resulted in lower oxygen and degraded trophic state indicators, most likely due to higher nutrient inputs in stormwater. For example, improved water clarity, total phosphorus, and chlorophyll-a in both 2016 and in 2018, compared to 2017, was likely due to the drier summer conditions in 2016 and 2018.

Lakes are classified by trophic class based on the amount of biological productivity in the lake.

Oligotrophic Lakes have low productivity and water quality is typically good.

Mesotrophic Lakes have moderate productivity and water quality is typically good-fair. Watchic Lake is a mesotrophic lake.

Eutrophic Lakes have high productivity and

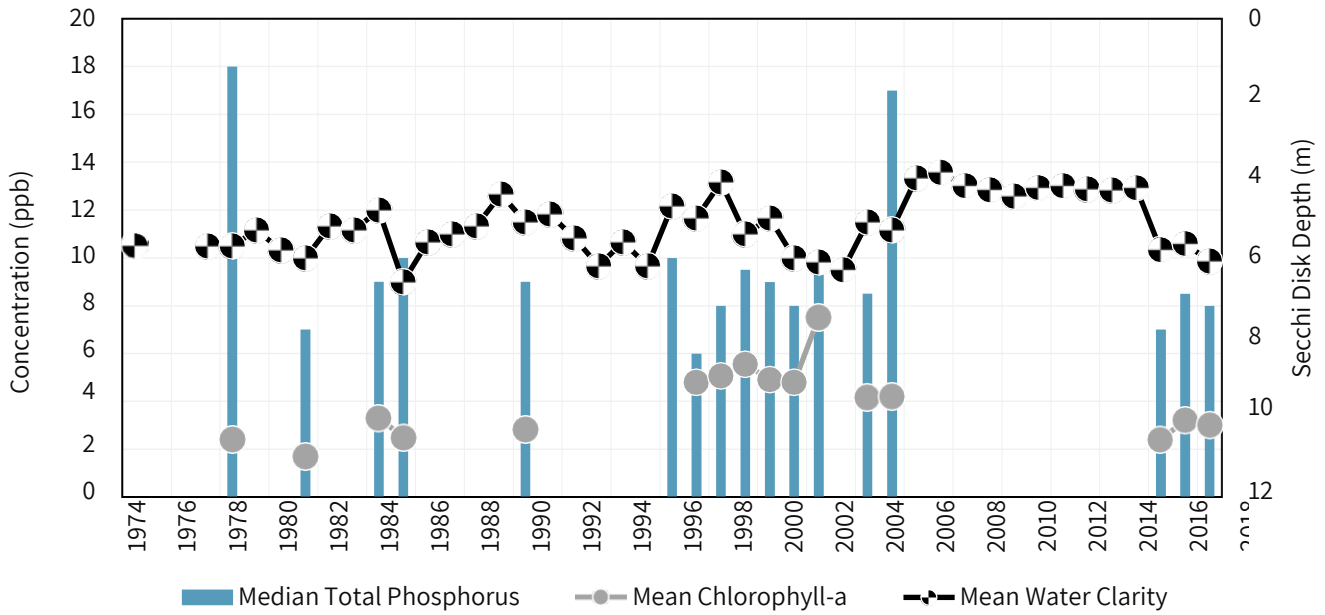


Figure A2. Watchic Lake mean annual water clarity and median annual total phosphorus and chlorophyll-a for epicore samples only. Trend analysis conducted using the non-parametric Mann Kendall test showed no statistically significant trends over time.

[10] Between 2006 and 2015 there was unusual stability in readings at about 4 meters. These data were not checked for quality control by the MEDEP and were not included in the trend analysis.

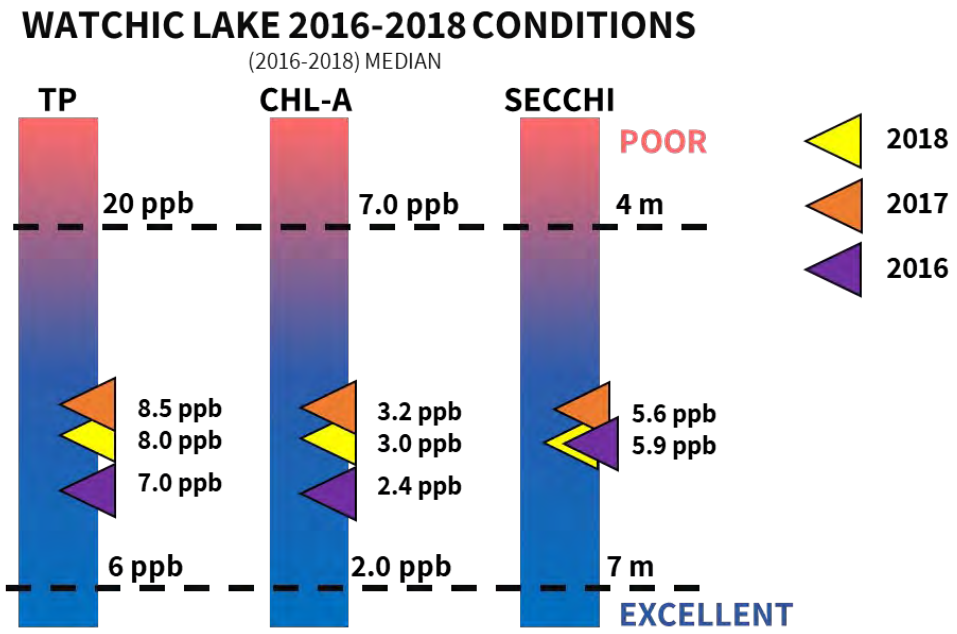


Figure A3. Trophic state indicators total phosphorus (TP), chlorophyll-a (CHL-A), and water clarity (SECCHI) from 2016-2018. Black dotted lines represent the upper and lower thresholds for each parameter that categorize the lake as moderately productive (personal communication, Jeremy Deeds, Aquatic Ecologist, MEDEP).

Continuous Monitoring

A common problem in Maine lakes is the depletion of dissolved oxygen in the deepest part of lakes throughout the summer months. This occurs when thermal stratification prevents warmer, oxygenated surface waters from mixing with cooler, oxygen-depleted (from chemical and biological processes) bottom waters in the lake. Dissolved oxygen levels below 5 ppm (and water temperature above 24 °C) can stress and reduce habitat for cold-water fish and other sensitive aquatic organisms. In addition, anoxia (low dissolved oxygen) at lake bottom can result in the release of sediment-bound phosphorus (otherwise known as internal phosphorus loading), which becomes a readily available nutrient source for algae. The availability of these nutrients is dependent on their co-occurrence in the lake profile with the algae species. This can happen by a few different mechanisms; (1) the nutrients are within the photic zone, (2) the algae have buoyant properties which allow it to move from the deep high phosphorus waters to the photic zone, or (3) the nutrients are mixed during fall turnover. While thermal stratification and depletion of oxygen in bottom waters is a natural phenomenon, it is important to keep tracking these parameters to make sure the extent and duration of low oxygen does not change drastically because of human disturbance.

Figure A4, on the following page, shows an example heat plot of dissolved oxygen (top) and temperature (bottom) from 2018. These plots help to identify the timing of the onset of spring stratification and fall turnover, as well as the extent and duration of low oxygen in the bottom of the lake. Continuous monitoring for the past three years has allowed the WLA to closely track changes to the lake. As this dataset grows, it will give the WLA a better understanding of the influence of human development and climate change on critical lake properties. Complete annual water quality reports for 2016, 2017, and 2018 can be found at the WLA webpage (https://watchiclake.org/about-watchic-lake/water-quality/).

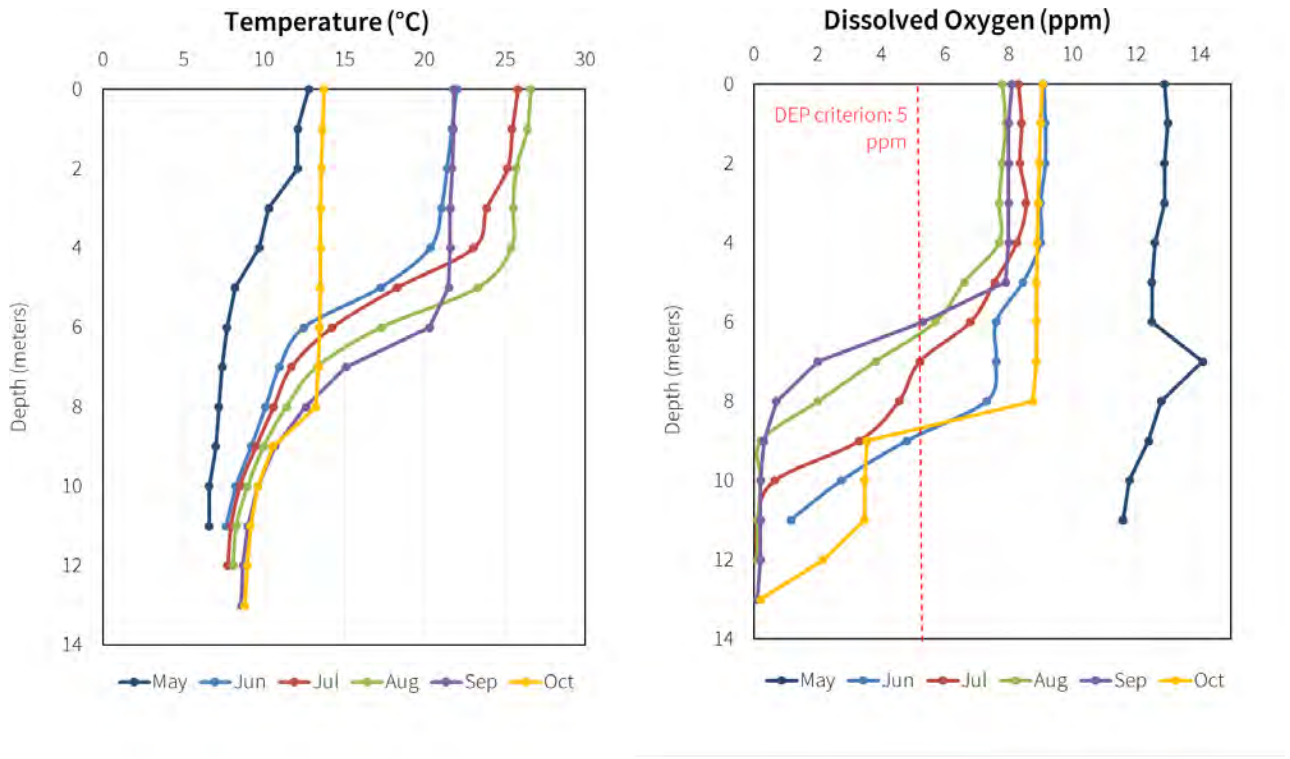


Figure A4. 2018 temperature (left) and dissolved oxygen (right) profiles for the deep spot of Watchic Lake. Displayed profiles represent the average monthly readings at each depth from FBE and WLA volunteers. Dissolved oxygen depletion at the bottom of the lake is evident as early as the June sampling (dropping below 5 ppm at 9 meters). In July - Sept, dissolved oxygen is below 5 ppm around 7 meters.

APPENDIX B: WATERSHED SURVEY REPORT

MEMORANDUM| WATERSHED SURVEY RESULTS

TO: Paul McNulty, Watchic Lake Association

FROM: Margaret Mills (Burns), FB Environmental Associates (FBE)

SUBJECT: Memorandum: Watershed Survey Results

DATE: September 25, 2019, revised November 7, 2019

CC: Forrest Bell, FB Environmental Associates(FBE)

ATTACHMENTS: (1) Watershed Survey Data as Appendix C to Watchic Lake Protection Plan; (2) Labeled Site Photos as zipped folder sent with Watchic Lake Protection Plan

This memorandum summarizes the results of the watershed survey conducted in the Watchic Lake watershed. FB Environmental Associates (FBE) was contracted to complete a watershed survey that identified and documented evidence of sediment erosion of "hotspots" of nutrient loading to surface waters in the Watchic Lake watershed. On April 22, 2019, FBE technical staff (Margaret Burns, Rich Brereton, Maggie Kelly, and Amanda Gavin) surveyed the entire watershed and followed up on sites identified by FBE in the 2016 Risk Assessment, identifying 26 sites that require implementation of Best Management Practices (BMPs) to improve impacts from stormwater, erosion, lack of infiltration (impervious cover), culvert restrictions, and/or lack of vegetated riparian buffer (Figure B1, page 3). Documentation at each site included describing the problem, making recommendations for fixing the problem, rating the site's impact to water quality, logging the sites geoposition, and taking photographs (refer to attached data). Recommended BMPs utilize existing local guidance from MEDEP watershed survey guide, as well as professional judgement by technical surveystaff.

Estimates of Best Management Practice implementation costs and pollutant load reductions, as well as impact ratings documented during the survey, were used to prioritize implementation at the 26 identified sites. The top ten erosion sites are described in more detail below. This survey work is part of the completion of the Watchic Lake Protection Plan.

SURVEY TECHNIQUES

The watershed survey was conducted on April 22, 2019 by FBE technical staff. The watershed was divided into two sections for survey completion. Survey groups were as follows:

(1) **Team A** (southern portion of watershed): Margaret Burns, Hydrologist, and Amanda Gavin, Project Scientist II
(2) **Team B** (northern portion of watershed): Rich Brereton, PhD., Water Resources Scientist, Maggie Kelly, ProjectScientist I

Field assessments were completed using maps identifying known potential pollution sources in the watershed area from previous surveys and known stream crossings, and using handheld, tablet computers with GPS and GIS software for data collection and photography to document the location and existing conditions of specific sites. Survey teams drove roadways in the watershed area and evaluated sites that posed a threat to downstream waterbodies. As part of the field work, the project team noted the location (based on GIS coordinates) and the extent of the stormwater impact or source areas, made preliminary recommendations about the type of stormwater management that would benefit the site, rated the severity of the problem, documented any observed site constraints for implementing the stormwater management option, and recorded any other relevant field observations. These data were then downloaded and entered into a set of assessment forms that combine the notes, mapped location and GPS coordinates, and photographs of the site.

POLLUTANT LOAD REDUCTION MODELING

Following field work, FBE generated pollutant load reduction estimates (phosphorus, nitrogen, and sediment) for sites identified in the watershed survey. We used the U.S. Environmental Protection Agency (USEPA) Region 5 model to complete this analysis.

USEPA Region 5 Model: For sites utilizing the Region 5 model for bank or gully stabilization, the dimensions of the bank or gully were measured either in the field by observers or by using aerial imagery and ArcGIS measuring tools. For sites utilizing the Region 5 model for Urban Runoff Loading Rate, the acreage of the contributing/drainage area was measured using ArcGIS measuring tools. The dominant soil type at each site location was identified using the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS) Web Soil Survey program. This tool allows the user to input the textural

class of the soil (e.g. sand, loamy sand, fine sandy loam). Additionally, the user selects the estimated lateral recession rate (ft/yr; for bank stabilization) or years of formation (for gully stabilization) of the erosion site using best professional judgment and/or anecdotes from local residents. The user also selects a BMP to implement for calculating the urban runoff loading rate. The model then calculates the sediment, phosphorus, and nitrogen load reductions (lbs/yr) as a result of implementing a BMP at that site.

The field data and pollutant load reduction calculations were then inputted into the BMP prioritization matrix. This is included as Attachment 1.

Examples of watershed survey sites (clockwise from top left); bank erosion (A-1), road surface erosion and gully formation (site A-9), hanging culvert (site B-2), and winter sand and sediment transport (A-11).

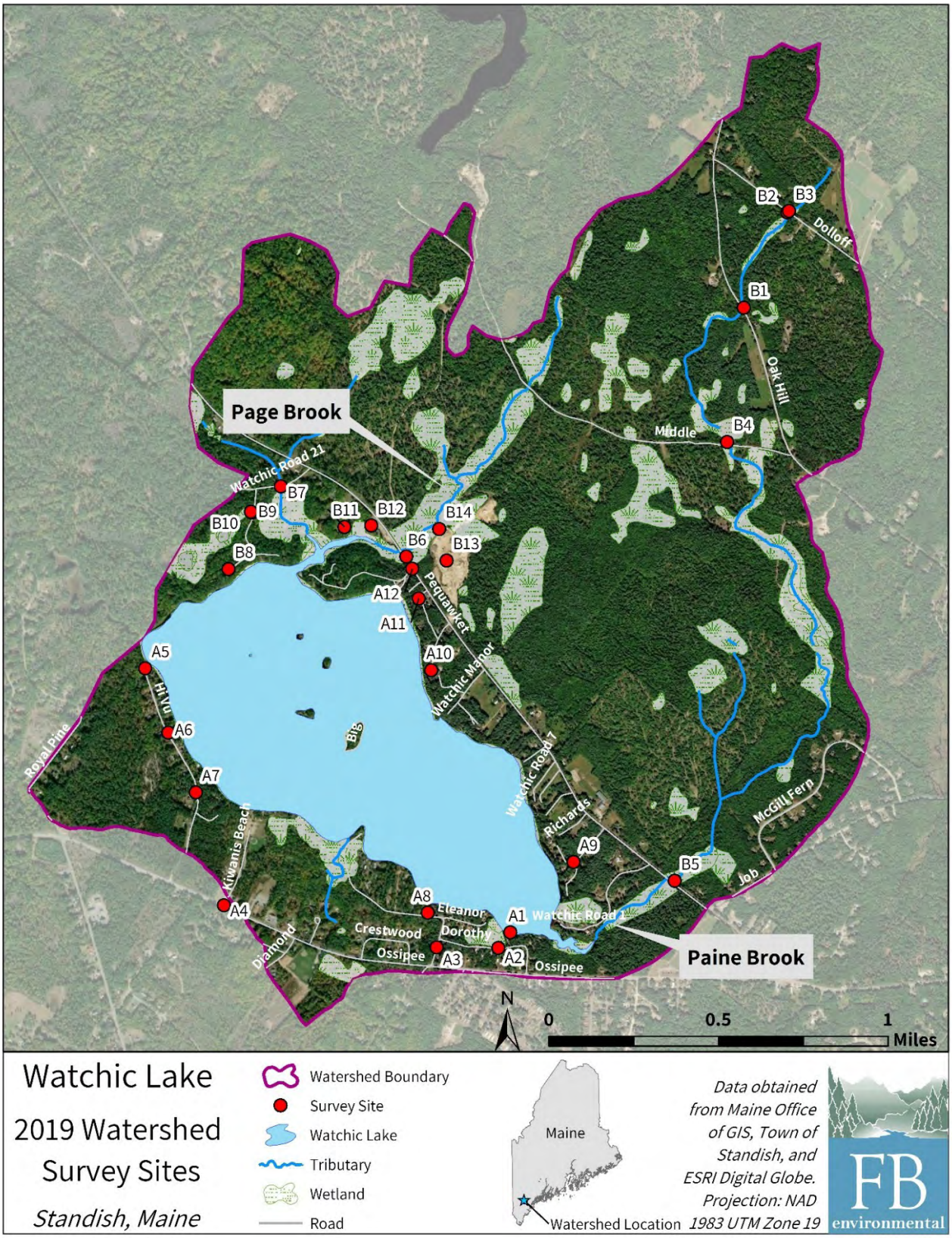


FIGURE B1. Map of all identified sites during the 2019 survey.

TOP TEN EROSION SITES

We used field observed impact ratings, pollutant load reduction estimates, and cost estimates to create a prioritized list of assessed sites. We recommend the board review all sites to determine the feasibility of implementation (e.g. landowner access, previous site work).

(1) End of Hi-Vu Drive (Site A5)

OBSERVATIONS: Road shoulder and ditch erosion is occurring along the end of Hi-Vu Drive. Evidence of large volumes of water draining to this area. The installed stormwater controls (ditch armoring, check dams, and settling basin) are clogged with leaves and sand.

RECOMMENDATIONS: Increase frequency of maintenance for the ditch and settling basin by removing leaves and sand. Install a runoff diverter to interrupt and direct flow at the launch to the settling basin.

Road shoulder erosion along Hi-Vu Drive and settling basin and ditches clogged with leaves and sand.

(2) Logging operation adjacent to Page Brook (Site B14)

OBSERVATIONS: Logging operations alongside Page Brook have created an inadequate buffer risking bank destabilization and increased sediment transport into the stream. Decreased buffers also reduce necessary stream shading for aquatic organisms.

RECOMMENDATIONS: Maintain buffer during future logging activities and plant new buffer along previously cleared areas. We recommend the WLA communicate with the landowner to create a working relationship moving forward.

Logging directly adjacent to Page Brook.

(3) Middle Road and Paine Brook Crossing (Site B4)

OBSERVATIONS: Culverts are undersized, crushed, clogged, or broken. Road surface erosion and sediment transport is evident in areas where water is flowing directly across the road. A beaver dam along the road has caused road flooding. ATV and logging use has destabilized paths and the road.

RECOMMENDATIONS: Consider road closure or rerouting. Replace culverts and stabilize road surface and edge. This project would require detailed engineered design.

One of several clogged or broken culverts (left) and the beaver dam adjacent to the road (right).

(4) Dolloff Road and Paine Brook Crossing (Site B2 and B3)

OBSERVATIONS: Road shoulder and ditch erosion are evident, allowing winter sand and sediment to wash down the bank and cause further bank erosion, directly adjacent to a Paine Brook tributary culvert.

RECOMMENDATIONS: Remove grader and plow berms and implement street sweeping practices to prevent winter sand and sediment from accumulating at the low point in the road and washing down the bank into the stream. Vegetate the road shoulder. Enlarge and re-align culvert.

Sand and sediment washing down the road shoulder, approximately 20 feet from Paine Brook.

(5) Watchic Terrace Road (Site A10)

OBSERVATIONS: High water volume runoff down Watchic Terrace Road is directed to an undersized filtration system causing severe road surface erosion and clogged riprap and culverts. Evidence of severe runoff (deep gullies) in upslope gravel driveways. Poor maintenance of catch basins along roadway and significant aggradation of winter sand.

RECOMMENDATIONS: Work with the road association to outline a maintenance plan for this treatment system, including the catch basins and the settling basin. Consider approaching the Town regarding maintenance of this roadway. If possible, hire an engineer to redesign the stormwater controls in this tight space.

Sand and sediment transport down Watchic Terrace Road, and winter sand accumulation at road end.

(6) Oak Hill Road Stream Crossing (Site B1)

OBSERVATIONS: This site has a slight perched culvert (approximately six inches).

RECOMMENDATIONS: Recommendations include enlarging the culvert and creating an armored plunge pool.

The perched outlet of the culvert crossing on Oak Hill Road.

(7) Kiwanis Beach Access Road (Site A4)

OBSERVATIONS: The Kiwanis Beach access road was not surveyed in 2019. However, a survey by WLA and FBE staff occurred in 2015. We have included this site using the 2015 survey results and aerial imagery, as no work is known to have occurred in this four-year period. During the 2019 survey, the entrance to the Kiwanis Beach access road had evidence of significant sediment accumulation. This gravel road leads directly to the beach and may be contributing sediment during runoff events. Additionally, in 2015 FBE noted the public beach area encroaching into the forested area to the southeast, evidenced by numerous trails.

RECOMMENDATIONS: Address sediment accumulation at the beginning of the roadway by encouraging street sweeping, re-establishing the curb and directing stormwater to a settling basin in the grass to the northwest of the road. Minimize sediment runoff down the access road. This could include the installation of waterbars that direct water to infiltration basins or infiltration trenches or updating the road to a porous pavement surface. Address beach encroachment by installing fencing to limit widening of paths and signage to alert beach users to the impact of walking off-trail.

(Top)theentranceoftheKiwanisBeachaccessroaddocumentedduring the 2019 survey. (Bottom) the Kiwanis Beach documented during the 2015 survey. Theaccess road runsdirectly to this section of the beach.

(8) Watchic Road #3 (Site A9)

OBSERVATIONS: Moderate surface erosion on the roadway on Watchic Road #3. The road shoulder has a plow/grader berm. Additionally, the private road off Watchic Road #3 crosses a wetland and has significant ponding and large ruts from vehicle traffic.

RECOMMENDATIONS: Re-grade Watchic Road #3 and install runoff diverters to a settling basin. Hire an engineer to assess private road crossing in wetland area.

(Right) Photos of Watchic Road #3 showing road surface erosion and significant ponding/rutting along the private road.

(9) End of Watchic Road #15 (Site A11)

OBSERVATIONS: Significant sediment accumulation and a large grader/blow berm at the end of the road (pictured to the right).

RECOMMENDATIONS: Install a waterbar (or similar structure) to intercept runoff and direct water to a rain garden. Additionally, improve vegetated buffer between the end of the road and the lake to increase filtering capacity.

Two photos of Watchic Road #15 showing significant sediment accumulation and the proximity of the end of the road to Watchic Lake.

(10) Eleanor Drive (Site A8)

OBSERVATIONS: A local resident alerted us to runoff concerns on Eleanor Drive. A low point in the road is receiving significant runoff during storm events and water is running across a residential lawn directly into Watchic Lake.

RECOMMENDATIONS: We recommend the installation of a thin buffer along the residential property to intercept runoff. Eleanor Drive is paved until this section; continuing pavement will help with sediment loads; however, runoff will still occur.

(Left) Residential lawn receiving heavy runoff during storm events, (Right) Eleanor Drive road area contributing runoff to the residential lawn.

APPENDIX C: WATERSHED SURVEY DATA

Table C1. April 22, 2019 watershed survey sites with draft pollutant load reduction calculations and cost estimates. **Construction and design costs are highly variable and these estimates should be used for planning purposes only.**

SITE ID	LOCATION	PROBLEM	PROBLEM NOTES	FIELD IMPACT RATING*	RECOMMENDED BMP	TSS LBS./YR.	TP LBS./YR.	TN LBS./YR.	ESTIMATED COST RANGE
A5	Hi-Vu Drive Terminus	Surface Erosion, Road Shoulder Erosion	Slight surface erosion, slight road shoulder erosion	Medium	Maintenance, install runoff divert	5,200	2.20	4.50	$100 - $1,000
B14	Logging operation behind Shaw Earth Works	Buffer	Lack of Buffer due to clearcut patches of land. Severely reduced buffer	High	Establish buffer	2,000	0.85	1.70	$1,500 - $3,500
B4	Middle Road stream crossing	Culvert, Animals /Nutrients	Culvert crushed/broken; waterfowl/wildlife gathering area, sp. beaver	High	Replace culverts, consider road closure	3,160	1.34	2.68	$5,000 - $8,000
B3	Dolloff Road	Soil Erosion/Sediment	Road shoulder/ditch erosion, roadside plow/grader berm, winter sand	Low	Street Sweeping, vegetate shoulder	1,669	0.67	1.12	$1,500 - $3,500
A10	Watchic Terrace Road	Severe water volume runoff to undersized system; no maintenance/ cleaning of catch basins.	Severe surface erosion, clogged/undersized settling basin and riprap swale	High	Maintain existing stormwater controls, reconsider responsible entity for maintenance, enlarge/redesign system	2,070	1.08	-	$5,000 - $10,000
B1	Oak Hill Road stream crossing	Culvert	Slight hanging (no fish passage)	Low	Enlarge/armor plunge pool	40	0.02	0.04	$100 - $1,000
A4	Entrance to Kiwanis Beach Road and Kiwanis Access Road	Surface Erosion, Road Shoulder Erosion	Moderate surface erosion, slight road shoulder erosion	Medium	Repave edge, install curb, install vegetated buffer/rain garden, install waterbars to vegetated filter or infiltration trench OR install pervious pavement	1,277	0.84	5.42	$3,500 - $5,000
A9	Watchic Road #3	Surface erosion, roadside plow/grader berm	Moderate surface erosion	Medium	Grade road, install runoff diverters to settling basin	2,070	1.08	-	$3,500 - $7,500
A11	Watchic Road #15 End	Roadside Plow/Grader Berm		Medium	Install rain garden	204	0.10	0.65	$500 - $1,000
A8	Eleanor Drive	Surface Erosion, Road Shoulder Erosion	Moderate Surface erosion, slight road shoulder erosion	Medium	Add waterbars and buffer strip	880	0.37	0.74	$1,500 - $3,500
A1	Watchic Road #4 lake access	Surface Erosion, Poor Buffer	Moderate surface erosion, undercut/eroded shoreline, inadequate shoreline vegetation	Medium	Stabilize bankside of road to launch point	160	0.12	0.24	$500-$1,500
A3	Watchic Road #4	Sediment in Road	Sediment appears to be from winter sanding	Medium	Street sweeping	209	0.06	-	$500 - $1,500
B2	Dolloff Road stream crossing	Culvert	Hanging (no fish passage); undercut	Low	Replace/enlarge culvert	360	0.16	0.32	$1,500 - $3,500
B8	Watchic Road 21	Soil Erosion/Sediment	Road shoulder/ditch erosion, roadside plow/grader berm	Low	Vegetate shoulder	107	0.05	0.34	$200 - $8,000

SITE ID	LOCATION	PROBLEM	PROBLEM NOTES	FIELD IMPACT	RECOMMENDED BMP	TSS LBS./YR.	TP LBS./YR.	TN LBS./YR.	ESTIMATED COST RANGE
B5	Pequawket Trail/Rte 113 stream crossing	Culvert, Soil Erosion/Sediment	Culvert: Misaligned, scouring; bank undercut above culvert	Low	Armor and vegetate culvert inlet	40	0.02	0.03	$100 - $500
B9	Watchic Road 21	Culvert, Soil Erosion/Sediment	Culvert clogged; road shoulder/ditch erosion and winter sand	Low	Replace culvert, maintenance, remove winter sand	360	0.15	0.30	$1,500 - $3,500
B7	Watchic Road 21	Culvert, Soil Erosion/Sediment	Culvert hanging (no fish passage); road shoulder/ditch erosion and winter sand	Low	replace culvert, armor/vegetate inlet and outlet, vegetate road shoulder, remove winter sand	560	0.23	0.47	$3,000 - $5,000
A2	Dorothy Drive Hill	Surface Erosion, Ditch, Road Shoulder Erosion	Slight surface erosion, slight ditch erosion, slight road shoulder erosion	Medium	Regrade road, vegetate road shoulder	320	0.13	0.27	$2,000 - $5,000
B11	404 Pequawket Trail	Soil Erosion/Sediment	Unstable path/trail access, bare waterfront/eroded roots	Low	Infiltration steps, reroute trail	500	0.37	-	$6,000 - $1,000
A6	Mid-way along Hi-Vu Drive	Surface Erosion, Culvert, Ditch, Road Shoulder Erosion	Severe surface erosion, culvert: unstable inlet/outlet, clogged, crushed/broken, undersized, severe ditch erosion, severe road shoulder erosion	High	Enlarge culvert, armor and vegetate ditch, regrade/crown road, add settling basin	700	0.30	0.60	$30,000 - $50,000
B10	Pequawket Trail/Rte 113 Page Brook crossing	Culvert	Hanging (no fish passage), rotting out at bottom (inlet and outlet)	Low	Replace culvert	80	0.02	0.06	$1,500 - $3,500
B12	The Outpost	Soil Erosion/Sediment, Buffer Issues	Soil Erosion/Sediment: Bare soil/fields, Road surface erosion. Buffer Issues: Poor/lack of shoreline vegetation/buffer	High	Buffer, stabilize bank, pave	410	0.29	3.89	$20,000 - $100,000
B6	Pequawket Trail/Rte 113 Page Brook crossing	Undercut Bank.		Medium	Replace culvert (Maine DOT is scheduled to complete 2019/2020).	80	0.07	0.13	-
A7	Hi-Vu Drive; bend in	None noted.	None noted. Active construction site in close	Low	Oversee construction	-	-	-	-
A12	Watchic Road 19/Connor Road Intersection	New development with evidence of artificial sand addition.	Possible artificial sand addition	Low	Inspect site and review permitting	-	-	-	-
B13	Shaw Earthworks	None noted.	Significant stormwater infrastructure. Included	Medium	Maintain existing stormwater controls	-	-	-	-

***sites were prioritized by a weighted value calculated by the following equation: (cost x impact)/TP reduction. Because of this, the recorded "impact" value is not directly correlated with the prioritization. Prioritization factors include the cost and potential total phosphorus reduction values.**

Gray rows were recorded for maintenanceonly.

TSS= Total suspended solids; TP = Total Phosphorus; TN = TotalNitrogen

APPENDIX D: SHORELINE SURVEY METHODOLOGY AND DATA

Shoreline Survey Methodology

Initially developed by FBE in collaboration with the MEDEP Lakes Unit, the survey documented the condition of the shoreline for each shoreline 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 shoreline survey methods are used throughout New Hampshire and Maine and recognized by MEDEP. Vegetated buffer was scored from one to five, with one being an excellent natural buffer with a mix of trees and shrubs, and five being all lawn or bare ground with no buffer. Presence of bare soil was scored from one to four, with one being no bare soil and four being large amounts of exposed soil present. Extent of shoreline erosion was scored from one to three, with one being no erosion visible and three being moderate to severe shoreline erosion. Distance to shore was scored from one to three, with one being a structure more than 150 feet from the shoreline, and three being a structure closer than 75 feet to the shoreline. Slope was scored from one to three, with one being little to no slope, and three being a steep slope. LakeSmart property awards were not taken into account for parcel scoring. Refer to Table D1 for a full breakdown of scoring. Tables D2 and Figure D1 provide summary statistics and mapping. Table D3 provides the full database.

Table D1. Evaluation criteria for shoreline parcels.

Buffer:	1=Excellent Buffer (all-natural vegetation – trees of mixed sizes and shrubs)
	2=Good (some trees and shrubs, some bare areas)
	3= Moderate (a few small trees/shrubs, some lawn)
	4=Minimal (mostly lawn, some shrubs)
	5=No buffer (all lawn/bare)
Bare Soil:	1=No exposed soil
	2=Minimal exposed soil
	3=Fair amount of exposed soil
	4=Large amounts of exposed soil
Shoreline Erosion:	1=No erosion visible
	2=Some erosion visible
	3=Moderate to severe shoreline erosion
Structure Distance	0=No structure
	1=More than 150’
	2=75-150’
	3= Less than 75’
Slope:	1=Little to no slope (3-8°)
	2=Moderate slope (8-20°)
	3=Steeply sloped (>20°)
Shoreline Disturbance Score:	Total of all columns

Table D2. Frequency of shoreline disturbance scores, with lower scores indicating lower impact (minimal erosion or runoff issues) and higher scores indicating greater impact (significant erosion or runoff issues). Scores 4-5 are undeveloped parcels (dark green); scores 6-9 are developed but with minimal erosion issues (light green); scores 10-13 are developed with moderate erosion issues (orange); and scores 14-17 are developed with significant erosion issues (red).

Shoreline Disturbance Score	Number of Parcels with Score	Percentage	Group Percentage
4	5	3%	3%
5	1	1%	
6	6	3%	22%
7	7	4%	
8	5	3%	
9	21	12%	
10	19	11%	65%
11	41	23%	
12	34	19%	
13	19	11%	
14	9	5%	10%
15	6	3%	
16	1	1%	
17	1	1%	
Total	**175**	**100%**	**100%**

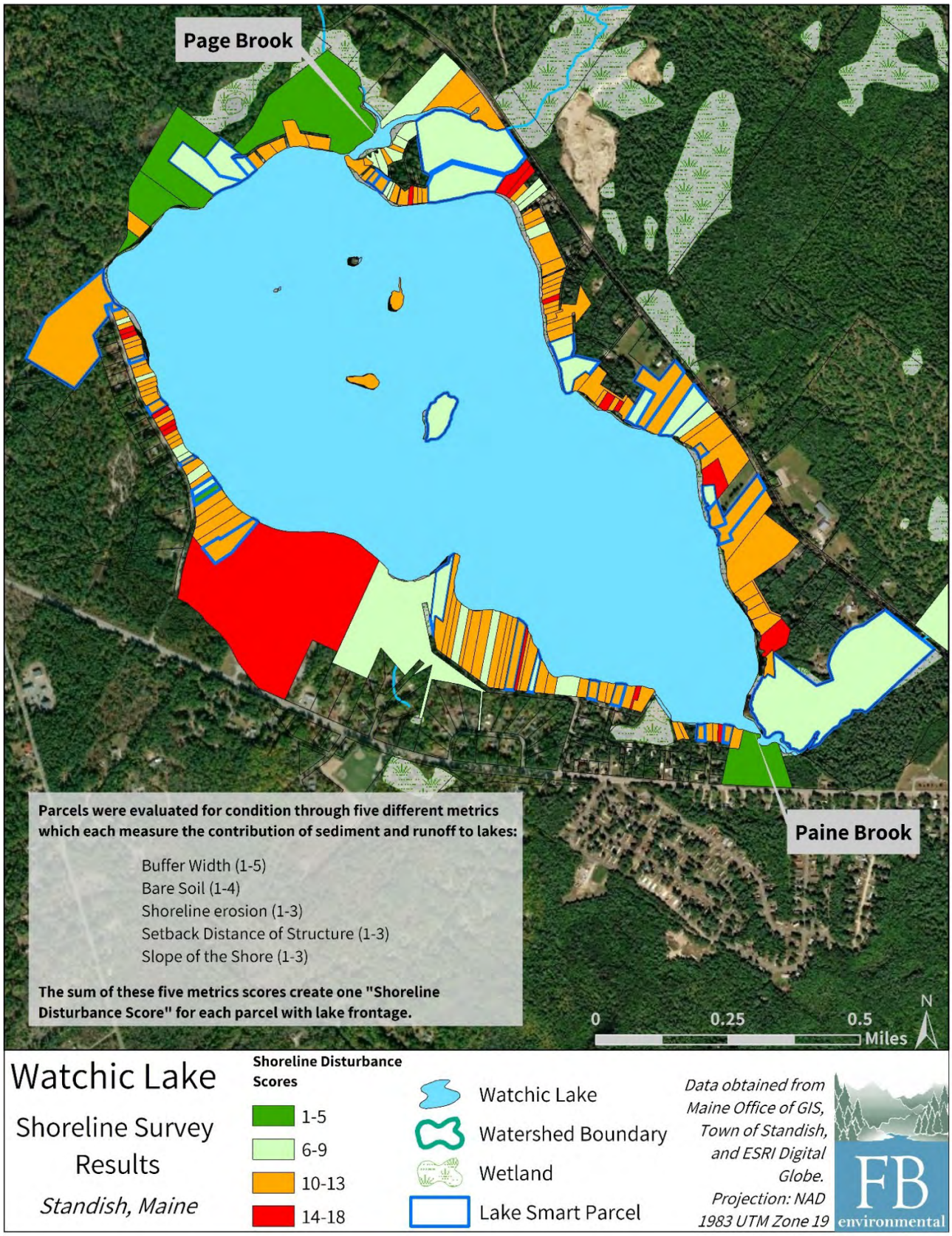


Figure D1. Map of shoreline disturbance scores for individual shorefront properties on Watchic Lake. Refer to Table 2 caption for description of color coding

Table D3. 2019 shoreline survey parcel data.

PARCEL ID	BUFFER (1-5)	BARE SOIL (1-4)	SHORELINE EROSION (1-3)	DISTANCE (1-3)	SLOPE (1-3)	SHORELINE DISTURBANCE SCORE (Total)	LakeSmart Parcel?
5-84	1	1	1	0	1	4	No
4-12C	1	1	1	0	1	4	No
4-12A	1	1	1	0	1	4	No
27-3	1	1	1	0	1	4	No
25-52	1	1	1	0	1	4	Yes
4-12B	1	2	1	0	1	5	No
29-1	2	2	1	0	1	6	No
5-83	1	1	1	2	1	6	Yes
4-12G	1	1	1	2	1	6	Yes
4-12F	1	1	1	2	1	6	Yes
30-30	1	2	1	1	1	6	No
30-26	1	1	1	2	1	6	No
5-COM	2	2	2	0	1	7	No
26-34 ROW	2	2	2	0	1	7	No
5-80	1	1	1	3	1	7	No
30-29	1	1	1	3	1	7	No
30-23	2	2	1	1	1	7	No
30-38	1	1	1	2	3	8	Yes
30-24	2	2	1	2	1	8	No
30-1	2	1	1	3	1	8	Yes
26-8	2	1	1	2	2	8	No
25-49	2	1	1	3	1	8	No
30-16	5	1	1	1	1	9	No
5-72C	2	1	2	2	2	9	No
5-62	3	1	1	3	1	9	Yes
5-24B	2	2	1	3	1	9	Yes
30-51	2	2	2	1	2	9	No
30-42	2	1	1	3	2	9	No
30-41	2	2	2	2	1	9	No
30-17	2	2	1	3	1	9	No
29-3B	2	2	2	2	1	9	Yes
29-1A	2	2	1	3	1	9	Yes
29-15A	1	2	1	2	3	9	Yes
29-13	1	2	2	2	2	9	Yes
28-14	2	1	1	3	2	9	Yes
26-4	4	2	2	0	1	9	No
26-19	1	1	1	3	3	9	No
26-16	2	1	1	2	3	9	Yes
25-51	2	1	2	3	1	9	Yes
25-46	2	1	1	2	3	9	No
25-45	2	1	1	2	3	9	No
25-30	2	2	1	3	1	9	No
25-20	3	1	1	3	1	9	No
4-5	2	1	1	3	3	10	Yes

PARCEL ID	BUFFER (1-5)	BARE SOIL (1-4)	SHORELINE EROSION (1-3)	DISTANCE (1-3)	SLOPE (1-3)	SHORELINE DISTURBANCE SCORE (Total)	LakeSmart Parcel?
30-8	2	1	1	3	3	10	No
30-28	3	2	1	3	1	10	No
30-20	2	2	1	3	2	10	No
30-2	3	2	1	3	1	10	No
30-15	4	1	1	3	1	10	No
30-14	2	2	1	3	2	10	No
29-3C	4	2	2	1	1	10	Yes
29-37	3	1	1	3	2	10	No
29-33	4	1	1	3	1	10	No
29-17	2	2	1	2	3	10	No
28-8	2	2	2	2	2	10	No
26-15	3	2	1	2	2	10	No
26-13	3	1	1	3	2	10	No
26-11	2	2	1	3	2	10	Yes
25-56	2	1	1	3	3	10	No
25-42	2	1	2	2	3	10	No
25-31	3	1	2	3	1	10	No
25-21	4	1	1	3	1	10	No
ROW (End of Hi-Vu Drive)	5	4	1	0	1	11	No
30-40A	4	4	2	0	1	11	No
26-35	4	4	2	0	1	11	No
5-24A	4	1	2	3	1	11	No
4-12E	2	2	2	2	3	11	No
30-5	3	2	2	3	1	11	No
30-48	4	1	1	3	2	11	No
30-25	2	3	2	3	1	11	No
30-19	3	2	2	3	1	11	Yes
30-12	3	1	1	3	3	11	No
29-9	4	2	2	2	1	11	No
29-34	4	2	1	3	1	11	No
29-31	3	1	1	3	3	11	No
29-29	3	1	1	3	3	11	No
29-28	3	1	1	3	3	11	No
29-27	3	1	1	3	3	11	No
29-2	3	3	1	2	2	11	No
29-13A	2	3	2	3	1	11	No
29-12	4	2	1	3	1	11	No
28-5	4	2	1	3	1	11	No
28-17	3	2	1	3	2	11	Yes
28-15	3	3	2	1	2	11	No
28-12	3	2	1	3	2	11	Yes
28-11	3	2	1	3	2	11	Yes
27-2	2	1	2	3	3	11	Yes
26-39	5	1	1	3	1	11	No
26-38	2	2	1	3	3	11	No

PARCEL ID	BUFFER (1-5)	BARE SOIL (1-4)	SHORELINE EROSION (1-3)	DISTANCE (1-3)	SLOPE (1-3)	SHORELINE DISTURBANCE SCORE (Total)	LakeSmart Parcel?
26-34	4	2	2	2	1	11	No
26-24	2	2	2	2	3	11	Yes
26-20	3	2	1	2	3	11	No
26-2	4	2	1	3	1	11	No
26-1	4	1	2	3	1	11	No
25-58	3	1	1	3	3	11	Yes
25-53	4	2	1	3	1	11	No
25-48	3	1	1	3	3	11	No
25-41	2	1	2	3	3	11	No
25-37	3	1	1	3	3	11	No
25-32	3	1	1	3	3	11	No
25-29	3	2	2	3	1	11	No
25-26	3	1	1	3	3	11	No
25-24	2	1	2	3	3	11	No
25-19	3	2	2	3	1	11	No
25-34	4	4	2	0	2	12	No
5-72E	4	2	3	2	1	12	No
30-49	3	2	2	3	2	12	No
30-4	4	2	2	3	1	12	No
30-22	3	2	2	3	2	12	No
30-18	4	2	2	3	1	12	Yes
29-35	3	3	2	2	2	12	No
29-32	4	2	1	3	2	12	No
29-16	2	3	2	2	3	12	No
28-9	3	2	1	3	3	12	No
28-7	4	2	2	3	1	12	No
28-4	4	2	2	3	1	12	No
28-18	4	3	2	1	2	12	No
28-16	4	2	2	3	1	12	No
28-1	3	3	2	3	1	12	No
27-3-X	4	2	2	2	2	12	No
26-9	4	3	2	1	2	12	No
26-37*	2	2	2	3	3	12	Yes
26-26-27	3	2	2	3	2	12	No
26-25	2	2	2	3	3	12	No
26-23	3	2	2	2	3	12	No
26-22	3	2	2	2	3	12	No
26-18	3	2	1	3	3	12	No
26-17	3	2	2	2	3	12	No
26-10A	3	2	2	3	2	12	No
25-54	3	2	1	3	3	12	No
25-50	4	3	1	3	1	12	No
25-47	3	2	2	2	3	12	Yes
25-43	2	2	3	2	3	12	No
25-38	2	2	2	3	3	12	No

PARCEL ID	BUFFER (1-5)	BARE SOIL (1-4)	SHORELINE EROSION (1-3)	DISTANCE (1-3)	SLOPE (1-3)	SHORELINE DISTURBANCE SCORE (Total)	LakeSmart Parcel?
25-33	4	1	1	3	3	12	No
25-27	4	1	1	3	3	12	Yes
25-25	3	2	1	3	3	12	No
30-48 ROW	5	3	3	0	2	13	No
5-82	5	1	2	3	2	13	No
5-81	2	2	3	3	3	13	No
30-50	2	3	3	3	2	13	No
30-3	4	3	2	3	1	13	No
30-21	4	3	2	3	1	13	No
30-11	4	2	1	3	3	13	No
30-10	3	2	2	3	3	13	No
29-3E	4	4	2	2	1	13	No
29-26 ROW	4	3	2	1	3	13	No
29-11	4	3	2	3	1	13	No
28-3	4	3	2	3	1	13	No
26-7	3	3	2	3	2	13	No
26-6	4	2	2	3	2	13	No
26-5	5	2	2	3	1	13	No
26-21	3	2	2	3	3	13	Yes
26-10	4	3	2	2	2	13	No
25-55	2	3	2	3	3	13	No
25-35	4	2	2	3	2	13	Yes
25-28	3	3	2	2	3	13	No
5-16	3	4	3	3	1	14	No
30-39	5	4	2	2	1	14	No
28-2	4	4	2	3	1	14	No
28-14-1	3	4	2	3	2	14	No
27-1	4	2	2	3	3	14	No
26-28	4	2	2	3	3	14	No
26-12	4	3	2	3	2	14	No
25-36	4	1	3	3	3	14	No
25-23	4	2	2	3	3	14	No
30-39a	5	4	2	3	1	15	No
30-13	5	2	2	3	3	15	No
29-8	5	4	2	3	1	15	No
29-30	4	3	2	3	3	15	No
29-10	5	4	2	3	1	15	No
25-40	3	3	3	3	3	15	No
25-22	4	3	3	3	3	16	No
25-39	4	4	3	3	3	17	No