



Northwood Lake

DRAFT Watershed-Based Management Plan

August 2026

Prepared by
FB Environmental Associates



NORTHWOOD LAKE

WATERSHED-BASED MANAGEMENT PLAN

AUGUST 2026 | **DRAFT**

Prepared by **FB Environmental Associates**
in partnership with the Northwood Lake Watershed Association



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ABBREVIATIONS

ACRONYM	DEFINITION
AIPCPR	Aquatic Invasive Plant Control, Prevention and Research Grants
ACEP	Agricultural Conservation Easement Program
CAGR	Compound annual growth rate
CAP	Community Action Programs Emergency Funds
CCD	County Conservation District
CDBG	Community Development Block Grants
CSP	Conservation Stewardship Program
CWSRF	Clean Water State Revolving Fund
EPA	United States Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
FBE	FB Environmental Associates
ILFP	In-Lieu Fee Program
kg/yr	Kilograms per year
LCHIP	Land and Community Heritage Investment Program
LID	Low Impact Development
LISFF	Long Island Sound Features Fund
LLRM	Lake Loading Response Model
LWCF	Land and Water Conservation Fund
MCCD	Merrimack County Conservation District
MS4	Municipal Separate Storm Sewer Systems
NAWCA	North American Wetlands Conservation Act
NEFRF	Northeast Forests and Rivers Fund
NFWF	National Fish and Wildlife Foundation
NH ARM	NH Aquatic Resource Mitigation Fund
NHDES	New Hampshire Department of Environmental Services
NLWA	Northwood Lake Watershed Association
NRCS	Natural Resources Conservation Service
ppb, ppm	parts per billion, parts per million
RCP	Regional Conservation Partnership Program
RCCD	Rockingham County Conservation District
RCCP	Regional Conservation Partnership Program
RPC	Regional Planning Commission
SCM	Stormwater control measure
USDA	United States Department of Agriculture
VLAP	Volunteer Lake Assessment Program
WMP	Watershed-Based Management Plan
μS/cm	Microsiemens per centimeter

DEFINITIONS

Adaptive management approach recognizes that the entire watershed cannot be restored with a single restoration action or within a short time frame. The approach provides an iterative process to evaluate restoration successes and challenges to inform the next set of restoration actions.

Anoxia is a condition of low dissolved oxygen in water.

Areal water load is the total volume of water flowing into a lake per year normalized to the lake surface area and is expressed in units such as feet per year. It can be interpreted as the depth of inflowing water that would cover the lake surface each year.

Assimilative capacity is a lake's capacity to receive and process nutrients (phosphorus) without impairing water quality or harming aquatic life.

Build-out analysis combines projected population estimates, current zoning restrictions, and a host of additional development constraints (e.g., conservation lands, steep slope and wetland regulations, existing buildings, soils with low development suitability, and unbuildable parcels) to determine the extent of buildable area in the watershed.

Chlorophyll-*a* is a measurement of the green pigment found in all plants, including microscopic plants such as algae. Measured in parts per billion or ppb, it is used as an estimate of algal biomass.

Clean Water Act was enacted to protect the chemical, physical, and biological integrity of surface waters in the U.S. and requires states to establish water quality standards to ensure that surface waters can support human and ecological uses.

Cyanobacteria are photosynthetic bacteria that can grow prolifically as blooms when enough nutrients and light are available. Cyanobacteria can produce cyanotoxins, which can be highly toxic to humans and other life forms.

Dissolved oxygen is a measure of the amount of oxygen dissolved in water. Low oxygen can directly kill or stress organisms and stimulate release of phosphorus from bottom sediments.

Epilimnion is the top layer of lake water directly affected by seasonal air temperature and wind. This layer is well-oxygenated by wind and wave action. Northwood Lake is too shallow to have a true Epilimnion.

Eutrophication is the process by which lakes become more productive over time (oligotrophic to mesotrophic to eutrophic). 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.

Fall turnover is the process of complete lake mixing when cooling surface waters become denser and sink, especially during high winds, forcing warmer, less-dense water to the surface. This process is critical for the natural exchange of oxygen and nutrients between surface and bottom layers in the lake.

Flushing rate (inverse of retention time) is the fraction of the lake volume that is replaced per year. It is calculated by dividing the flow in or out by the volume of the waterbody.

Full build-out refers to the time and circumstances in which, based on a set of restrictions (e.g., environmental constraints and current zoning), no more building growth can occur, or the point at which lots have been subdivided into the minimum size allowed.

Impervious surfaces or impervious cover refer to any surface that will not allow water to soak into the ground. Examples include paved roads, driveways, parking lots, and roofs.

Internal phosphorus loading is the release of phosphorus bound to lake sediments into the water column. The phosphorus can be used as fuel for plant and algae growth.

Low impact development is an alternative approach to conventional site planning, design, and development that reduces the impacts of stormwater by working with natural hydrology and minimizing land disturbance by treating stormwater close to the source, and preserving natural drainage systems and open space, among other techniques.

Nonpoint source pollution comes from diffuse sources throughout a watershed, such as stormwater runoff, seepage from septic systems, and gravel road erosion. One of the major constituents of nonpoint source pollution is sediment, which contains a mixture of nutrients (like phosphorus) and inorganic and organic material that stimulate plant and algae growth.

Oligotrophic lakes are less productive or have fewer nutrients (i.e., low levels of phosphorus and chlorophyll-*a*), deep Secchi disk transparency readings (4.0 meters or greater), and high dissolved oxygen levels throughout the water column. **Eutrophic** lakes have more nutrients and are therefore more productive and exhibit algal blooms more frequently than oligotrophic lakes. **Mesotrophic** lakes fall in-between with an intermediate level of productivity.

pH is the standard measure of the acidity or alkalinity of a solution on a scale of 0 (acidic) to 14 (basic).

Polymictic refers to a lake that undergoes complete water mixing multiple times per year, or continuously throughout the year, rather than separating into distinct thermal layers for extended periods.

Riparian refers to wildlife habitat found along the banks of a lake, river, or stream. Not only are these areas ecologically diverse, but they are also critical to protecting water quality by preventing erosion and filtering polluted stormwater runoff.

Secchi disk transparency is a vertical measure of the transparency of water (ability of light to penetrate water) obtained by lowering a black and white disk into the water until it is no longer visible. It is an indirect measure of algal productivity and is measured in meters.

Stormwater control measures (SCMs) are practices designed to minimize discharge of nonpoint source pollution from developed land to lakes and streams. Watershed-based management plans should include both **non-structural** (non-engineered) and **structural** (engineered) SCMs for existing and new development to ensure long-term restoration success. Best Management Practices (BMPs) is a term used interchangeably with SCMs.

Thermal stratification is the process whereby warming surface temperatures in summer create a temperature and density differential that separates the water column into distinct, non-mixable layers.

Total phosphorus is one of the major nutrients needed for algae and plant growth. It is generally present in small amounts (measured in parts per billion or ppb) and limits growth in lakes. In general, as the concentration of phosphorus increases, the amount of algae and plant biomass also increases.

Trophic state is the degree of eutrophication of a lake and is designated as oligotrophic, mesotrophic, or eutrophic.



EXECUTIVE SUMMARY

The challenges facing Lake Northwood Lake and how we can continue to address them together.



Located in Northwood, Deerfield, and Epsom, New Hampshire, Northwood Lake (660 acres) is a headwater lake to the Little Suncook River, and an invaluable natural resource for residents, boaters, campers and wildlife alike. The 24-square-mile Northwood Lake watershed is characterized by forests, headwater lakes, many streams, residential neighborhoods, and commercial centers. The lake's long-term health depends on how communities manage land use, development, and changing environmental impacts. Fortunately, the lake is supported by the Northwood Lake Association (NLWA) and Town of Northwood which have dedicated resources to the lake and an outstanding network of volunteers to lead and support protection efforts for the lake.

THE PROBLEM

Northwood Lake has historically faced challenges with variable milfoil, an invasive aquatic plant, but sustained efforts by NHDES, the Town of Northwood, and the Northwood Lake Watershed Association have brought plant coverage down significantly through adaptive management strategies. However, as invasive plant populations have been controlled, cyanobacteria blooms have become an emerging threat, with multiple NHDES warnings issued in recent years. Driven by shallow waters, warm temperatures, and phosphorus loading from stormwater runoff, these recurring blooms continue to threaten public health and impair the lake's recreational use.

Key stressors include:



Phosphorus inputs from stormwater runoff, shoreline erosion, septic failures, roads, fertilizers, and agricultural activities.



Climate variability, with larger storms and longer ice-free periods.

Because phosphorus is the limiting nutrient in this freshwater system, reducing phosphorus loading remains the central water quality objective for Northwood Lake. An increase in phosphorus inputs will elevate the risk, frequency, and intensity of cyanobacteria blooms.

The watershed survey identified 52 problem sites and 115 impacted shorefront properties, with runoff from development contributing 86% of the phosphorus load to Northwood Lake. Without action, development and climate pressures will accelerate water quality decline.

THE GOAL

The goal is to protect water quality and recreation in Northwood Lake. The Northwood Lake Watershed-Based Management Plan sets a ten-year goal to meet New Hampshire water quality standards for the designated uses of aquatic life integrity and primary contact recreation by reducing concentrations of phosphorus and the likelihood of harmful cyanobacteria blooms. This goal can be accomplished through the following objectives:

OBJECTIVE 1: Reduce phosphorus loading from existing development by at least 5.7% (42.65 kilograms per year) to decrease the predicted annual average total phosphorus concentration.

OBJECTIVE 2: Offset phosphorus loading from future development to maintain average summer in-lake total phosphorus concentrations in the next ten years.

THE SOLUTION

Partners from the NLWA watershed plan Steering Committee, FBE, and NHDES, created the action plan, which includes:

- **Structural Stormwater Control Measures:** runoff capture, shoreline buffers, erosion stabilization, and septic upgrades.
- **Monitoring:** continuing long-term lake monitoring with the NHDES Volunteer Lake Assessment Program (VLAP).
- **Education and Outreach:** strengthening community education on septic care, fertilizer use, stormwater, and shoreline protection.
- **Policy and Land Use Tools:** promoting low impact development and resilient development standards by revising ordinances and ensuring enforcement.

The cost of implementation is estimated at around \$2,000,000 over the next ten years, funded through state and federal grants, municipal commitments, and private support, in addition to the dedication and commitment of volunteer time and support to manage plan implementation. Many costs were unknown or roughly estimated and should be updated as information becomes available. Cost estimates are provided in the Action Plan where possible.

THE KEY TO SUCCESS

This watershed management plan meets the nine key planning elements required by the United States Environmental Protection Agency. Northwood Lake will now be eligible for federal watershed assistance grants. The success of this plan will depend on continued strong coordination by the NLWA, watershed towns, active engagement from shoreline landowners, and sustained financial and volunteer support. Because phosphorus reductions are complex and influenced by both local and region-wide conditions, adaptive management will be essential to track progress and adjust strategies over time. With collaboration, commitment, and long-term investment, the community can protect Northwood Lake and ensure a healthy future for this treasured natural resource.

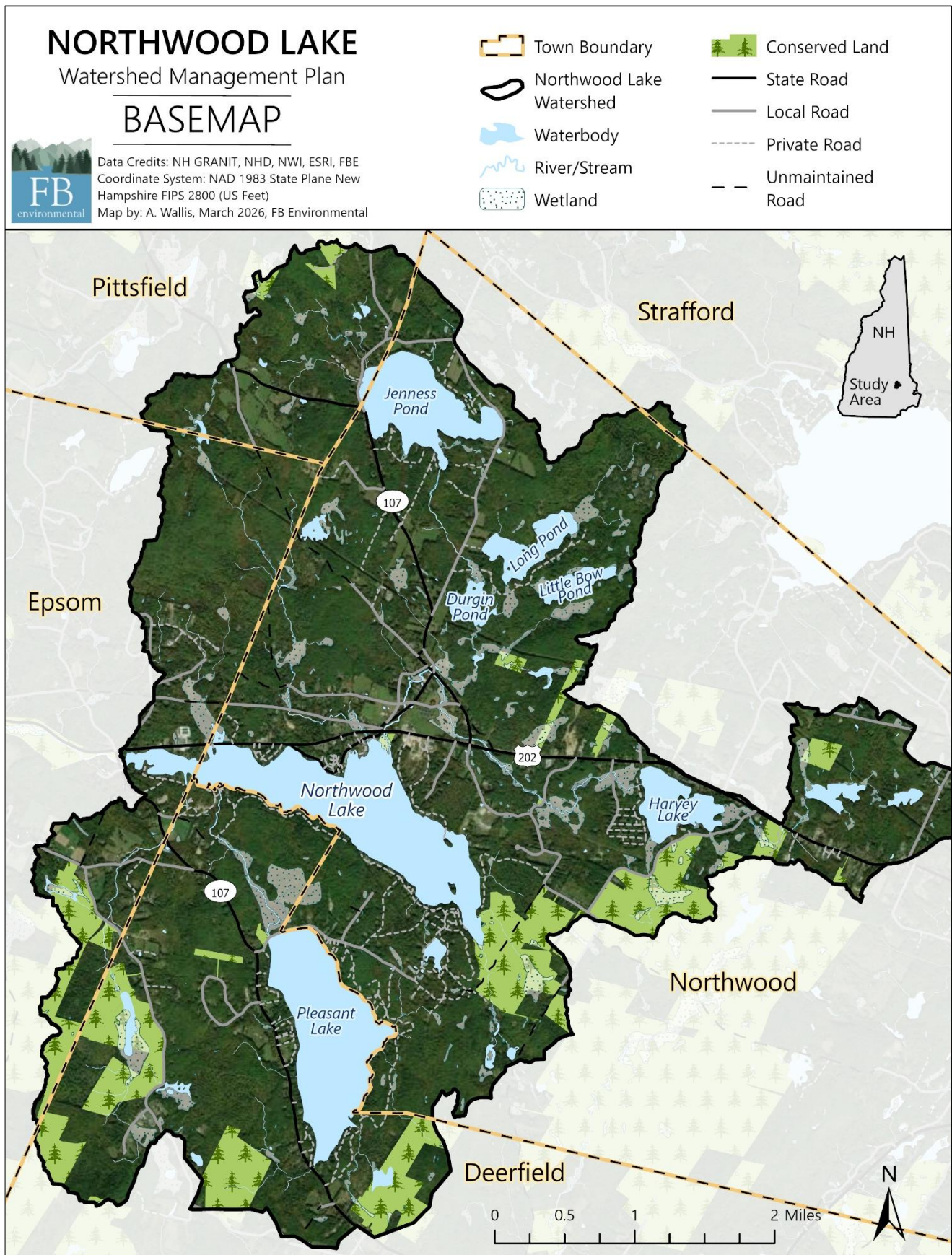


Figure 1. Northwood Lake watershed base map.

1 INTRODUCTION

1.1 WATERBODY DESCRIPTION AND LOCATION



Watershed Overview and Hydrology

The Northwood Lake watershed encompasses 24 square miles across Northwood (57%), Deerfield (23%), Epsom (13%), Pittsfield (7%), and Strafford (<1%), New Hampshire (Figure 1). The highest points of elevation along the watershed boundary are Nottingham Mountain at 1,348 feet above sea level and Catamount Mountain at 1,322 feet above sea level. Northwood Lake (1.03 square miles, 660 acres) sits at approximately 516 feet above sea level.

The watershed is characterized by forested uplands, extensive wetlands, and a network of headwater lakes, ponds, and streams that drain to Northwood Lake. These headwater ponds include Pleasant Lake (0.75 square miles), Jenness Pond (0.42 square miles), Harvey Lake (0.18 square miles), Long Pond (0.14 square miles), Little Bow Pond (0.06 square miles), and Durgin Pond (0.04 square miles). These ponds, along with general flow from the landscape, travel to Northwood Lake through a number of streams including Flat Meadow Brook, Griffin Brook, Kelsey Brook, Tucker Brook, Narrows Brook, Jenness Brook, and the Gulf.

Lake levels are regulated by a dam at the outlet of Northwood Lake. Water levels are lowered each fall to provide recreational opportunities for canoeists and kayakers in the Little Suncook River while also reducing winter ice damage along shoreline properties and to provide storage for spring flood waters.

Wetlands, **riparian** corridors, and forested headwaters play a critical role in moderating runoff, retaining sediment and nutrients, and supporting aquatic and terrestrial habitat throughout the watershed.



Climate

The watershed experiences a temperate climate with cold winters, warm summers, and seasonally variable precipitation. Average annual precipitation for the last ten years in the area is 47.2 inches. Recent regional trends toward more intense precipitation events and longer summer dry periods have increased the importance of stormwater management and watershed resilience. High-intensity precipitation can accelerate erosion, mobilize nutrient-rich sediments, and overwhelm roadside and shoreline drainage systems, while prolonged warm periods can increase productivity in surface waters. These climatic factors heighten the sensitivity of the lake to land use practices in the watershed.



Land Cover and Development

Land cover in the watershed is dominated by mixed forest, wetlands, and low-density residential development, with more concentrated development occurring along major road corridors and lake

shorelines. Major road corridors around Northwood Lake are U.S. Route 202 (Franklin Pierce Highway) and N.H. Route 107, along with many other town and private roads. Commercial businesses line Route 202 along the northern shoreline of Northwood Lake. Agricultural areas are scattered throughout the watershed. Shoreline development, road networks, aging septic systems, and increasing **impervious surfaces** represent the primary features influencing runoff quantity and quality. Even at relatively low development densities, cumulative impacts from many individually small sources, such as driveways, lawn areas, and unpaved roads can contribute substantial sediment and nutrient loads to surface waters.



Ecological Value

The watershed's forests comprise a mix of conifers, such as white pine and eastern hemlock, and deciduous species such as beech, red oak, and maple. Major wetland complexes around the lake include the wetlands at the outlets of Pleasant and Harvey lakes, to the north of Route 202 just to the west of Spruce Cove Road, and along many of the tributary streams. These diverse habitats provide critical refuge for a wide range of wildlife. Large mammals such as moose, deer, black bear, coyote, and bobcat have been known to roam the upland areas, while smaller species like fox, raccoon, porcupine, fisher, mink, and snowshoe hare thrive in mixed habitats. Aquatic environments support otter, muskrat, and beaver populations, and wetlands provide habitat for reptiles and amphibians such as turtles, snakes, frogs, and salamanders.

The watershed also hosts a rich bird community, from common species like wild turkeys, ruffed grouse, and songbirds to key water-associated species such as herons, loons, ducks, geese, cormorants, and bald eagles. Fish and insect populations support both aquatic and terrestrial food webs. Of special note, the watershed is home to threatened and endangered species, including reproducing populations of common loons. For more information on rare, endangered, or threatened species, see the [2024 Natural Resources & Water Resources chapter of the Northwood Master Plan](#).



Human Use and Water Access

Northwood Lake and the contributing watershed support a wide range of recreational opportunities. A public boat launch can be found on Northwood Lake, Pleasant Lake, and Jenness Pond. A cartop access point is also located on Harvey Lake. Northwood Lake also hosts the MacCallum's Boathouse. There are two town/community beaches along Northwood Lake and a children's summer camp (Lantern Light Camp at the Wah-Tut-Ca Reservation). The shoreline of Northwood Lake also hosts over 200 private residences, many with their own docks and water access points.

1.2 WATERSHED PROTECTION GROUPS



The [Northwood Lake Watershed Association](#) (NLWA) serves as the non-profit organization dedicated to protecting and preserving the water quality and natural resources of Northwood Lake. Formed in 1992, the NLWA is led by an all-volunteer Board of Directors and supported by seasonal and year-round residents across Deerfield, Epsom, and Northwood, as well as local businesses and municipal funding from all three towns. The NLWA participates in water quality monitoring and conservation initiatives to track lake health and drive local stewardship, education, and long-term protection efforts for the entire watershed.



The [Rockingham County Conservation District](#) (RCCD) and the [Merrimack County Conservation District](#) (MCCD) are two of ten county conservation districts in New Hampshire that operate as resource management agencies and subdivisions of local governments. Both districts focus on addressing critical resource concerns, including water quality, erosion, wetland and forest health, nonpoint source pollution, and stormwater management. To protect these natural resources, they partner with landowners, farmers, schools, and municipalities on local projects such as stream restoration, invasive species management, and pollinator habitat enhancement.



The [New Hampshire Association of Conservation Commissions](#) works to provide educational assistance to conservation commissions throughout New Hampshire (216 in total). As a non-profit organization, the New Hampshire Association of Conservation Commissions' mission is to instill responsible use of the available natural resources by promoting conservation and serving as the communication link between conservation commissions, while providing technical support on the logistics of conservation commission meetings and document language. Conservation commissions in the Northwood Lake watershed largely include those of Northwood, Deerfield, Epsom, and Pittsfield.



Regional Planning Commissions (RPCs) serve as advisory and technical support agencies for municipalities across New Hampshire. The Northwood Lake watershed falls within the jurisdiction of the [Strafford RPC](#), [Southern New Hampshire Planning Commission](#), and the [Central New Hampshire RPC](#). These organizations provide professional planning assistance to local towns, helping to update master plans, guide land use regulations, secure grant funding, and coordinate intergovernmental efforts to protect shared water resources and manage watershed-wide development.





NH LAKES is a statewide, publicly-supported, non-profit organization working to restore and preserve the health of New Hampshire's lakes. NH LAKES facilitates the Lake Host and LakeSmart programs along with other outreach and education campaigns and provides funding to towns and watershed associations for lake restoration and protection efforts.



The **New Hampshire Department of Environmental Services** (NHDES) partners with local organizations to improve watershed-level water quality by supporting communities in setting goals, developing management plans, and addressing contamination through financial and technical assistance.



The **Society for the Protection of New Hampshire Forests** is a statewide non-profit land conservation organization that works to protect forests, water resources, wildlife habitat, and scenic landscapes across New Hampshire. Through land conservation, sustainable forest management, advocacy, and education, the organization promotes long-term stewardship and public access to the state's natural resources.



Southeast Land Trust of New Hampshire (SELT) works across southeastern New Hampshire to conserve land for clean water, wildlife habitat, local food, and community health. Within the Northwood Lake watershed, SELT collaborates with landowners, towns, and conservation partners to protect wetlands, headwater streams, and forest lands through permanent conservation easements and acquisitions.



Bear-Paw Regional Greenway is a land trust dedicated to creating a network of conserved lands across the towns of the Deerfield, Epsom, and Northwood area (among others in the Strafford and Rockingham region). By focusing on connected wildlife corridors and natural water resources, Bear-Paw helps preserve the undeveloped forest buffers and tributaries that naturally filter water draining into Northwood Lake.

1.3 PURPOSE AND SCOPE

The purpose of the Northwood Lake Watershed-Based Management Plan (WMP) is to prioritize implementation efforts over the next ten years (2027-2036) to protect and improve the water quality of Northwood Lake. The plan aims to meet state water quality standards for the designated uses of both aquatic life integrity for mesotrophic waterbodies and primary contact recreation. A major goal is to reduce the likelihood of harmful cyanobacteria blooms in the lake.

As part of this plan, a water quality and **assimilative capacity** analysis, shoreline survey, watershed survey, **build-out analysis**, and land-use model were conducted to better understand the sources of **phosphorus** and other pollutants to the lake (Sections 2 and 3). Results from these analyses were used to establish the water quality goal and objectives (Section 2.4), reprioritize recommended management strategies for the identified pollutant sources (Section 4), and update estimated pollutant load reductions and costs needed for remediation (Sections 5 and 6). Recommended management strategies involve using a combination of **structural and non-structural stormwater control measures (SCMs)**, as well as an **adaptive management approach** that allows for regular updates to the plan (Section 4). An Action Plan (Section 5) with associated timeframes, responsible parties, and estimated costs was updated in collaboration with the Work Group and public during a community forum (Section 1.5). This plan update meets the nine key planning elements required by the United States Environmental Protection Agency (EPA) so that communities become eligible for federal watershed assistance grants administered by NHDES (Section 1.4).

1.4 INCORPORATING EPA'S NINE ELEMENTS

EPA guidance lists nine key planning elements that highlight important steps in restoring and protecting water quality for any waterbody affected by **nonpoint source pollution**. The nine key planning elements found within this plan are as follows:

A. IDENTIFICATION OF THE CAUSES AND SOURCES OF NONPOINT SOURCE POLLUTION

Sections 2 and 3 highlight known sources of nonpoint source pollution to Northwood Lake and describe the results of the watershed survey and other assessments. These sources of pollutants must be controlled to achieve the load reductions estimated in this plan, as discussed in item (B) below.

B. ESTIMATION OF POLLUTANT LOADING AND LOAD REDUCTIONS EXPECTED FROM MANAGEMENT MEASURES

Sections 2 and 5 describe the calculation of pollutant loading to Northwood Lake and the amount of reduction needed to meet the water quality goal, respectively.

C. DESCRIPTION OF NONPOINT SOURCE MANAGEMENT MEASURES

Sections 4 and 5 identify ways to achieve the estimated phosphorus load reduction and reach water quality targets. The Action Plan focuses on several major topic areas categorizing action items that address nonpoint source pollution.

D. ESTIMATION OF TECHNICAL AND FINANCIAL ASSISTANCE

Sections 5 and 6 include a description of the associated costs, sources of funding, and primary authorities responsible for implementation. Funding sources should be diverse, including local, state, and federal grants, local organizations, private donations, and landowner contributions to support Action Plan implementation.

E. DEVELOPMENT OF EDUCATION AND OUTREACH COMPONENT

Section 4 describes how the educational component of the plan is already being or will be implemented.

F. SCHEDULE FOR IMPLEMENTING THE NONPOINT SOURCE MANAGEMENT MEASURES

Section 5 provides a list of action items and recommendations to reduce the phosphorus load to Northwood Lake. Each item has a set schedule that defines when the action should begin and/or end or run through if an ongoing activity. The schedule should be adjusted by NLWA regularly (see Section 4.4 on Adaptive Management and Section 6.1 on Plan Oversight). While phosphorus is the primary nutrient driving this plan, NLWA and municipalities should also consider reductions in sediment, nitrogen, and bacteria, where applicable, to support overall water quality improvements and align with broader reporting expectations.

G. DESCRIPTION OF INTERIM MEASURABLE MILESTONES FOR MEASURING PROGRESS

Section 6 outlines indicators along with milestones for implementation success that should be tracked annually.

H. SET OF CRITERIA

Sections 2 and 6 can be used to determine whether phosphorus loading reductions are being achieved over time and whether progress meets water quality targets. If targets are not met, these sections provide criteria to determine whether the plan should be revised.

I. DEVELOPMENT OF MONITORING COMPONENT

Section 6 describes the long-term water quality monitoring strategy for Northwood Lake, which allows for evaluation of implementation effectiveness over time against the criteria in (H) above. The success of this plan cannot be evaluated without ongoing monitoring and assessment and careful tracking of load reductions following implementation of action items.

1.5 COMMUNITY INVOLVEMENT AND PLANNING

The plan was developed through collaborative efforts, including several interim meetings with and presentations to the Steering Committee. Participants included FB Environmental Associates (FBE), NLWA, and NHDES (see Acknowledgments).

1.5.1 Plan Development Meetings

Several meetings were held over the duration of the plan's development.

July 25, 2025	FBE and NLWA conducted a project kick-off meeting during the 2025 NLWA annual meeting.
August 20, 2025	FBE met with NLWA for a beginning project check in to review the scope of work, timeline, and expectations.
September 18, 2025	FBE met with volunteers from the NLWA to conduct the shoreline survey.
October 16 and 24, 2025	FBE met with volunteers from the NLWA to conduct the watershed survey.
February 27, 2026	FBE met with NLWA to review the findings from the water quality analysis.
May 21, 2026	FBE met with NLWA to review the Lake Loading Response Model, build-out analysis, and water quality goal.
June 18, 2026	FBE met with NLWA to review the Action Plan.
June 20, 2026	NLWA hosted a representative from NHLAKES during an educational event about lake friendly living and shoreline protection.
August 15, 2026	FBE presented the draft WMP at the Northwood Lake Annual Meeting.

1.5.2 Draft WMP Public Presentation and Review Period

A public presentation was held at the Northwood Lake Annual Meeting on Saturday August 15, 2026, to summarize the analyses and recommendations detailed in the plan. The presentation was attended by approximately 30 members of the NLWA and community. A portion of the presentation was dedicated to educating the audience on actions we can all take to help achieve the greater goal. The presentation was followed by a 30-day review period where the public had additional time to digest the material, read the draft WMP, and provide comments and recommendations for edits. Written comments were received and incorporated into the final plan.

2 WATER QUALITY ASSESSMENT

This section provides an overview of the past, current, and predicted future state of water quality based on data assessment and watershed modeling. These analyses identified pollutants of concern and helped provide the basis to set water quality goals and objectives for Northwood Lake.

2.1 WATER QUALITY SUMMARY

Water quality assessment can be complex. Here are the key points to know:

- ☛ **Northwood Lake has been well managed for invasive aquatic species.**

Northwood Lake has been infested with invasive aquatic species, namely variable milfoil and brittle naiad. Active management by NLWA, NHDES, and the Town of Northwood has drastically reduced the extent of the invasive species. Diligent, volunteer-based Weed Watcher and Lake Host programs have continued to keep these invaders at bay.

- ☛ **Northwood Lake is not currently supporting all its designated uses.**

Elevated concentrations of phosphorus prevent Northwood Lake from fully supporting its designated uses of aquatic life integrity and recreation. Consequently, the lake's health and the public's safety during recreation remain threatened by low pH, invasive plants, elevated bacteria, and harmful cyanobacteria blooms.

- ☛ **The water quality of Northwood Lake is threatened by increased nutrient loading from human activities and extreme weather events.**

Northwood Lake has elevated but stable concentrations of total phosphorus. Historically, the lake showed signs of improving chlorophyll-*a* concentrations, but the trend has since plateaued.

- ☛ **Beaches along Northwood Lake have elevated fecal bacteria that threaten public health and recreation.**

Northwood Town Beach and Lynn Grove Association Beach are assessed as impaired for recreation due to elevated levels of fecal bacteria in the wadable swimming zone. The source of fecal bacteria could be from humans, pets, or wildlife or a combination of these.

2.1.1 Water Quality Standards and Impairment Status

The federal **Clean Water Act** requires states to determine designated uses for all surface waters within their jurisdiction, develop water quality criteria to protect those designated uses, and establish antidegradation provisions (Env-Wq 1708) that set limits on impacts to water quality from development.

Designated uses define activities and services that surface waters should support. For surface waters in New Hampshire, the six designated uses are as follows, and those applicable to this plan are **bolded**:

- **Aquatic life integrity** (i.e., supporting a balanced, integrated, and adaptive community of organisms having species composition, diversity, and functional organization comparable to similar natural habitats)
- **Primary contact recreation** (i.e., swimming)
- Secondary contact recreation (i.e., boating, fishing)
- Fish consumption
- Shellfish consumption
- Potential drinking water supply

All surface waters in New Hampshire are legislatively classified as either Class A or Class B (Env-Wq 1700). Class A waters are of the highest quality and are protected for use as drinking water sources (with treatment). Class B waters are still considered good quality and are the most common, intended to be suitable for swimming, fishing, and supporting aquatic life. Northwood Lake is Class B.

NHDES biologists survey New Hampshire lakes to determine their **trophic state** – a way of describing overall lake health based on water clarity, nutrients, and plant and algae growth. Lakes are placed into one of three categories. Northwood Lake is classified as mesotrophic (NHDES, 1979; NHDES, 2000).

Oligotrophic	<i>low nutrients and algae biomass, good clarity, and healthy habitat for cold water fish</i>
Mesotrophic	<i>moderate nutrients and algae biomass, still good for recreation and aquatic life</i>
Eutrophic	<i>higher nutrients and algae biomass, reduced water clarity, limited uses</i>

Water quality criteria serve as a “yardstick” for measuring whether a lake is healthy enough to support its designated uses (like swimming or aquatic life) based on whether it is Class A or B or oligotrophic, mesotrophic, or eutrophic. These criteria include parameters such as nutrient levels (e.g., phosphorus), algae levels (**chlorophyll-a** and prevalence of cyanobacteria), dissolved oxygen, and pH. If water quality measurements do not meet the criteria for designated uses according to the NHDES Consolidated Assessment and Listing Methodology, the lake is assessed as impaired. Water quality criteria for each classification and designated use in New Hampshire are legislatively enabled in RSA 485 A:8, IV and detailed in administrative rules Env-Wq 1700.

To meet requirements under the Clean Water Act, state agencies such as NHDES produce an Integrated Report that assesses the quality of surface waters across the state every other year. This Integrated

Report combines the 305(b) Surface Water Quality Report that provides a general overview of state surface water quality and the 303(d) List of Impaired Waters that identifies surface waters not supporting one or more designated uses and requiring a Total Maximum Daily Load. A Total Maximum Daily Load is a limit on how much pollution a waterbody (like a river, lake, or stream) can safely handle while still supporting its designated uses.

Northwood Lake is assessed as impaired for aquatic life integrity due to the presence of non-native aquatic plants and slightly low **pH** (NHDES, 2024) (Table 1). An impairment caused by low pH is common across New Hampshire as legacy effects from acid rain linger. Additionally, aquatic life integrity is impaired due to elevated total phosphorus concentrations. The lake is also assessed as impaired for primary contact recreation due to the presence of cyanobacteria hepatotoxic microcystins and *E. coli* concentrations exceeding the state's thresholds. *E. coli* levels are also high enough to assess the lake as impaired for secondary contact recreation.

NHDES rates water quality based on the most severe impairment of any parameter for which the assessment unit was evaluated, as presented in Table 1. A waterbody may receive a "severe" or "poor" rating due to the potential impact of low pH on aquatic life yet still have excellent water quality regarding parameters related to lake trophic status, chlorophyll-*a*, dissolved oxygen, and/or recreational uses.

Table 1. NHDES assessment units covering lakes/ponds in the Northwood Lake watershed and their associated water quality rating as reported on the NHDES 2024 Watershed Report Cards. Each assessment unit listed here is also impaired for fish consumption due to elevated concentrations of mercury in fish tissue, as are many waterbodies in New Hampshire.

Assessment Unit Name	AUID	Size (acres)	Impaired Designated Use	Parameter Causing the Impairment	Water Quality
Northwood Lake	NHLAK700060502-08-01	660	Aquatic life integrity	Non-native aquatic plants, pH	Poor
			Primary contact recreation	Cyanobacteria hepatotoxic microcystins, <i>E. coli</i>	Severe
			Secondary contact recreation	<i>E. coli</i>	Poor
Northwood Lake – Town Beach	NHLAK700060502-08-02	0.36	Primary contact recreation	Cyanobacteria hepatotoxic microcystins, <i>E. coli</i>	Severe
Northwood Lake – Camp Wah-Tut-Ca Beach	NHLAK700060502-08-03	1.38	None	None	Likely good
Northwood Lake – Lynn Grove Association Beach	NHLAK700060502-08-04	0.17	Primary contact recreation	<i>E. coli</i>	Severe

Headwater lakes, ponds, and streams within the Northwood Lake watershed have also been assessed. Pleasant Lake and Long Pond are impaired for aquatic life integrity due to low dissolved oxygen concentrations and low pH. Jenness Pond is impaired for aquatic life integrity due to elevated concentrations of chlorophyll-*a*, total phosphorus, and low pH, as well as for primary contact recreation due to the presence of cyanobacteria hepatotoxic microcystins. Harvey Lake is impaired for aquatic life integrity due to low dissolved oxygen concentrations and low pH, as well as for primary contact recreation due to elevated concentrations of chlorophyll-*a* and the presence of cyanobacteria hepatotoxic microcystins. For additional details specific to these waterbodies, please refer to the [2024 Watershed Report Card Assessments](#).



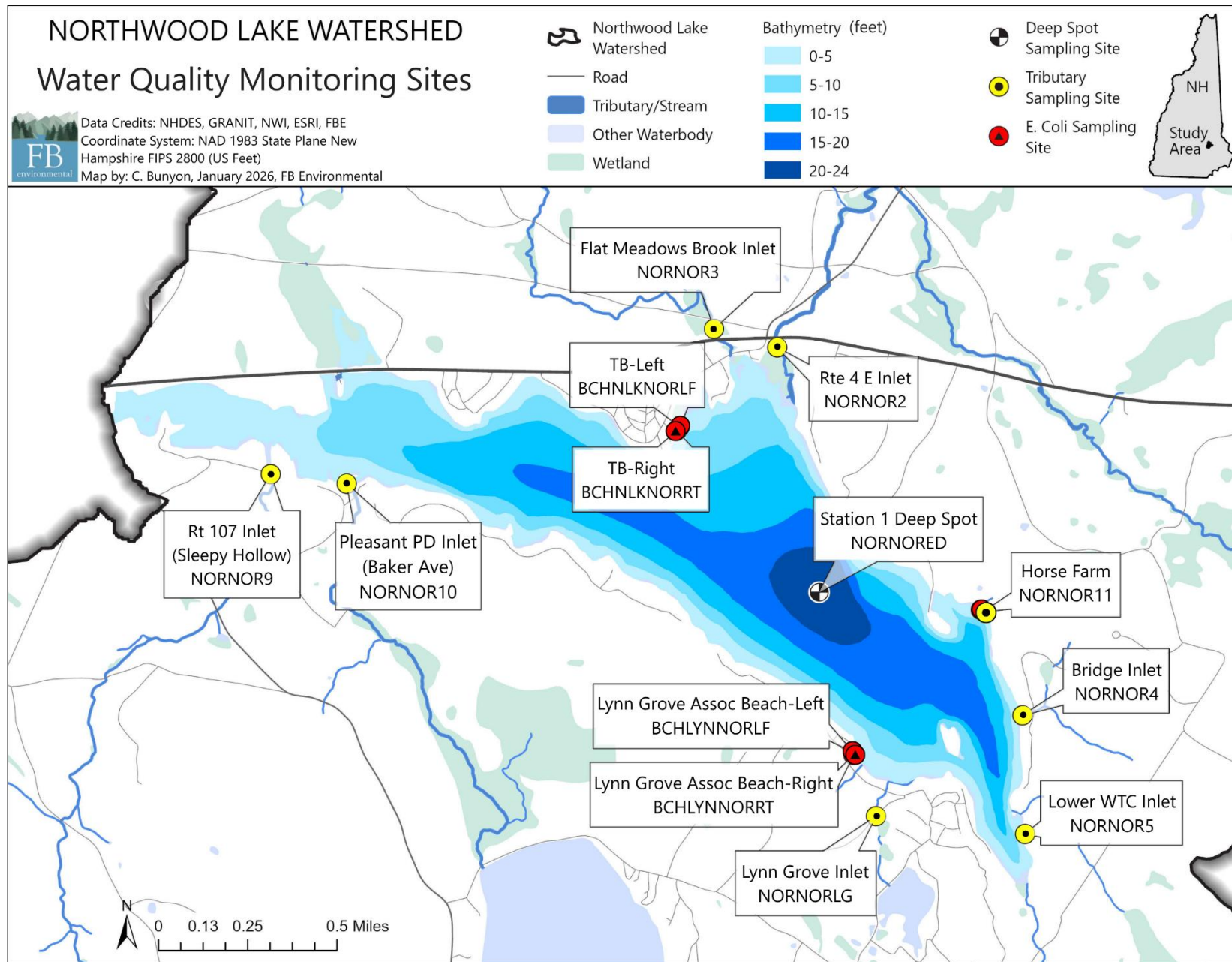


Figure 2. Select water quality sampling sites in and around Northwood Lake with lake bathymetry.

2.1.2 Trophic State Indicators – Total Phosphorus, Chlorophyll-*a* and Secchi Disk Transparency

Total phosphorus, chlorophyll-*a*, and **Secchi disk transparency** are trophic state indicators, reflecting biological productivity in lake ecosystems. The combination of these parameters helps determine the extent of **eutrophication** in lakes and helps signal changes in lake water quality over time. For example, if the water becomes less clear (lower Secchi disk transparency), it may be because more algae are growing – often fueled by higher phosphorus levels – or because other materials are suspended in the water. These changes usually point to impacts from human activity or other disturbances in the surrounding watershed.

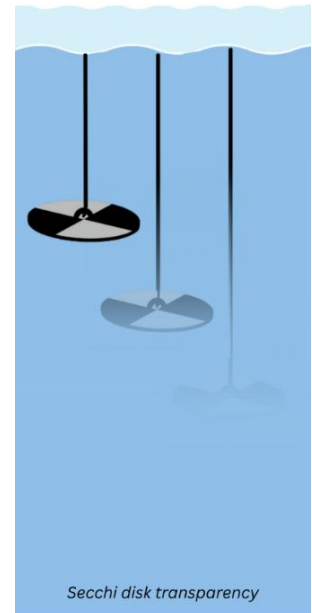
Concentrations of total phosphorus are very similar between the surface and bottom of the lake at the deep spot (NORNORED) (Figure 3). Median values fall around 11-12 ppb, with 50% of the dataset near 10-13 ppb at the surface, and 10-12 at the bottom. A handful of samples (two from the surface and five from the bottom) can be seen as outliers on the graph. Outliers may be a result of environmental conditions at the time

the sample was collected such as from storms carrying additional amounts of phosphorus to the watershed. Occasional elevated values are a natural part of any long-term environmental monitoring dataset. These values are spread out through time, with the first occurring in 1993 and the last occurring in 2018. Laboratory notes indicate the results are valid, and comments within the dataset do not indicate any unusual conditions. These are not flagged as true outliers and are therefore included in this analysis.

No statistically significant improving or worsening trends were found for surface **total phosphorus** concentrations from the recent (2016-2025), historical dataset (1979-2015), or full dataset (1979-2025) at the deep spot (NORNORED). Therefore, total phosphorus concentrations are considered stable over time (Figure 4).

No statistically significant improving or worsening trends were identified for **chlorophyll-*a*** concentrations from the recent years (2016-2025) or full period of record (1979-2025). The period from 1979-2015 shows a decreasing (improving) trend ($p=0.03$). This indicates that chlorophyll-*a* was improving, but with the addition of the most recent 10 years of data, chlorophyll-*a* concentrations have become stable over time (Figure 4).

Secchi disk transparency also did not show a statistically significant improving or worsening trend at NORNORED using either method (with or without a view scope) regardless of the period of time considered. Therefore, Secchi disk transparency is considered stable over time for Northwood Lake (Figure 4).



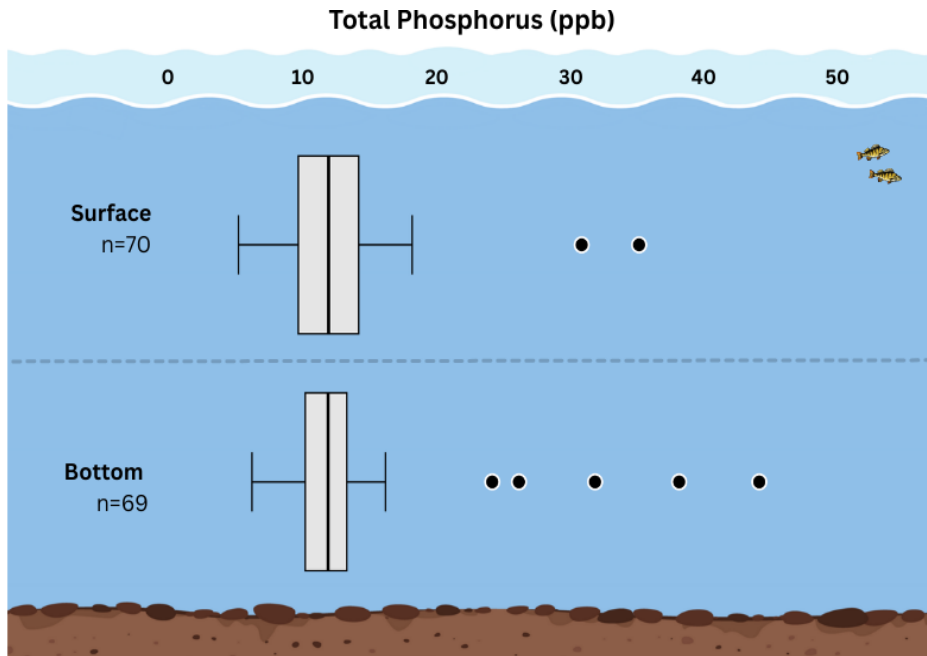


Figure 3. Boxplots showing median total phosphorus concentration at the surface and bottom of Northwood Lake from the deep spot (NORNORED) in the past 10 years, 2016-2025. The boxes show the 25th, 50th (median), and 75th percentiles of the data. The whiskers show 1.5 times the interquartile range (or the range from the 25th to 75th percentiles). Points are outlier observations.

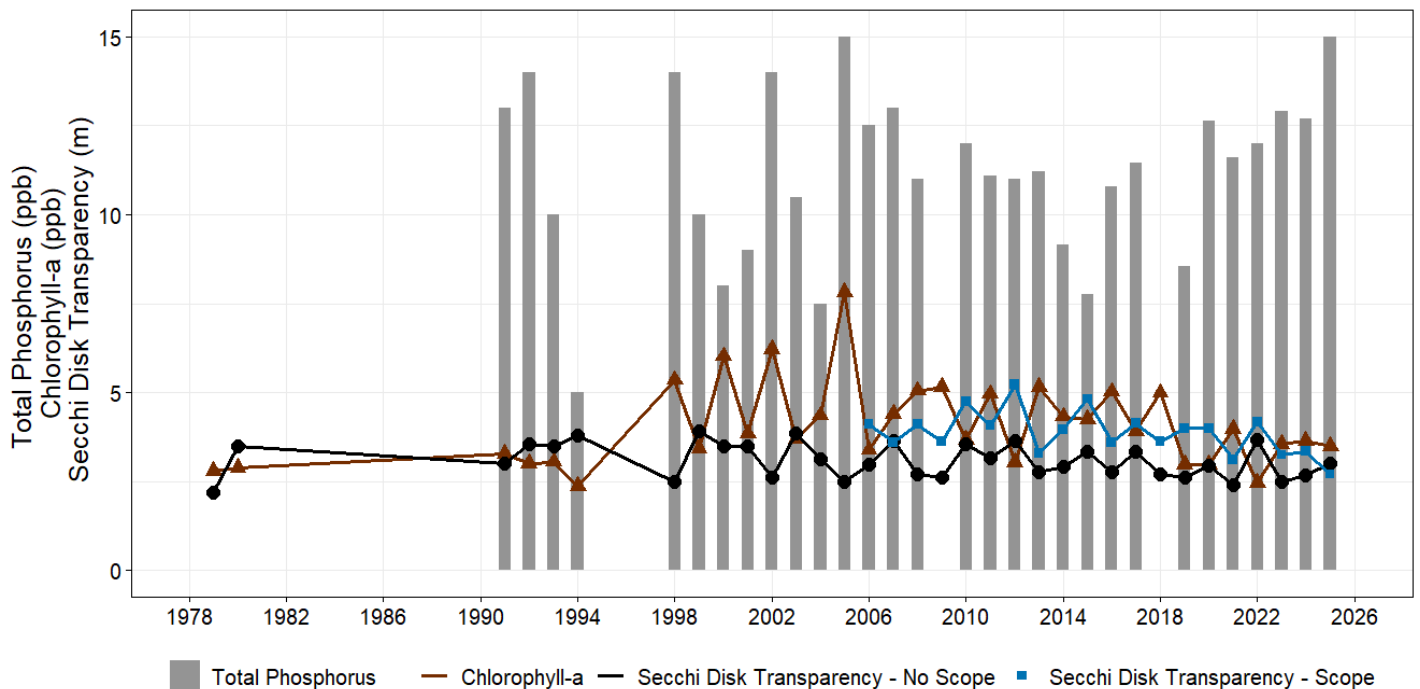


Figure 4. Median surface total phosphorus, median surface chlorophyll-*a*, and median water clarity (Secchi disk depth for scope and no scope methods) measured at Northwood Lake largely in June-September from 1979-2025 at the deep spot station (NORNORED). ppb = parts per billion. m = meters.

2.1.3 Dissolved Oxygen and Water Temperature

A common occurrence in New Hampshire's lakes is the depletion of dissolved oxygen in the deepest waters throughout the summer months. However, Northwood Lake is considered **polymictic**, meaning it is too shallow to stratify and instead undergoes frequent mixing of the surface and bottom waters throughout the year. Because of this continual mixing, Northwood Lake does not experience long periods of anoxia, or a lack of oxygen, at the bottom of the lake (Figure 5). However, profiles that extend to 6 meters have measured dissolved oxygen concentrations below 5 ppm, a concentration which inhibits aquatic life. 6 meters is just above the soil/water interface at the deepest spot, as Northwood Lake measures 24 feet deep, or 7.3 meters.

Low dissolved oxygen levels (below 5 ppm) combined with warmer water temperature (above 24 °C) can stress and reduce habitat for cold water fish and other sensitive aquatic organisms. In addition, very low dissolved oxygen (called anoxia) at the lake bottom can trigger the release of sediment-bound phosphorus, a process known as internal phosphorus loading. This phosphorus then becomes available to fuel algae and cyanobacteria growth. It will be important to continue collecting dissolved oxygen and temperature profiles at the deep spot throughout the summer and into September to ensure the amount of water that is anoxic does not extend into shallower depths. Tracking oxygen and temperature over time is also important to detect whether conditions are changing due to human impacts, such as excess phosphorus entering from the watershed.

Figure 5 shows average temperature and dissolved oxygen profiles for Northwood Lake during the summer sampling seasons (1979–2025). There is no sharp change in temperature which would indicate a stratified lake, suggesting instead that Northwood Lake mixes regularly.

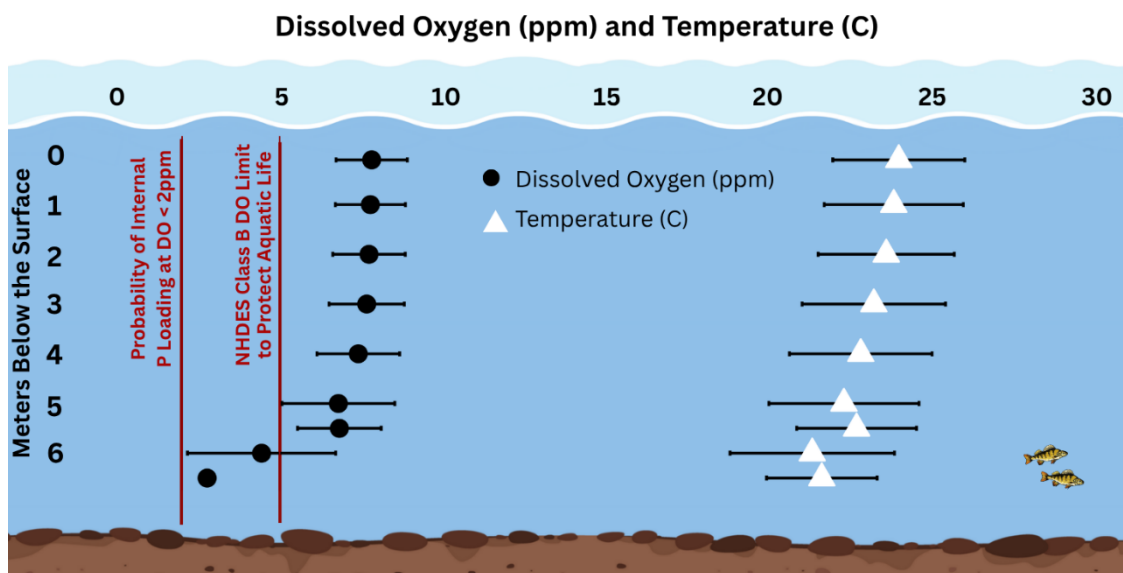


Figure 5. Dissolved oxygen (black circles) and water temperature (white triangles) depth profiles for the deep spot of Northwood Lake (NORNORED). Dots represent average values across sampling dates for each respective depth. Error bars represent standard deviation. Data represents profiles collected from 1979 to 2025 (n=28 for dissolved oxygen and 27 for temperature). Red lines at 5 ppm and 2 ppm represent thresholds for aquatic life integrity and internal phosphorus loading risk, respectively, due to low dissolved oxygen.

2.1.4 Phytoplankton (Cyanobacteria) and Zooplankton

Algae and cyanobacteria naturally occur in the environment and are essential for lake health. Algae and cyanobacteria biomass are primarily regulated by nutrient inputs and lake mixing processes, although other factors such as light availability and temperature also influence their growth. Human disturbances, such as erosion, overapplied fertilizers, polluted stormwater, excess animal waste, and inadequately treated wastewater can increase nutrient inputs to lakes and tributaries. Excess nonpoint source pollution in the form of nutrient loading in human-impacted lakes, combined with rising air temperatures, has increased the prevalence of harmful algal (cyanobacteria) blooms in lakes across the U.S.

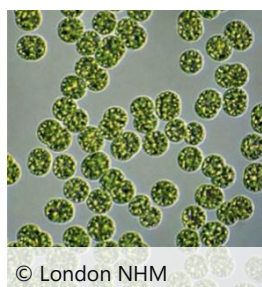
Cyanobacteria are single-celled bacteria that can photosynthesize. They often grow in colonies and, under bloom conditions, can sometimes produce dangerous toxins such as microcystins. These toxins may cause a wide range of health effects in humans, pets, livestock, and wildlife, including neurological, liver, kidney, and reproductive organ damage, gastrointestinal pain or illness, vomiting, eye, ear, and skin irritation, mouth blistering, tumor growth, seizure, or, in rare cases, death. Blooms can form dense mats or surface scum that can occur within the water column, attached to bottom sediments, or along the shoreline.

There are several common cyanobacteria in New Hampshire lakes, such as:



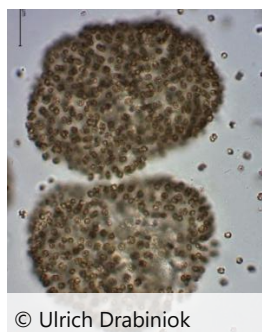
Dolichospermum

Formerly *Anabaena*, typically observed as filaments, can produce microcystin, anatoxins, saxitoxin, and cylindrospermopsin.



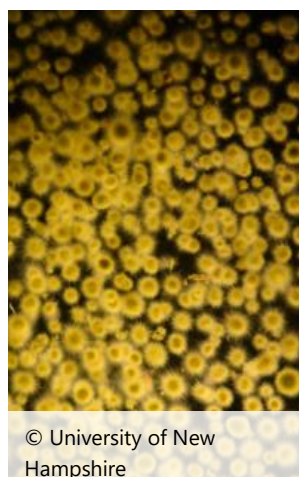
Microcystis

Typically observed as variations of small-celled colonies, can produce microcystin and anatoxin.



Woronichinia

Typically forms dense colonies, can produce microcystin.



Gloeotrichia

Typically observed as radiating colonies forming spherical aggregates, can produce microcystin and cylindrospermopsin, and can regulate buoyancy to access nutrients from sediments before rising to the surface to form blooms.



Planktothrix

Formerly *Oscillatoria*, typically observed as filaments, can produce microcystin and cylindrospermopsin, can maintain high growth rate at relatively low light intensities when it forms blooms deeper in the water column (NHDES, 2020).

Cyanobacteria are becoming more common even in low-nutrient lakes, likely because of a warming climate. Warmer water, longer periods of stratification, greater water column stability, less mixing, and reduced flushing during low-flow periods all create conditions that allow cyanobacteria to thrive and outcompete other phytoplankton species (Przytulska, Bartosiewicz, & Vincent, 2017; Paerl, 2018; Favot, et al., 2019). Many cyanobacteria can regulate their buoyancy and move up and down in the water column to capture sunlight near the surface and access phosphorus near the bottom, even during stratification or under low oxygen conditions. Some cyanobacteria can become dormant in sediment and jump-start cell reproduction once conditions are favorable (i.e., warm water temperatures and plenty of sunlight and nutrients). Some species can also obtain atmospheric nitrogen when sufficient light and nutrients such as phosphorus, iron, and molybdenum (a mineral that is essential for life in small amounts and is found in soils and water) are available. Others can store excess nitrogen and phosphorus within their cells for later use when conditions improve.

Because of these traits, and with climate warming favoring their dominance, cyanobacteria play a central role in reinforcing lake eutrophication. They can accelerate nutrient enrichment in low-nutrient systems and hinder the recovery of lakes already in a eutrophic state (Dolman, et al., 2012; Cottingham, Ewing, Greer, Carey, & Weathers, 2015). Understanding these feedbacks will be critical for developing more effective lake management and restoration strategies.

It is impossible to fully eradicate cyanobacteria in lakes as they are naturally occurring bacteria that have been on the planet for millennia and are resilient to environmental changes. It is likely that the prevalence of cyanobacteria will increase and possibly accelerate in lakes affected by extreme weather changes, though year-to-year variability in weather may determine the timing, extent, and severity of cyanobacteria blooms in any given year. However, conditions favorable for cyanobacteria blooms can be substantially minimized by reducing nutrient-rich runoff from the landscape. Water level and flow influence bloom dynamics by either flushing cyanobacteria and nutrients downstream during high-flow events or, conversely, by limiting upstream nutrient inputs during lower-flow conditions, which can reduce the nutrient availability needed to sustain bloom growth.

Cyanobacteria Bloom History

Through 2024, NHDES issued a warning when cyanobacteria densities exceeded 70,000 cells/mL, advising people, pets, and livestock to avoid contact with potentially toxic waters. Watches were issued when blooms might pose a risk or were approaching that threshold and remained active for up to one week. Watches were also issued when a bloom occurred outside the reporting season (May-October) or when a bloom was identified via photograph and not officially enumerated from a sample. NHDES' system for issuing warnings and watches changed in 2025. NHDES now issues a warning if cyanobacteria cell counts exceed 70,000 cells per milliliter at multiple locations, indicating that the bloom is a more widespread, lake-wide concern. Otherwise, NHDES issues a watch if reports are only for one location or for shoreline accumulations. More detailed information on the [NHDES Cyanobacteria Harmful Algal Bloom Program](#) can be found online.

Northwood Lake has had seven officially reported NHDES cyanobacteria bloom warnings, as displayed in Table 2, the first of which was issued in 2013 (NHDES, 2025). The shortest warning, in 2013, lasted 2 days, while the longest warning, in 2021, lasted 40 days. Each warning has been dominated by *Microcystis*,

Dolichospermum (formerly *Anabaena*), or a combination of the two. Both *Microcystis* and *Dolichospermum* are potentially toxin producing species of cyanobacteria.

Table 2. Cyanobacteria advisories/warnings issued by NHDES for Northwood Lake (NHDES, 2025). Note the observed cell concentrations in 2025 is elevated but did not trigger a warning by NHDES.

Advisory Year	Duration (days)	Dominant Taxa	Total Cell Concentration (cells per milliliter)
2013	2	<i>Dolichospermum</i> (formerly <i>Anabaena</i>)	450,978
2021	40	<i>Microcystis</i>	170,000
2022	8	<i>Microcystis</i> , <i>Dolichospermum</i>	289,000
2023	12	<i>Dolichospermum</i>	109,000
2023	7	<i>Dolichospermum</i>	325,600
2023	7	<i>Dolichospermum</i>	649,200
2023	14	<i>Microcystis</i> , <i>Dolichospermum</i>	235,000
2025	-	<i>Dolichospermum</i>	1,670,000
2025	-	<i>Dolichospermum</i>	420,000

Dominant Phytoplankton and Zooplankton

Phytoplankton and zooplankton samples were first collected and analyzed during the 1979 and 2000 NHDES Trophic Surveys of Northwood Lake. Each survey includes two biological sampling events; one in the summer and one in the winter. The dominant phytoplankton species were *Asterionella* (diatom) in the winter for both surveys and *Tabellaria* (diatom) in the summer of 1979 and *Dinobryon* (golden-brown) in the summer of 2000.

The 2024 Data Summary of the NHDES VLAP Individual Lake Report for Northwood Lake shows phytoplankton population (relative percent cell count per taxa) for 2013, 2015, 2017, 2019-2022, and 2024. Cyanobacteria have the highest relative percentages in 2013, 2015, 2020, and 2022. Golden-brown algae were highest in 2017, and diatoms were highest in 2019 and 2024 (NHDES, 2024)

The dominant zooplankton species in the 1979 were *Calanoid copepods* in the winter and summer, and *Bosmina*, commonly known as water fleas (winter of 2001) and *Tintinnidium*, commonly known as bell animals (summer of 2000). The shift from *Calanoid copepods* in 1979 to *Bosmina* and *Tintinnidium* in 2000-2001 suggests the lake may be experiencing increased nutrient levels, which is a common pattern in New Hampshire lakes as surrounding watersheds develop over time. *Calanoid copepods* typically indicate clearer, lower-nutrient conditions, while the presence of smaller-bodied zooplankton like *Bosmina* and protozoans like *Tintinnidium* often reflects higher productivity and organic matter in the water column. This zooplankton community change is worth monitoring alongside other water quality parameters like nutrients, clarity, and chlorophyll-*a* to understand the lake's overall trajectory.

Rotifers

small zooplankton whose population can respond quickly to environmental changes

Copepods

small crustaceans that eat phytoplankton and provide an important food source to fish

Cladocerans

include Daphnia, which are among the most efficient grazers of phytoplankton

2.1.5 Chloride and Specific Conductivity

Chloride pollution can cause harm to aquatic organisms and interfere with natural processes when concentrations reach toxic levels. In New Hampshire, the chronic impairment threshold is 230 ppm for chloride (about 835 $\mu\text{S}/\text{cm}$ specific conductivity). Chloride concentrations in Northwood Lake are well below the chronic impairment threshold, though both chloride and specific conductivity generally exceed the median value of New Hampshire lakes/lakes (5 ppm for Chloride and 42.3 $\mu\text{S}/\text{cm}$ for conductivity).

Both chloride and specific conductivity show statistically significant increasing (worsening) trends over the data record (1979-2025) across both depths (Figure 6). Note that there were not enough samples to conduct a trend analysis for chloride at the bottom. The increasing trends suggest that chloride inputs from road salt used for winter deicing may be contaminating the lake. Additional contributors may include erosion and sediment runoff from unpaved roads (especially on steep slopes), as well as wastewater inputs from septic systems, water softeners, and surface runoff or shallow groundwater flow from agricultural practices and fertilizers.

Although current levels do not pose an immediate threat, continued increases could eventually push the lake toward chronic chloride toxicity. Proactively reducing salt use and addressing erosion in the watershed will help protect Northwood Lake from future impacts.

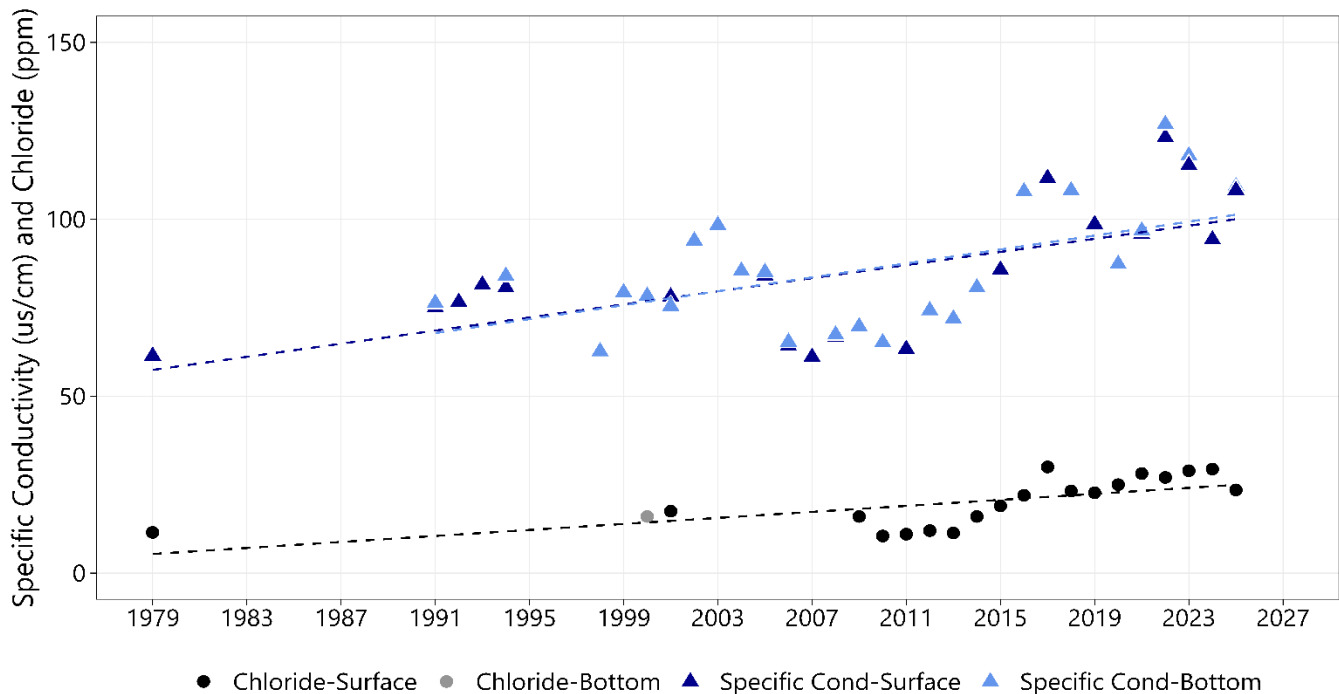


Figure 6. Yearly median of monthly medians for chloride and specific conductivity in the deep spot of Northwood Lake (NORNORED). Dashed lines indicate a statistically significant increasing (degrading) trend for chloride at the surface, and specific conductance at the surface and bottom. There was not enough data for chloride-bottom trend analysis. ppm = parts per million.

2.1.6 Turbidity

Turbidity is a measure of how clear or cloudy water is, caused by particles in the water scattering or absorbing light. In lakes and streams, turbidity can be influenced by phytoplankton and/or cyanobacterial colonies, organic matter, and suspended sediment. Higher turbidity indicates lower water clarity, which limits photosynthesis and aquatic plant growth, stresses filter-feeding organisms, and can damage fish gills. Because suspended particles absorb sunlight, turbid waters also tend to be warmer and hold less dissolved oxygen.

At the deep spot of Northwood Lake, turbidity values are low (~1 NTU). For comparison, New Hampshire's water quality standard for Class B waters is no more than 10 NTU above natural background conditions. While NHDES has not set a numeric value for "natural" turbidity, values below 1 NTU are generally considered natural and low¹.

Northwood Lake remains well below this 10 NTU threshold with a surface median of 1.07 NTU and a bottom median of 1.11 NTU (Figure 7). Turbidity is likely a bit higher at the bottom due to disturbance with the bottom sediment. Additionally, cyanobacteria may descend into bottom waters during high light intensity conditions, or to take advantage of bio-available phosphorus at these depths.

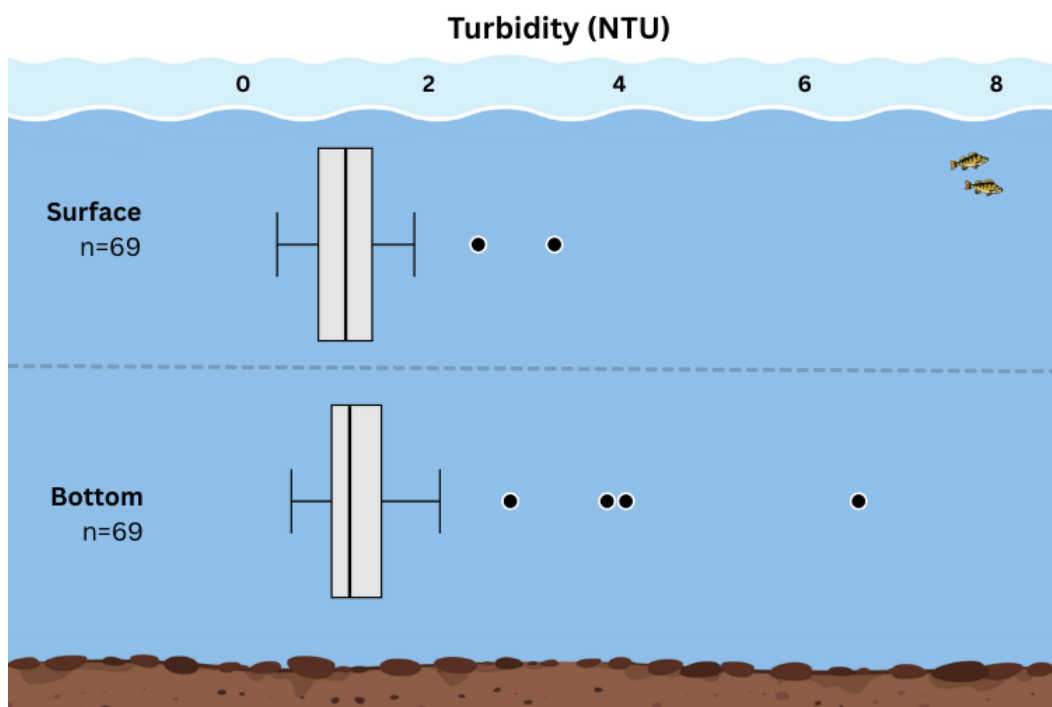


Figure 7. Boxplots showing median turbidity (in Nephelometric Turbidity Units (NTU)) in the surface and bottom at the deep spot of Northwood Lake (NORNORED) for the past 10 years (2016-2025).

¹ In the 2024 Consolidated Assessment and Listing Methodology (CALM), NHDES provides reference values aimed to represent natural turbidity that differ based on the month, derived from other streams. The reference values for streams in June, July, August, and September are 0.875, 0.831, 0.813, and 0.800 NTU, respectively.

2.1.7 pH

The pH of a waterbody describes how acidic or basic the water is, with 7 representing neutral. Lower values indicate more acidic conditions, while higher values indicate more basic conditions. The habitable range of pH for aquatic organisms is near neutral, with NHDES setting the standard for Class B waterbodies to have a pH between 6.5 and 8.0 to protect aquatic life (**Figure 8**). Monitoring the pH of Northwood Lake is especially important as the lake is classified as impaired for aquatic life integrity due to low pH.



Figure 8. Graphic of the pH scale, indicating the zone which supports aquatic life.

Median pH at the surface of at the deep spot of Northwood Lake (NORNORED) from 1979-2025 regularly falls below a pH of 6.5, which is the lower (more acidic) end of the acceptable range set by NHDES (Figure 9). Across the two depth zones from 2016-2025, pH has generally been lower (more acidic) at the surface. The surface waters may be slightly more acidic due to the input of dissolved organic acids from watershed runoff.

The median surface pH falls just below the NHDES guideline range for supporting aquatic life (Figure 9). Low pH can stress aquatic organisms, and when pH falls below ~5.5, it can also mobilize iron and aluminum-bound phosphorus from lake sediments, further degrading water quality.

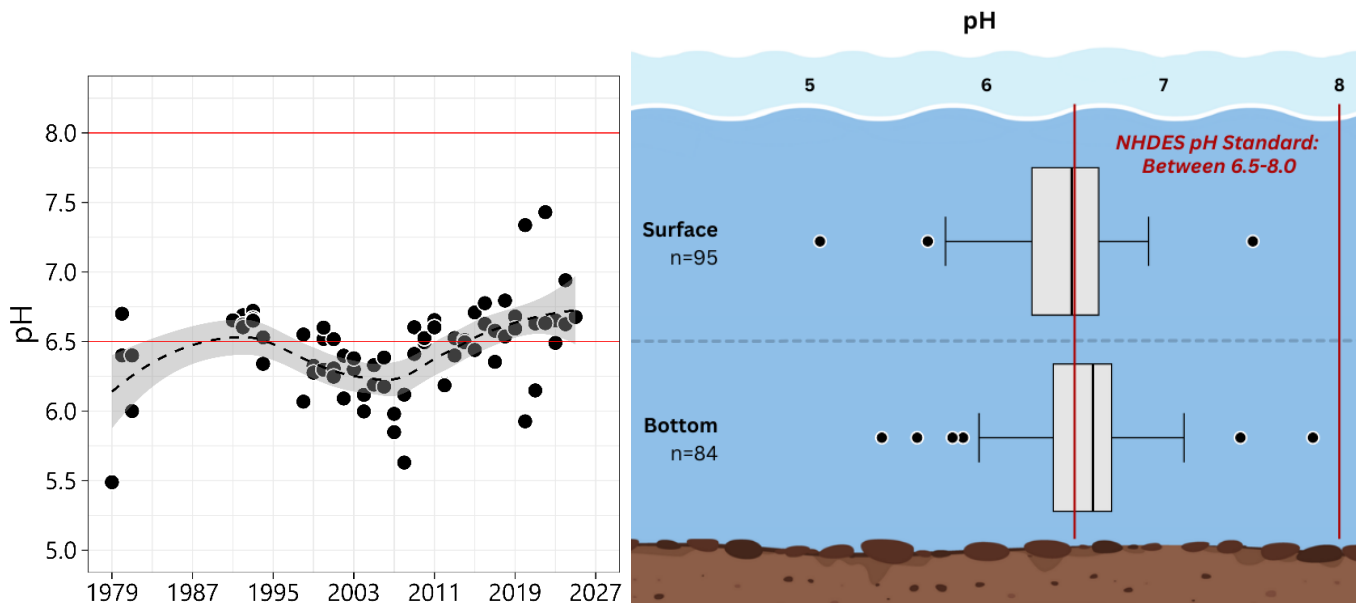


Figure 9. (Left) Yearly median of monthly medians for surface pH in the deep spot of Northwood Lake (NORNORED). (Right) Boxplots showing median pH at the surface and bottom of the deep spot of Northwood Lake (NORNORED) for the past 10 years, 2016-2025. Values were converted to the concentration of hydrogen ions before being summarized and logarithmically transformed back to the pH scale. The area between the red lines represents the zone which supports aquatic life.

2.1.8 Invasive Species



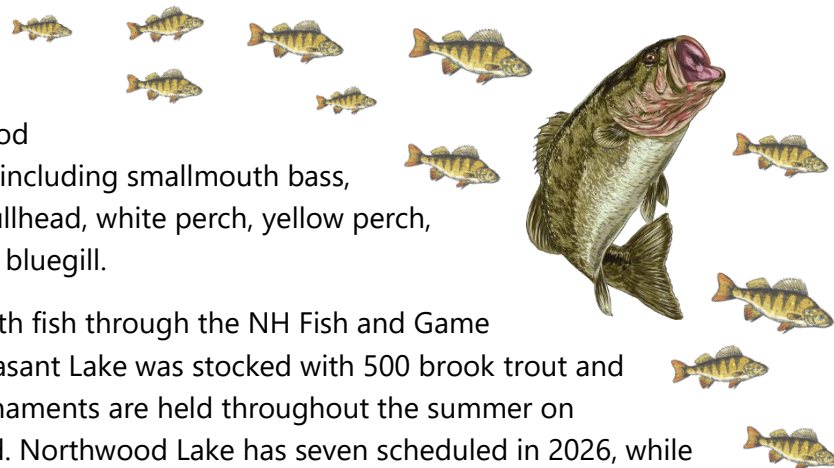
The introduction of non-indigenous invasive aquatic plant species to New Hampshire's waterbodies has been on the rise. These invasive aquatic plants are responsible for habitat disruption, loss of native plant and animal communities, reduced property values, impaired fishing and degraded recreational experiences, and high removal costs. Once established, invasive species are difficult and costly to remove. There are multiple programs that help prevent the introduction of invasive species and monitor the lakes, including the Lake Host Program and the Weed Watcher Program.

Northwood Lake has suffered from invasive aquatic plants, specifically variable milfoil (*Myriophyllum heterophyllum*, emerging in 1990) and European naiad (*Najas minor*, emerging in 2015). At its peak, variable milfoil covered nearly half the lake's surface area. The prolific plants interfered with boating, swimming, and fishing, causing a problem for the community at large. In response, NHDES developed an adaptive management strategy to control the spread through multiple methods of treatment: targeted herbicide applications (primarily 2,4-D and ProcettaCOR) for larger patches, diver-assisted suction harvesting (DASH) for moderate patches, hand-pulling by trained volunteer divers for small patches, and annual winter drawdown for supplemental control (NHDES, 2022). These combined efforts have successfully reduced variable milfoil coverage to less than 20% of the lake in some years according to the Management Plan published in 2022. Both the Town of Northwood and the Northwood Lake Watershed Association actively support control efforts and maintain prevention programs including Lake Host inspections and Weed Watcher monitoring. The primary challenge is that the lake's shallow depth, organic sediments, and extensive littoral zone create optimal habitat for variable milfoil, and the plant's vegetative reproduction through fragmentation enables rapid spread. Sustained management efforts are needed for it to not dominate the lake's aquatic plant community, and for the lake to support its designated uses once again.

2.1.9 Fish

Fish are important in ecosystem food webs and for providing recreational opportunities. Northwood Lake supports populations of warm water species including smallmouth bass, largemouth bass, eastern chain pickerel, brown bullhead, white perch, yellow perch, chain pickerel, black crappie, brown bullhead, and bluegill.

Northwood Lake is not currently being stocked with fish through the NH Fish and Game Department, though Pleasant Lake is. In 2026, Pleasant Lake was stocked with 500 brook trout and 1800 rainbow trout. Open water bass fishing tournaments are held throughout the summer on Northwood Lake, Pleasant Lake, and Jenness Pond. Northwood Lake has seven scheduled in 2026, while Pleasant Lake and Jenness Pond have five and one scheduled respectively.



2.1.10 Tributaries

The water quality of streams that contribute water, nutrients, contaminants, and more to Northwood Lake can reveal areas throughout the watershed contributing disproportionate amounts of certain parameters. Stream health is also critical because they often abut wetlands and serve as the home to various aquatic biota and macroinvertebrates. Ten stream water quality sites for Northwood Lake are part of the VLAP program: Northwood Lake – Bridge Inlet, Flat Meadows Brook Inlet, Horse Farm, Lower WTC Inlet, Lynn Grove Inlet, Pleasant PD Inlet (Baker Ave), Rt 107 Inlet (Sleepy Hollow), and Rte 4 E Inlet (Figure 2) (NHDES, 2024). Note that the VLAP site Northwood Lake-Pine Point was not analyzed as it only had one year of data and is not at the outlet of a tributary. Data have been summarized below by day, then month, then year for total phosphorus, chloride, specific conductivity, pH, and bacteria (*E. coli*)

Tributary Total Phosphorus

The EPA's *Ambient Water Quality Criteria Recommendations for Rivers and Streams* recommend a reference total phosphorus level of 23.75 ppb within the sub-ecoregion containing the Northwood Lake watershed. Concentrations greater than 23.75 ppb indicate the tributary is influenced by anthropogenic actions within the stream's subwatershed (US EPA, 2000). Tributary total phosphorus concentrations around Northwood Lake are generally stable, though some tributaries show significant trends over time. The Horse Farm tributary shows a statistically significant increasing (worsening) trend, while the Rt 107 Inlet (Sleepy Hollow) and the Rte 4 E Inlet show statistically significant decreasing (improving) trends (Figure 10). Though concentrations fluctuate, tributaries with higher total phosphorus concentrations include the Bridge Inlet, Flat Meadows Brook Inlet, Horse Farm, WTC Inlet, Pleasant PD Inlet (Baker Ave) and Rte 4 E Inlet. Extra attention should be directed to the subwatershed draining to the Horse Farm tributary to address and reduce phosphorus load entering the stream given the elevated concentrations and increasing trend.

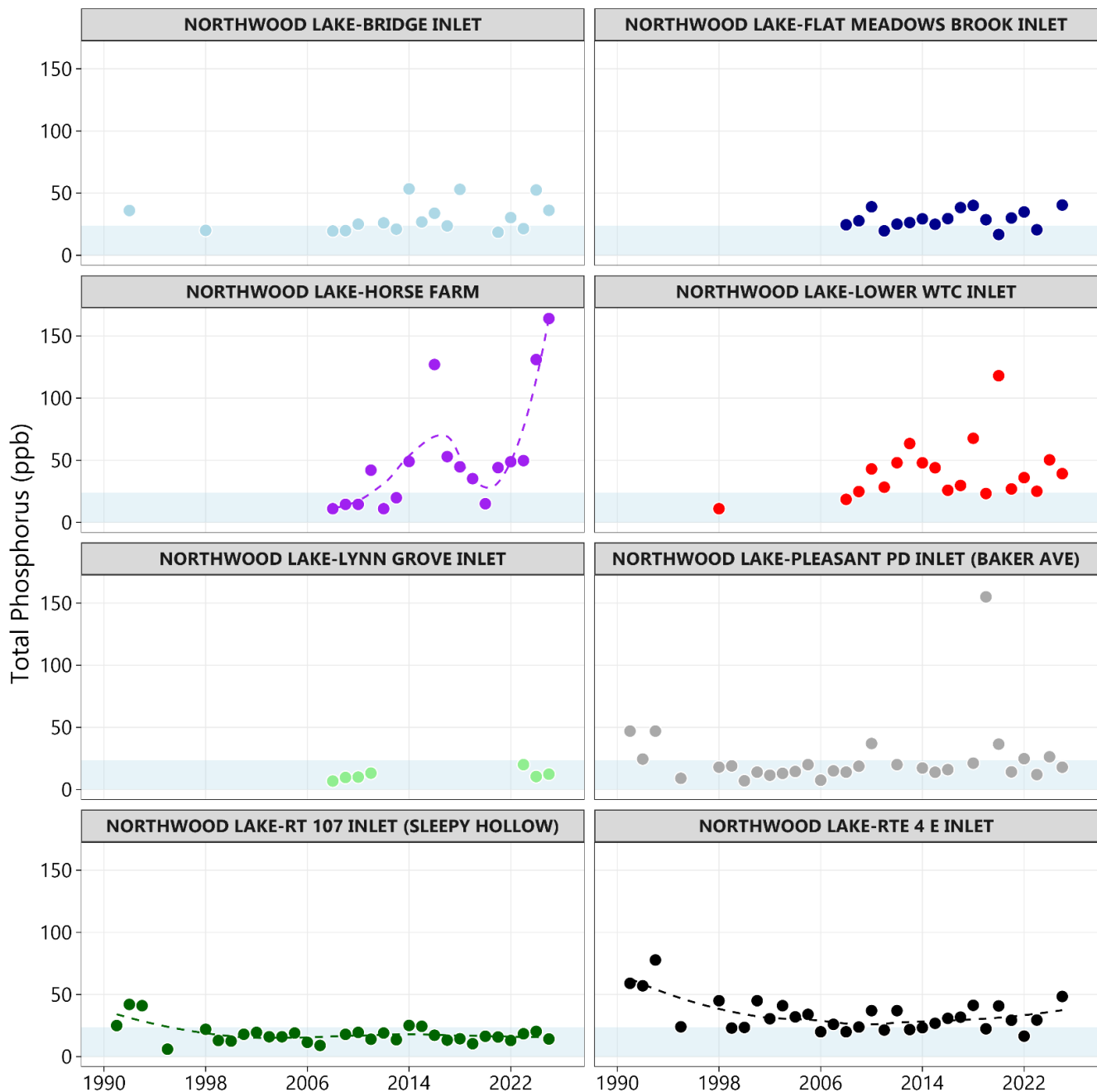


Figure 10. Yearly median of monthly medians for total phosphorus at NHDES VLAP tributary sites for Northwood Lake. Dashed lines indicate statistically significant trends. An outlier of 451 ppb in 2015 was removed from the Northwood Lake-Horse Farm graph. The blue band represents the range of concentrations between 0 and 23.75 ppb, the background range of total phosphorus for this sub-ecoregion. Data above this range indicates influence by anthropogenic actions within the stream's subwatershed. ppb = parts per billion.

Chloride and Specific Conductivity

Specific conductivity is a measure of the water's ability to conduct an electrical current. In the context of tributaries, specific conductivity relates to the concentration of ionic compounds in the water. Inputs to tributaries that affect specific conductivity include various types of salts (road salt), ions bound in soil, and ions found in wastewater and agricultural runoff. Chloride and specific conductivity levels are well below the chronic toxicity threshold of 230 ppm for chloride (which roughly equates to 835 $\mu\text{S}/\text{cm}$ for specific conductivity). However, statistically significant increasing (worsening) trends were found for chloride at the following tributaries: Bridge Inlet, Horse Farm, Pleasant PD Inlet (Baker Ave), and Rt 107 Inlet (Sleepy Hollow) (Figure 11). Specific conductivity was also increasing at the following tributaries: Bridge Inlet, Horse Farm, and Pleasant PD Inlet (Baker Ave) (Figure 12).

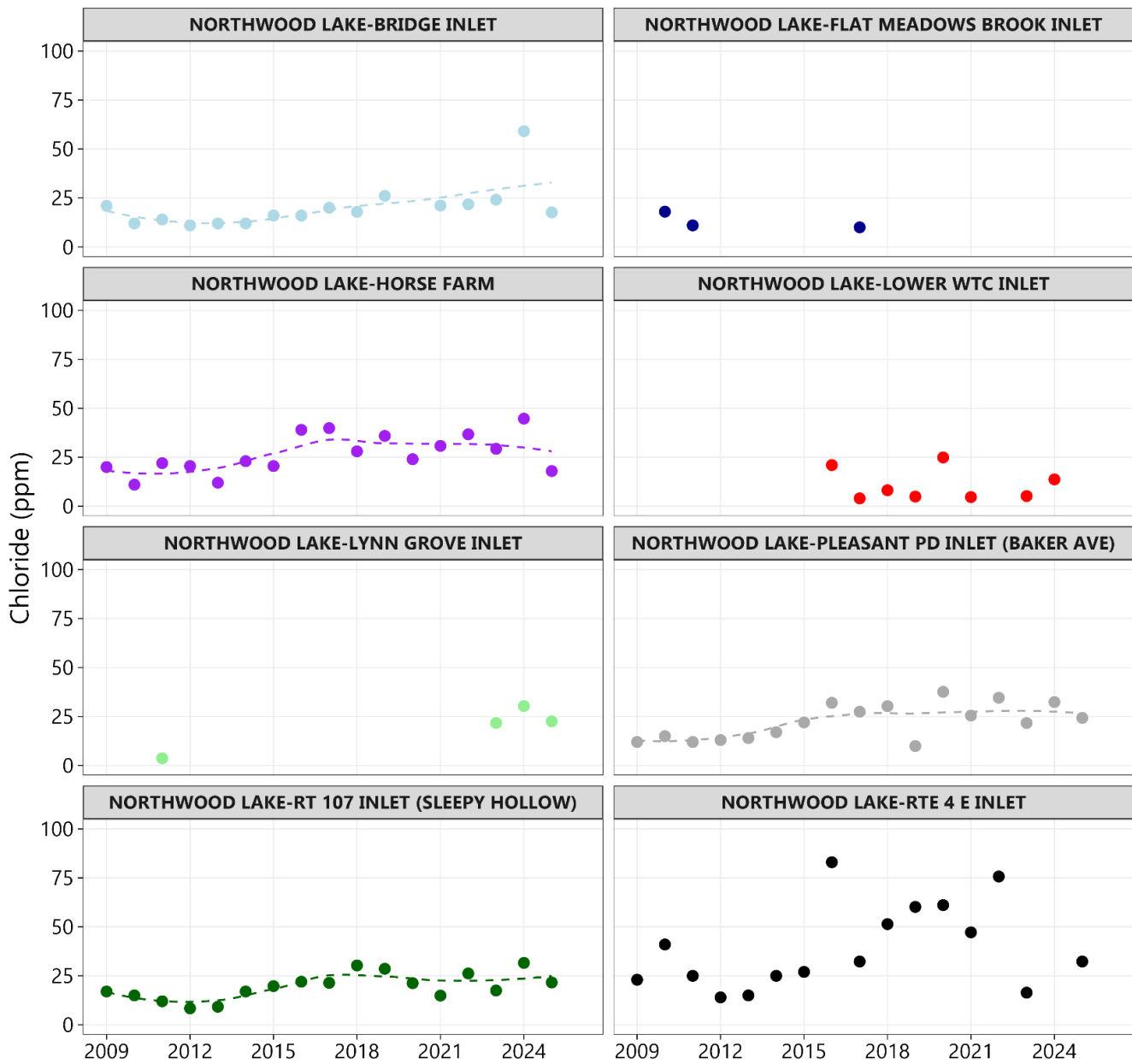


Figure 11. Yearly median of monthly medians for chloride at NHDES VLP tributary sites for Northwood Lake. Dashed lines indicate significant increasing trends. ppm = parts per million.

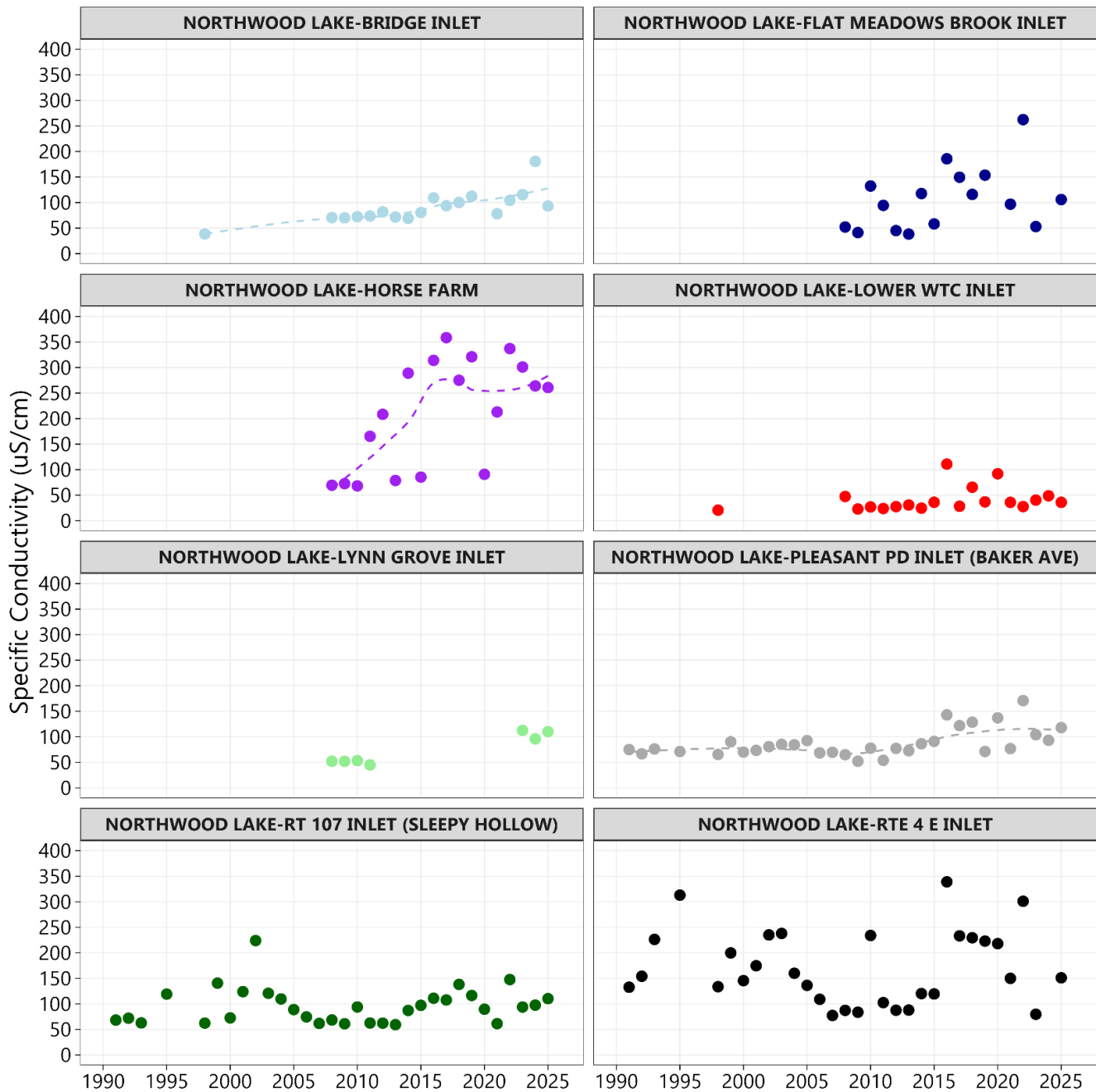


Figure 12. Yearly median of monthly medians for specific conductivity at NHDES VLAP tributary sites for Northwood Lake. Dashed lines indicate significant increasing trends. $\mu\text{S}/\text{cm}$ = microsiemens per centimeter.

pH

NHDES assesses Flat Meadow Brook, Lynn Grove Brook, Northwood Lake-Lower WTC Inlet, and Northwood Lake-Bridge Inlet streams as part of the Surface Water Quality Assessments. The 2024 assessment indicates that all five of these streams are impaired for aquatic life integrity due to low pH (NHDES, 2024). Horse Farm Brook, though not assessed, is the only tributary site to show a statistically significant increasing trend in pH. All other sites show no trend where a trend analysis is possible (>10 years of data), indicating pH in these tributaries is stable over time though fluctuations do occur (Figure 13).

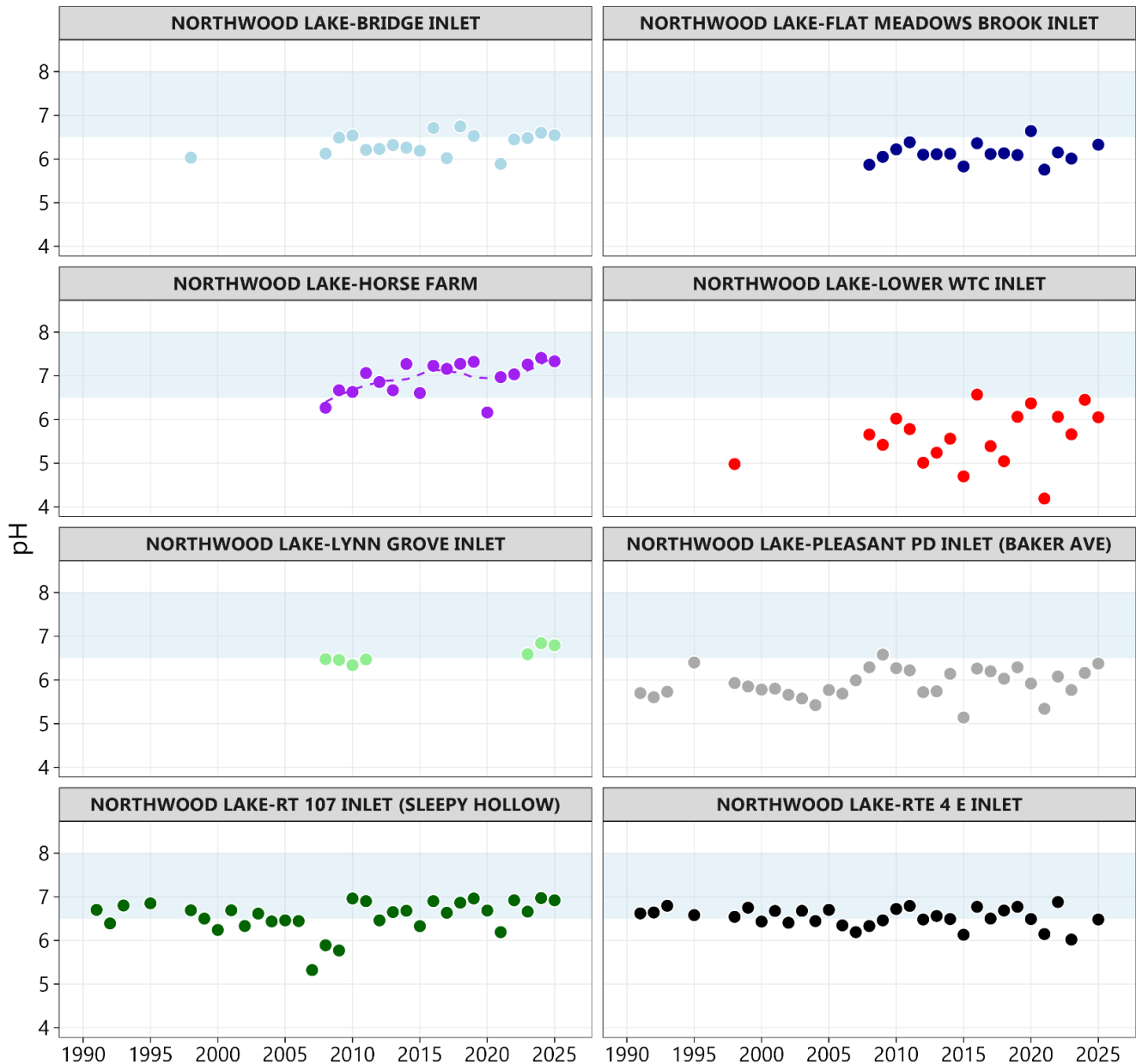


Figure 13. Yearly median of monthly medians for pH at NHDES VLAP tributary sites for Northwood Lake. Dashed lines indicate significant increasing trends. The blue band indicates the range suitable for aquatic life protection.

2.1.11 Beaches *E. Coli* Data Summary

Beaches on Northwood Lake are regularly sampled for fecal contamination using the indicator bacteria *E. coli* to protect the health of swimmers and other users of the beach. Fecal contamination in lake beaches may occur from various sources, such as wildlife/waterfowl, recreation, and nearby failing septic systems. NHDES sets the water quality criteria for a designated beach on a Class B waterbody at a geometric mean of 47 MPN/100mL and a single sample criterion of 88 MPN/100mL for *E. coli*.

The Surface Water Quality Assessments performed by NHDES in 2024 found that the Northwood Lake Town Beach (TB) and Lynn Grove Association Beach are impaired for Primary Contact Recreation due to elevated levels of *Escherichia coli* (*E. coli*), (NHDES, 2024). NHDES found that Northwood Lake at Camp Wah-tut-ca (WTC) Beach, Lower WTC Inlet, the inlet stream, the bridge inlet, and the Pleasant Lake to Northwood Lake stream were not impaired for Primary Recreation Contact in the same assessment (not shown in Figure 14). The Horse Farm site is not included in this SWQA as it is not a beach but is included in Figure 14.

E. coli data exists for many sites along the shoreline. However, sampling over time has not been consistent to a select group of sites. The three sites with the most recent data include Northwood Lake TB-Left, Northwood Lake TB-Right, and Northwood Lake-Horse Farm. In addition, sites Northwood Lake Lynn Grove Assoc Beach-Left and Northwood Lake Lynn Grove Assoc Beach-Right also have recent data but have not been sampled since 2018.

Many sites fall above the NHDES geomean limit (Figure 14). Most notably, Northwood Lake-Horse Farm had very elevated results in 2016 and 2021, reaching a geomean of 650 and 524 MPN/100 mL respectively. No site has been consistently below the geomean limit from 2016-2025.

Fecal contamination sampling at public beaches and public access points should remain a priority for NLWA and the community. Mitigation measures to reduce contamination should also be implemented which include but are not limited to waterfowl deterrents, pet waste signage and receptacles, and promoting proper septic system maintenance, and inspection/pump out schedules.

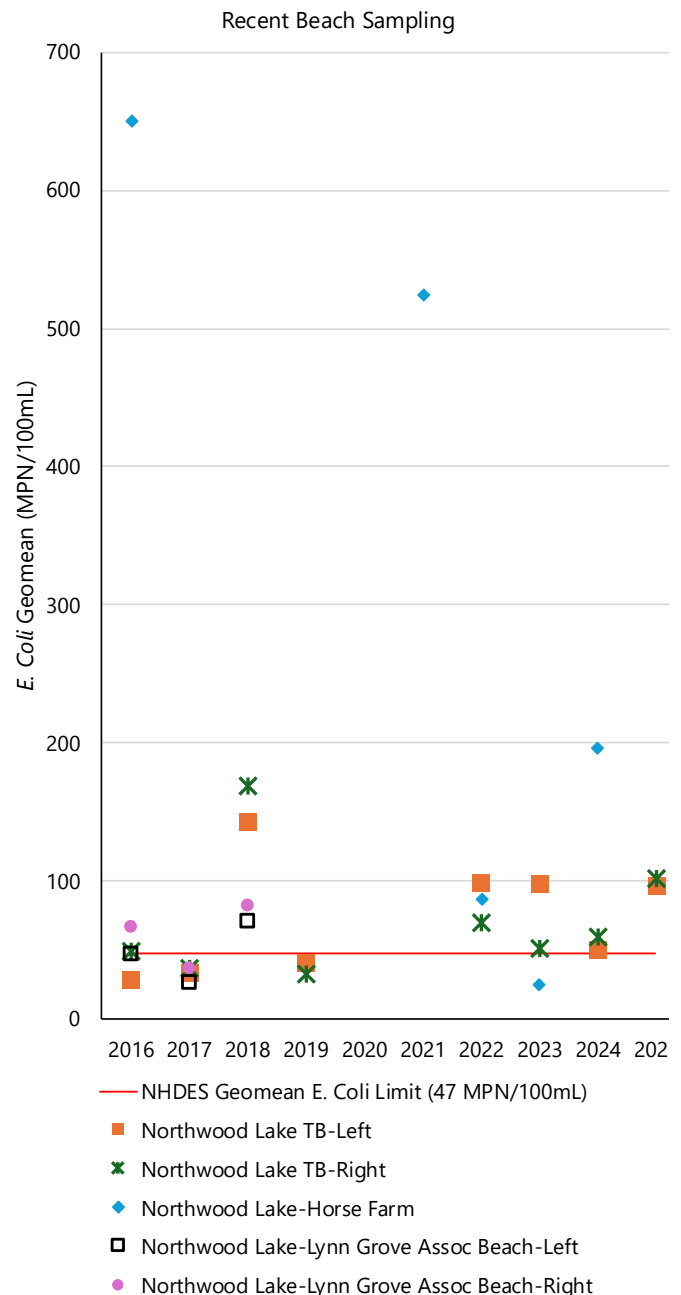


Figure 14. Yearly geomean of *E. coli* data at recent sampling locations on Northwood Lake (2016-2025). MPN = most probable number.

2.2 ASSIMILATIVE CAPACITY

The assimilative capacity of a waterbody describes the amount of pollutant that can be added to a waterbody without causing a violation of the **Anti-degradation Tiers** as listed in the NHDES [Consolidated Assessment and Listing \(CALM\) Methodology](#). The CALM criteria are based on specific thresholds for different water quality levels. Additionally, certain parameters are classified as either fully supporting or not supporting the associated **designated use**, such as pH for aquatic life integrity. These two frameworks under CALM criteria can be outlined as follows:

1. **Anti-degradation Tiers:** Evaluates parameters like phosphorus and chlorophyll-*a* to track whether water quality meets criteria and by what margins.
 - Tier 2 (High Quality): Water quality meets the water quality criteria and maintains a high-quality reserve or buffer of at least 10% above the impairment threshold.
 - Tier 1 (Caution Zone): Water quality meets criteria by less than 10%.
 - Impaired: Water quality does not meet the water quality criteria.
2. **Designated Use Support:** Evaluates parameters like pH, bacteria, cyanobacteria, and aquatic plants as either “fully supporting” or “not supporting” the lake’s designated use.

The assimilative capacity analysis determines which possible water quality conditions would result in impairment of the lake, and by what margin. Aquatic life integrity “standards” are specific to the lake’s **trophic classification**. Northwood Lake was classified as a mesotrophic waterbody in the 1979 and 2000 trophic surveys, therefore, the mesotrophic designation established the thresholds for the Northwood Lake assimilative capacity analysis. Additionally, Northwood Lake has five **designated uses** identified by NHDES: aquatic life integrity, fish consumption, potential drinking water supply, primary contact recreation (swimming), and secondary contact recreation (boating). For this WMP, we focus on aquatic life integrity and primary contact recreation. The assimilative capacity results for Northwood Lake’s current conditions are outlined below.

Aquatic Life Integrity:

- Chlorophyll-*a*: Designated as Tier 2. The median concentration of 3.85 ppb is well below (better than) the 4.8 ppb Tier 2 threshold.
- Total Phosphorus: Impaired. The median concentration of 12.75 ppb exceeds 12.0 ppb impairment threshold, resulting in a negative remaining assimilative capacity of -0.75 ppb.
- pH and Non-Native Plants: Not supporting. The median pH of 6.35 is slightly below (worse than) the 6.5 minimum impairment threshold, and non-native aquatic plants are present.

Primary Contact Recreation (swimming):

- Chlorophyll-*a*: Designated as Tier 2. The median concentration of 3.85 ppb is well below (better than) the 13.5 ppb Tier 2 threshold.
- Bacteria and Cyanobacteria: Not supporting. *E. coli* levels have exceeded the state thresholds and cyanobacteria blooms have interfered with recreational use.



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Results of the assimilative capacity analysis relative to the Anti-degradation Tiers show that Northwood Lake is Tier 2 for aquatic life use and primary contact recreation relative to chlorophyll-*a* and total phosphorus, but is not supporting the designated use of aquatic life due to pH and non-native aquatic plants. The lake also does not support the primary contact recreation use because of *E. coli* and cyanobacteria hepatotoxic microcystins; and does not support secondary contact recreation because of *E. coli*. Further reductions in phosphorus load are needed for total phosphorus to be in attainment on its own and to reduce the risk of cyanobacteria blooms. Additionally, targeted management of watershed bacterial sources such as stormwater runoff, pet waste, and septic systems is necessary to reduce *E. coli* concentrations and bring recreational uses back into attainment. Full anti-degradation and impairment thresholds determined under the assimilative capacity analysis are shown in Table 3.

Table 3. Assimilative capacity (AC) analysis results for the designated uses associated with Northwood Lake using mesotrophic Anti-degradation Tier standards based on water quality data collected from the deep spot (NORNORED). ppb = parts per billion.

Designated Use	Parameter	CALM Tier 2 Standard (ppb)	CALM Tier 1 Standard (ppb)	CALM Impaired Standard (ppb)	CALM Fully Supporting	CALM Not Supporting	Northwood Lake Existing Median WQ (ppb)*	Northwood Lake Remaining AC (ppb)	Northwood Lake Anti-degradation Tier	Designated Use Determination
Aquatic Life	Total Phosphorus*	<11.6	11.6-12	>12	Not applicable	Not applicable	12.75	-0.75	Impaired	Tier 2
	Chlorophyll- <i>a</i> *	<4.8	4.8-5	>5	Not applicable	Not applicable	3.85	1.15	Tier 2	
	pH*	Not applicable	Not applicable	Not applicable	>6.5 and <8.0	<6.5 or >8.0	6.35	0.15	Not applicable	Not Supporting
	Non-native aquatic plants	Not applicable	Not applicable	Not applicable	No known communities	Non-native aquatic plants are present	Not applicable	Not applicable	Not applicable	Not Supporting
Primary Contact Recreation (PCR)	Chlorophyll- <i>a</i>	0	13.5	15	Not applicable	Not applicable	3.85	11.15	Tier 2	Tier 2
	<i>E. coli</i>	Not applicable	Not applicable	Not applicable	Below a geometric mean of 95 and a single sample maximum of 406	Not meeting the supporting requirements	Not supporting PCR	No remaining AC	Not applicable	Not Supporting
	Cyanobacteria hepatotoxic microcystins	Not applicable	Not applicable	Not applicable	No blooms that significantly interfere with PCR	Blooms have significantly interfered with PCR	Blooms have significantly interfered with PCR	No remaining AC	Not applicable	Not Supporting
Secondary Contact Recreation (SCR)	<i>E. coli</i>	Not applicable	Not applicable	Not applicable	Below a geometric mean of 95 and a single sample maximum of 406	Not meeting the supporting requirements	Not supporting SCR	No remaining AC	Not applicable	Not Supporting

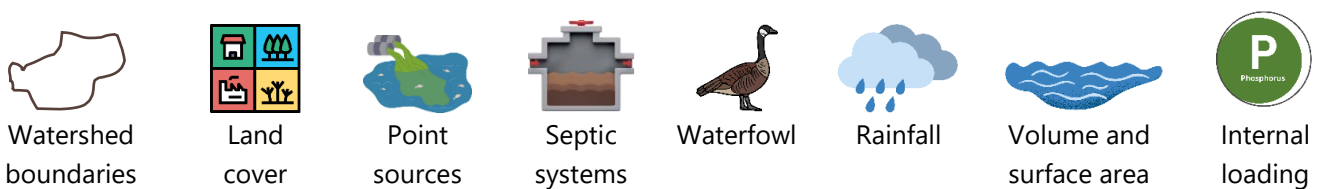
* Existing water quality data truncated to May 24-Sept 15 in the previous 10 years (2015-2024) for composite, "epilimnion", or "upper" samples (in order of priority on a given day). Data were summarized by day, then month, then year using median statistic.

2.3 WATERSHED MODELING

2.3.1 Lake Loading Response Model

Environmental modeling is the process of using mathematics to represent the natural world. Models can help explain how a system works, study cause and effect, or predict future conditions. Environmental models range from simple equations that can be solved with pen and paper, to complex computer programs requiring teams of people to operate.

For lakes, one common tool is the Lake Loading Response Model (LLRM). This model can make predictions about phosphorus concentrations, chlorophyll-*a* concentrations, and water clarity under different pollutant loading scenarios. These types of models play a key role in the watershed planning process, as pollutant load estimates are a required component of EPA's nine key planning elements. The LLRM is an Excel-based model that uses environmental data to develop a water and phosphorus loading budget for lakes and their tributaries (AECOM, 2009). Water and phosphorus loads (in the form of mass and concentration) are traced from various sources in the watershed through tributary basins and into the lake. The model incorporates the following data:



These data are combined with coefficients that quantify nutrient inputs from different sources, attenuation factors that account for nutrient loss, and equations from scientific literature on lakes, rivers, and nutrient cycles to generate annual average predictions of total phosphorus, chlorophyll-*a*, Secchi disk transparency, and algal bloom probability. The model can be used to identify current and future pollutant sources, estimate pollutant limits and establish water quality goals, and guide watershed improvement projects. A detailed description of the methodology employed for the Northwood Lake LLRM is provided in the *Northwood Lake, Lake Loading Response Model Report* (FBE, 2026a).

2.3.1.1 Lake Morphology and Flow Characteristics

The morphology (shape) and bathymetry (depth) of lakes and ponds are considered reliable predictors of water clarity and lake ecology. Large, deep lakes are typically clearer than small, shallow lakes as the differences in lake area, number and volume of upstream lakes, and **flushing rate** affect lake function and health. The **areal water load** is the depth of all inflowing water that would cover the entire lake surface area. The flushing rate is the number of times that the lake's volume is replaced per year.

Statistics for Northwood Lake

Surface area	=	660 acres
Shoreline	=	10.7 miles
Maximum depth	=	24 feet (7.3 meters)
Volume	=	8,150,120 cubic meters
Areal water load	=	49.03 feet per year (14.94 meters per year)
Flushing rate	=	4.90 times per year

2.3.1.2 Land Cover

Characterizing land cover within a watershed on a spatial scale can highlight potential sources of nonpoint source pollution that would otherwise go unnoticed in a field survey of the watershed. For instance, a watershed with large areas of developed land (i.e., impervious cover) and minimal forestland will likely be more at risk for nonpoint source pollution than a watershed with well-managed development and large tracts of undisturbed forest and/or protected forest, particularly along headwater streams. Land cover is also the essential element in determining how much phosphorus is contributed to surface water via stormwater runoff and baseflow.

Current land cover in the Northwood Lake watershed was determined by FBE using publicly available spatial datasets, Environmental Systems Research Institute World Imagery, and Google Earth imagery. See *Northwood Lake, Lake Loading Response Model Report* for more details on methodology. Land cover by major category for the Northwood Lake and Pleasant Lake watersheds was used to identify total phosphorus load by major land cover category for the entire watershed (Figure 15, Figure 16). Note that these metrics exclude the surface area of Northwood and Pleasant Lakes in order to focus on the landscape surrounding these waterbodies. **Developed areas cover 12% of the study area but contribute 64% of the total phosphorus watershed load to Northwood Lake.**

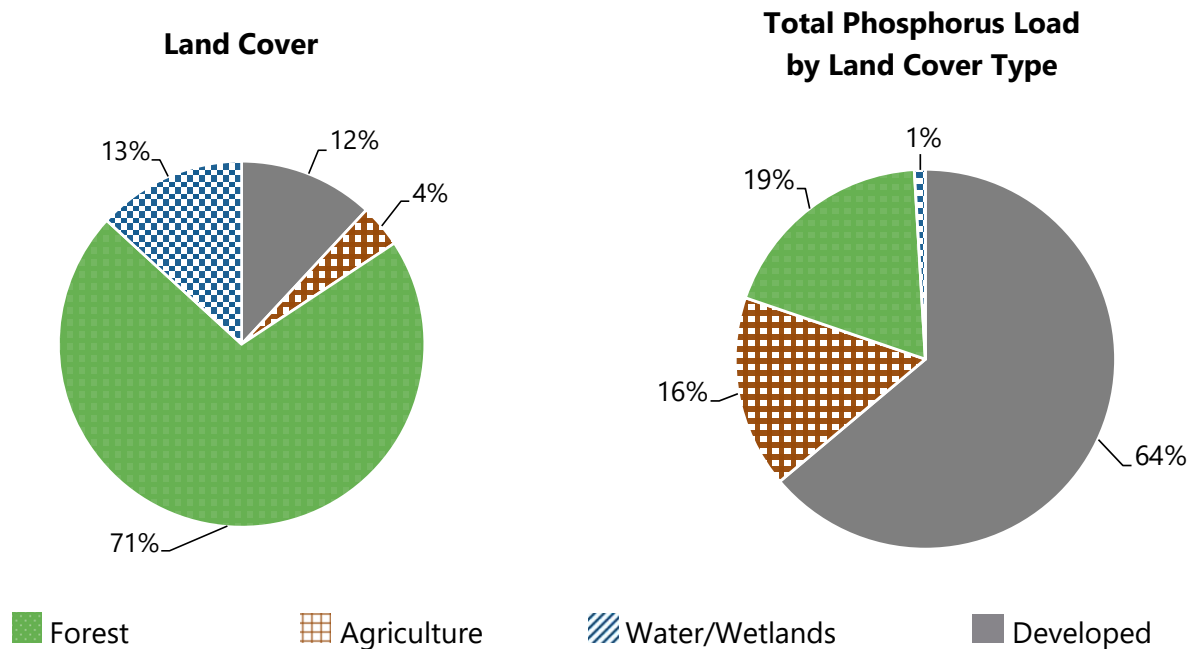


Figure 15. Northwood Lake watershed (including the Pleasant Lake watershed) land cover area by general category (agriculture, developed, forest, and water/wetlands) and total phosphorus watershed load by general land cover type. This shows that developed areas cover 12% of the watershed and contribute 64% of the total phosphorus watershed load to Northwood Lake. The water/wetlands category does not include the Northwood and Pleasant Lake areas.

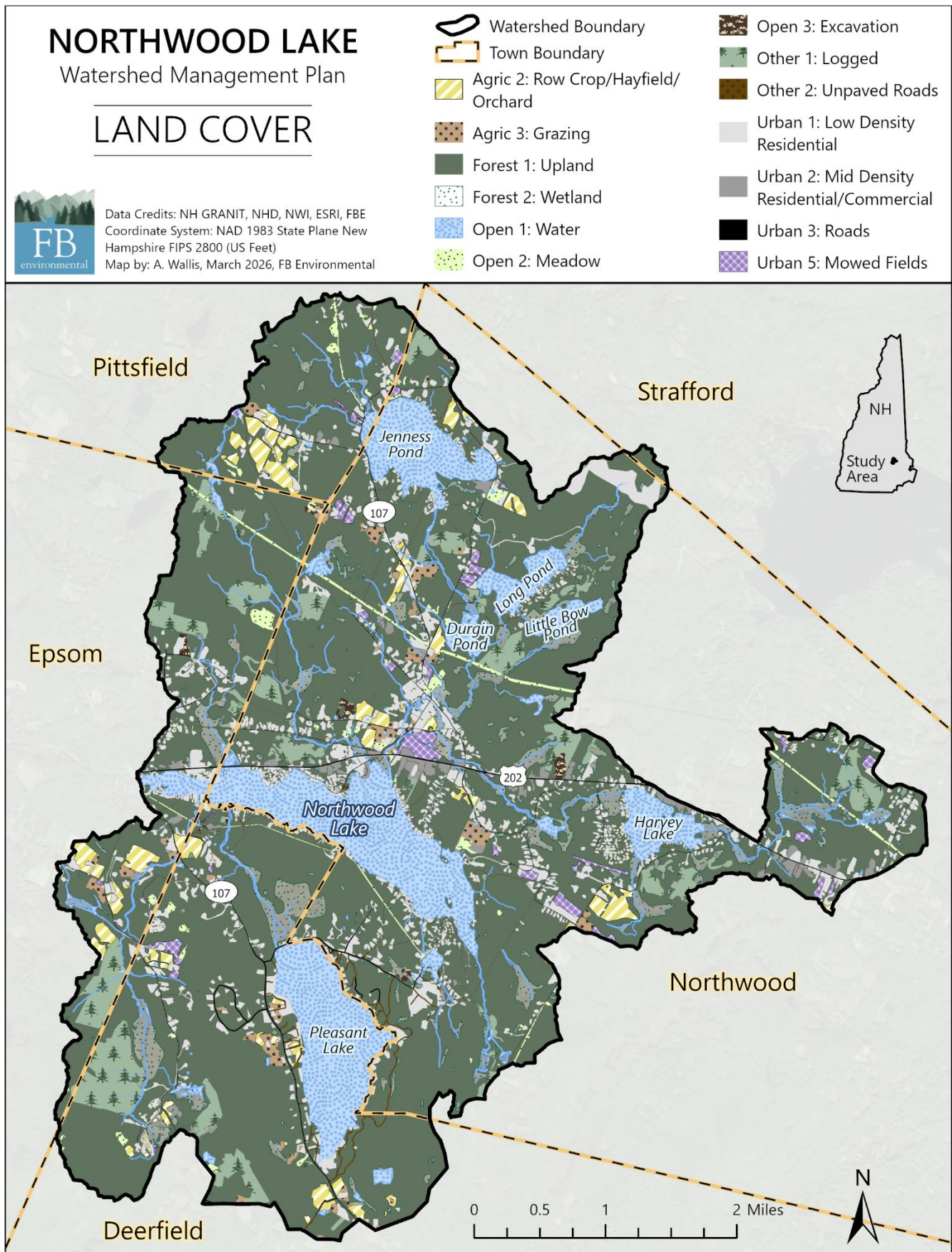


Figure 16. Land cover in the Northwood Lake watershed.

2.3.1.3 Internal Phosphorus Loading

Phosphorus that enters the lake and settles to the bottom can be re-released from sediment when chemical bonds between iron and phosphorus are broken under anoxic conditions, thus providing a nutrient source for algae, cyanobacteria, and plants. Internal phosphorus loading can also result from wind-driven wave action or physical disturbance of the sediment (boat propellers, aquatic macrophyte management activities).

Internal loading estimates were estimated based on dissolved oxygen and temperature profiles and bathymetry data. The profile data were used to determine the typical depth and frequency of low oxygen in lake bottom water. In addition, FBE collated surface and bottom water total phosphorus data collected from 1979-2025 to determine average difference between surface and bottom phosphorus concentrations. These estimates, along with volume of water with low oxygen and surface area, were used to determine the rate of release and mass of annual internal phosphorus load. Based on a review of the available phosphorus data, FBE determined that internal phosphorus loading could not be reliably empirically quantified because changes in the bottom water phosphorus concentration that could be related to internal loading are regularly masked by larger changes in water column phosphorus from external loading. As a result, the typically observed background level of internal phosphorus was used in the model.

Based on this assessment, internal loading represents only 4% of the total phosphorus load to Northwood Lake, indicating that it is a minor source at an annual scale. It may be functionally more relevant at critical times of year during the peak growing and recreational season.

2.3.1.4 Lake Loading Response Model Results

Current Load Estimation

Overall, model predictions for the two models, for Northwood Lake and Pleasant Lake, were in good agreement with observed data for total phosphorus (2% and 6%, respectively), moderate for Secchi disk transparency (10% and 14%, respectively), and poor agreement for chlorophyll-*a* (18% and 9%, respectively) (Table 4). It is important to note that the LLRM does not explicitly account for all the biogeochemical processes occurring within a waterbody that contribute to overall water quality and is less accurate at predicting chlorophyll-*a* and Secchi disk transparency. For example, chlorophyll-*a* is estimated strictly from nutrient loading, but other factors strongly affect algae growth, including transport of phosphorus from the sediment-water interface to the water column by cyanobacteria, low light from suspended sediment, grazing by zooplankton, presence of heterotrophic algae, and flushing effects from high flows. There was insufficient data available to evaluate the influence of these other factors on observed chlorophyll-*a* concentrations and Secchi disk transparency readings. The model predicts 26 bloom days for Northwood Lake and zero bloom days for Pleasant Lake (Table 4). Bloom days refer to the number of days where chlorophyll-*a* concentrations are greater than 8 ppb, and can be a bloom of cyanobacteria or green algae. Northwood Lake has experienced seven official cyanobacteria warnings issues by NHDES. The longest warning occurred in 2021, lasting 40 days, and three separate warnings occurred in 2023, all 13 days or less. Pleasant Lake has received no bloom warnings. Reported blooms likely under-represent the total blooms calculated in the model, which predicts upper water column cell densities.

Watershed runoff combined with baseflow (86%) was the largest phosphorus loading contribution across all sources to Northwood Lake (Table 5; Figure 17). The watershed load to Northwood Lake includes the total phosphorus load from Pleasant Lake. Of this 86%, 10% comes from Pleasant Lake and the Pleasant Lake outlet stream subwatershed. Shoreline septic systems (4%), atmospheric deposition (4%), internal loading (4%), and waterfowl (2%), were relatively smaller sources of phosphorus to Northwood Lake but may be seasonally important during low flow summer conditions. For Pleasant Lake, the model predicted 66% of the total phosphorus load originates from watershed sources, with shoreline septic systems (15%), atmospheric deposition (14%), internal loading (4%) and waterfowl (2%) making up the remaining phosphorus load.

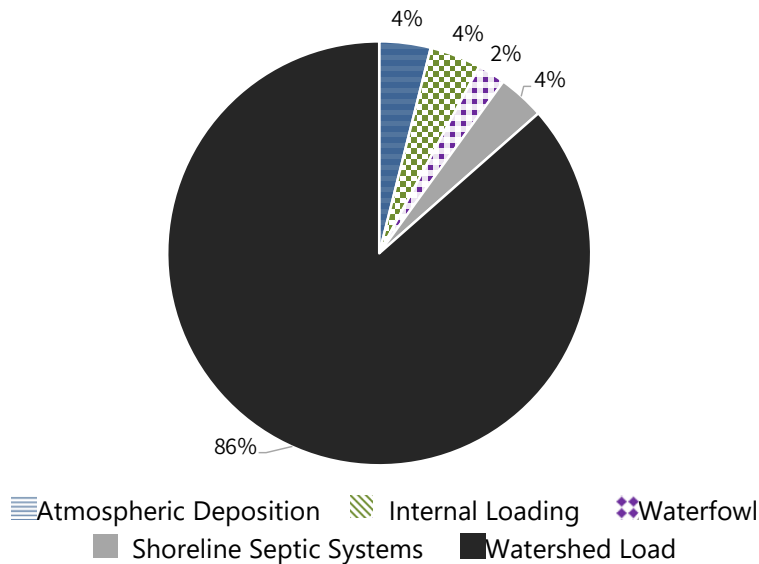


Figure 17. Summary of total phosphorus loading by major source for Northwood Lake. Note this includes the Pleasant Lake watershed.

Normalizing for the size of a sub-watershed by accounting for sub-watershed annual discharge and drainage area can better highlight sub-watersheds with elevated pollutant exports relative to their drainage area. Sub-watersheds with moderate to high phosphorus export rates (>0.2 kg/ha/yr) generally correspond to more developed areas, particularly dense urban development along Northwood Lake's shoreline and from the Pleasant Lake watershed (Table 6). Drainage areas directly adjacent to waterbodies have a direct hydrologic connection to the lake and are often targeted for development, increasing the potential for phosphorus export. Other high-loading areas with extensive developed land include sub-watersheds near US Route 202 and NH Route 107. The smaller, undeveloped sub-watersheds of Little Bow Pond Drainage and The Gulf Drainage have lower total phosphorus loads compared to more developed areas. A large portion of The Gulf Drainage is conserved under the Natural Resources Conservation Service (NRCS) Wetlands Reserve Program (WRP) WaTutCa and Anthony parcels. The northern portion of the watershed also has lower phosphorus loads due to more extensive forest cover.

Pre-Development Load Estimation

Once the model is calibrated for current in-lake phosphorus concentration, we can then manipulate land cover and other factor loadings to estimate pre-development loading scenarios (e.g., what in-lake phosphorus concentration was prior to human development, or the best possible water quality for the lake). Pre-development loading estimation showed that total phosphorus loading to Northwood Lake

increased by 337%, from 172.3 kg/yr prior to European settlement to 753.9 kg/yr under current conditions (Table 5). These higher current phosphorus sources are from development in the watershed, septic systems, atmospheric dust, and internal loading (Table 5, Table 6). Water quality prior to settlement was predicted to be excellent with extremely low phosphorus and chlorophyll-*a* concentrations and higher water clarity (Table 4).

Future Development Load Estimation

We also manipulated land cover and other factors to estimate future loading scenarios (e.g., what in-lake phosphorus concentration might be at full build-out under current zoning or the worst possible water quality for the lake). Refer to the *Northwood Lake Build-Out Analysis Memo* (FBE, 2026b) for details on methodology. Though not accounted for in the future model, projected increases in the frequency and intensity of storms and runoff events, along with longer dry periods and warming trends, may exacerbate erosion of phosphorus-laden sediment to surface waters and increase in-lake phosphorus concentrations (despite dilution and flushing assumed by the model). Future loading estimation showed that total phosphorus loading to Northwood Lake may increase by 62%, from 753.9 kg/yr under current conditions to 1,218.5 kg/yr at full build-out (estimated by 2069 with the 30-year compound annual growth rate) under current zoning (Table 5). Additional phosphorus will be generated from greater atmospheric dust, more septic systems, enhanced internal loading, and more development in the watershed (Table 5, Table 6). Development is expected to be particularly high in the undeveloped headwater areas. Compared to current conditions, the future Northwood Lake model predicted higher (worse) phosphorus (20.7 micrograms per liter), higher (worse) chlorophyll-*a* (7.8 micrograms per liter), and lower (worse) water clarity (2.3 meters) (Table 4). Predicted future water quality was similarly poor for Pleasant Lake (Table 4).



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Table 4. In-lake water quality modeled predictions for Northwood Lake and Pleasant Lake. TP = total phosphorus. Chl-a = chlorophyll-*a*. SDT = Secchi disk transparency. Bloom Days represent average annual probability of chlorophyll-*a* exceeding 8 micrograms per liter ($\mu\text{g/L}$).

Waterbody	Model Scenario	Measured Median TP ($\mu\text{g/L}$)	Modeled Median TP ($\mu\text{g/L}$)	Measured Mean Chl-a ($\mu\text{g/L}$)	Modeled Mean Chl-a ($\mu\text{g/L}$)	Measured Mean SDT (m)	Modeled Mean SDT (m)	Modeled Bloom Days
Northwood Lake	Pre-Development	not measured	2.9	not measured	0.5	not measured	10.1**	0
	Current (2025)	12.5*	12.8	3.6	4.3	3.6	3.3	26
	Future (2069)	not measured	20.7	not measured	7.8	not measured	2.3	141
Pleasant Lake	Pre-Development	not measured	1.88	not measured	0.4	not measured	14.2	0
	Current (2016)	5.0 (6.0) *	6.4	2.5	1.7	6.4	5.6	0
	Future (2052)	not measured	9.87	not measured	3.1	not measured	4.0	2

* Median total phosphorus concentration represents current in-lake total phosphorus from observed data in the surface and bottom and was used to calibrate the model. This value differs from the TP concentration following the assimilative capacity analysis method. An adjustment factor of 20% was added to the measured median TP value for Pleasant Lake. The adjusted value is shown in parenthesis.

** Value exceeds the maximum depth of the waterbody. Modeled Secchi depth for the pre-development scenario of Northwood Lake would hit the bottom as the lake is only approximately 7.3 meters deep.

Table 5. Total phosphorus (TP) and water loading summary by model and source for Northwood Lake and Pleasant Lake. Note that Pleasant Lake is included in the loads for Northwood Lake. kg/yr = kilograms per year.

Waterbody	Development State	Measurement	Atmospheric	Internal	Waterfowl	Shoreline Septic System	Watershed Load	Total Load To Lake
Northwood Lake	Pre-Development	TP (kg/yr)	18.7	0.0	16.0	0.0	137.6	172.3
		Percent	11	0	9	0	80	100
		Water (cubic meters per year)	3,242,425	0	0	0	36,849,508	40,091,933
	Current (2025)	TP (kg/yr)	29.4	29.4	16.0	29.9	649.3	753.9
		Percent	4	4	2	4	86	100
		Water (cubic meters per year)	3,242,425	0	0	30,173	36,629,965	39,902,563
	Future (2069)	TP (kg/yr)	66.7	47.6	16.0	38.0	1050.1	1,218.5
		Percent	6	4	1	3	86	100
		Water (cubic meters per year)	3,242,425	0	0	40,298	36,826,908	40,109,631
Pleasant Lake	Pre-Development	TP (kg/yr)	21.3	0.0	3.0	0.0	21.0	45.4
		Percent	47	0	7	0	46	100
		Water (cubic meters per year)	1,532,355	0	0	0	5,200,863	6,733,218
	Current (2016)	TP (kg/yr)	21.3	5.5	3.0	22.8	100.1	152.7
		Percent	14	4	2	15	66	100
		Water (cubic meters per year)	1,532,355	0	0	23,475	5,162,276	6,718,106
	Future (2052)	TP (kg/yr)	21.3	5.5	3.0	28.9	186.0	244.7
		Percent	9	2	1	12	76	100
		Water (cubic meters per year)	1,668,881	0	0	29,844	5,424,749	7,123,473

Table 6. Summary of land area, water flow, total phosphorus (TP) concentration, and watershed loading by model and sub-watershed for Northwood Lake. Land area does not include the area of the lakes. Note that Pleasant Lake is not included in the table because it was modeled separately. (kg/yr = kilograms per year; Ha = hectares).

Development State	Measurements	Cobblestone Dr. Drainage (242 Ha)	Direct Drainage to Northwood Lake (582 Ha)	Durgan Pond Drainage (1,119 Ha)	Flat Meadow Brook Drainage (621 Ha)	Griffin Brook Drainage (702 Ha)	Harvey Lake Drainage (583 Ha)	Jennes Pond Drainage (659 Ha)	Little Bow Pond Drainage (96 Ha)	Long Pond Drainage (304 Ha)	Narrows Brook Drainage (669 Ha)	Pleasant Lake Outlet Stream (194 Ha)	The Gulf Drainage (149 Ha)
Pre-Development Watershed Loads	Water flow (cubic meters per year)	1,551,693	3,991,901	7,373,454	3,989,106	4,517,698	3,231,431	3,192,002	516,099	1,692,216	13,716,422	8,076,164	1,006,524
	Calculated phosphorus concentration (milligrams per liter)	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.002	0.004
	Phosphorus mass (kg/yr)	7.7	192	4.7	199	22.6	172	19.7	2.6	9.1	203	18.2	4.7
	Phosphorus mass by area (kilograms per hectare per year)	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Current (2025) Watershed Loads	Water flow (cubic meters per year)	1,542,656	3,946,219	7,319,472	3,993,946	4,487,124	3,194,786	3,172,537	516,021	1,674,386	13,594,431	8,057,403	1,008,187
	Calculated phosphorus concentration (milligrams per liter)	0.020	0.030	0.019	0.013	0.019	0.023	0.017	0.005	0.019	0.021	0.008	0.006
	Phosphorus mass (kg/yr)	36.1	1183	33.5	61.8	1022	97.7	81.2	3.3	42.4	129.1	64.2	6.8
	Phosphorus mass by area (kilograms per hectare per year)	0.15	0.20	0.22	0.10	0.15	0.17	0.12	0.03	0.14	0.19	0.07	0.05
Future (2069) Watershed Loads	Water flow (cubic meters per year)	1,534,010	3,925,722	7,247,360	3,950,716	4,469,832	3,178,533	3,140,788	512,241	1,657,126	13,488,349	8,454,580	1,003,698
	Calculated phosphorus concentration (milligrams per liter)	0.030	0.039	0.037	0.033	0.026	0.032	0.034	0.018	0.038	0.035	0.013	0.014
	Phosphorus mass (kg/yr)	54.1	1720	50.4	1520	138.3	135.9	166.4	12.1	82.9	188.6	111.2	15.7
	Phosphorus mass by area (kilograms per hectare per year)	0.22	0.30	0.32	0.24	0.20	0.23	0.25	0.13	0.27	0.28	0.15	0.11

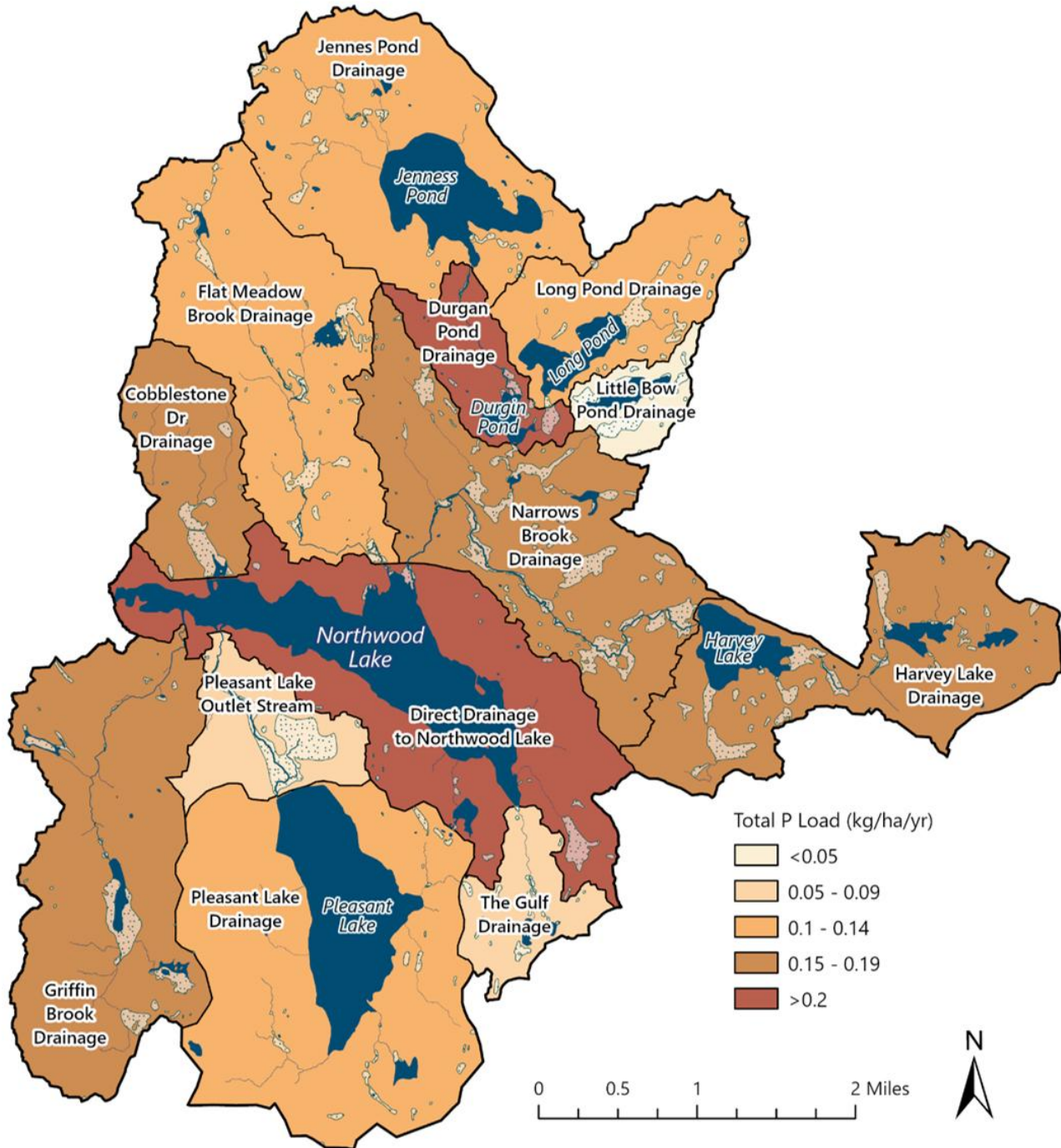


Figure 18. Map of the current total phosphorus watershed loads per unit area (kg/ha/yr) for each sub-watershed. Higher phosphorus loads per unit area are concentrated in the more developed southern portion of the watershed.

2.3.2 Build-out Analysis

A **build-out analysis** identifies areas with development potential and projects future development based on a set of conditions (e.g., zoning regulations, environmental constraints) and assumptions (e.g., population growth rate). A build-out analysis shows what land is available for development, how much development can occur, and at what densities. **"Full build-out"** is a theoretical condition representing the moment in time when all available land suitable for residential, commercial, and industrial uses has been developed to the maximum capacity permitted by local ordinances and zoning standards. Local ordinances and zoning standards are subject to change, and the analysis requires simplifying assumptions; therefore, the results of the build-out analysis should be viewed as planning-level estimates only for potential future outcomes from development trends. *Refer to the Northwood Lake Watershed Build-out Analysis for methods* (FBE, 2026b).



FULL BUILD-OUT is a theoretical condition representing the moment in time when all available land suitable for residential, commercial, and industrial uses has been developed to the maximum capacity permitted by current local ordinances and current zoning standards.

To determine where development may occur within the study area, the build-out analysis first subtracts land unavailable for development due to physical constraints, including environmental restrictions (e.g., wetlands, conserved lands, hydric soils), zoning restrictions (e.g., shoreland zoning, street right-of-ways, and building setbacks), and practical design considerations (e.g., lot layout inefficiencies) Figure 19). Existing buildings also reduce the capacity for new development.

The build-out analysis showed that 47% (6,220 acres) of the full study area is buildable under current zoning regulations (Table 7; Figure 20). FBE identified 1,869 existing buildings within the watershed, and the build-out analysis projected that an additional 1,792 buildings could be constructed in the future resulting in a total of 3,661 buildings in the full watershed (Table 8; Figure 21).



Table 7. Amount of buildable land within the Northwood Lake watershed by zone for each town. Total area does not include waterbodies (lakes and ponds).

Town	Zone	Total Area (acres)	Buildable Area (acres)	Percent Buildable Area
Deerfield	Agricultural-Residential District	3,030	1,130	37%
Epsom	Residential/Agricultural Zone	1,780	851	48%
	Residential/Commercial Zone	86	31	36%
Pittsfield	Rural District	1057	926	88%
Strafford	Agricultural/Residential	22	22	100%
Northwood	General District	5424	2440	45%
	Wellhead Protection Overlay District	1765	820	46%
Total		13,164	6,220	47%

Table 8. Projected increase in buildings by zone within the Northwood Lake watershed.

Town	Zone	Number Existing Buildings	Number Projected Buildings	Total Number Buildings	Percent Increase
Deerfield	Agricultural-Residential District	336	257	593	76%
Epsom	Residential/Agricultural Zone	120	256	376	213%
	Residential/Commercial Zone	36	18	54	50%
Pittsfield	Rural District	54	284	338	526%
Strafford	Agricultural/Residential	0	7	7	not calculable
Northwood	General District	895	813	1,708	91%
	Wellhead Protection Overlay District	428	157	585	37%
Total	Total	1,869	1,792	3,661	96%

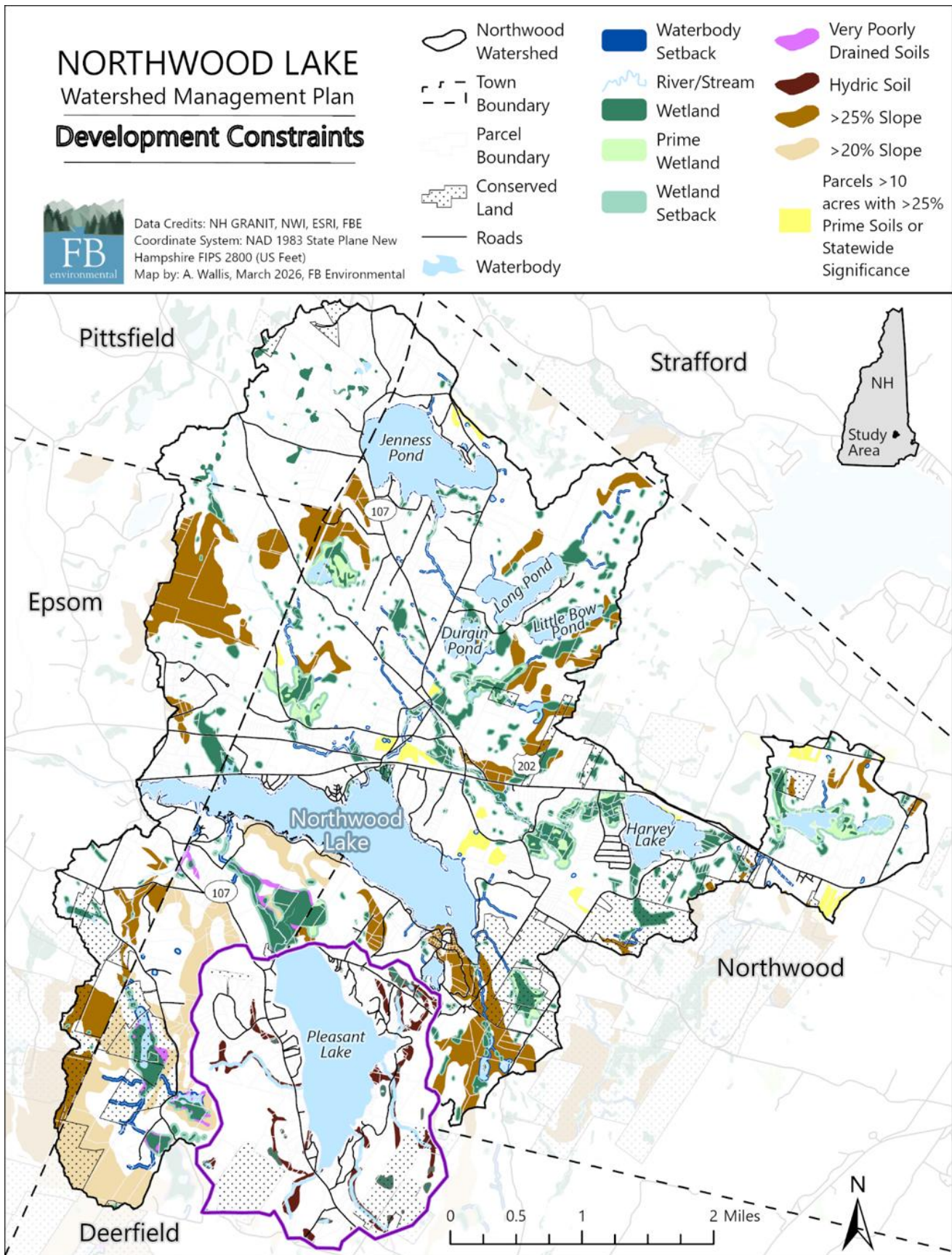


Figure 19. Development constraints in the Northwood Lake watershed.

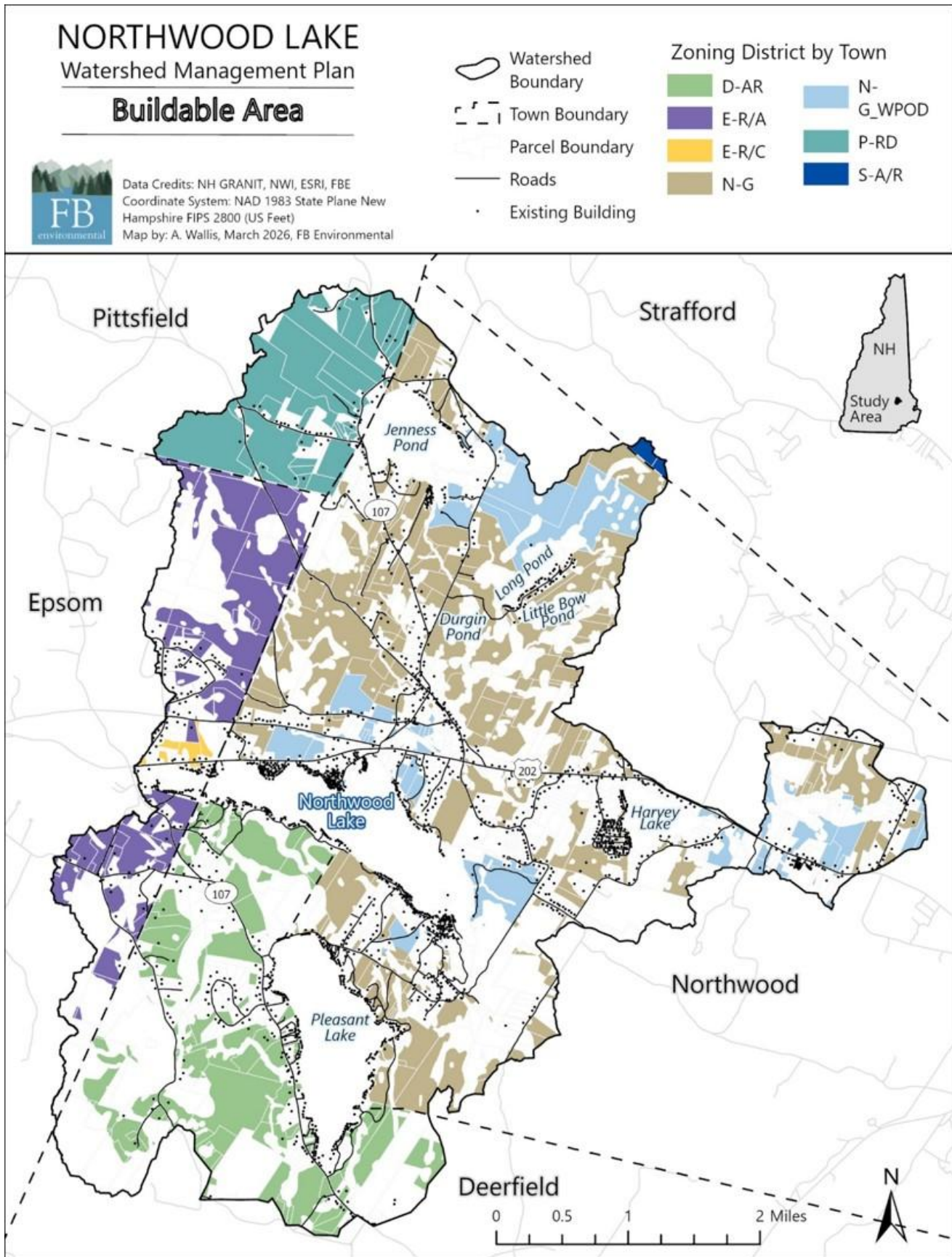


Figure 20. Buildable area by zoning district for each town within the Northwood Lake watershed. Refer to Appendix A for an acronym key.

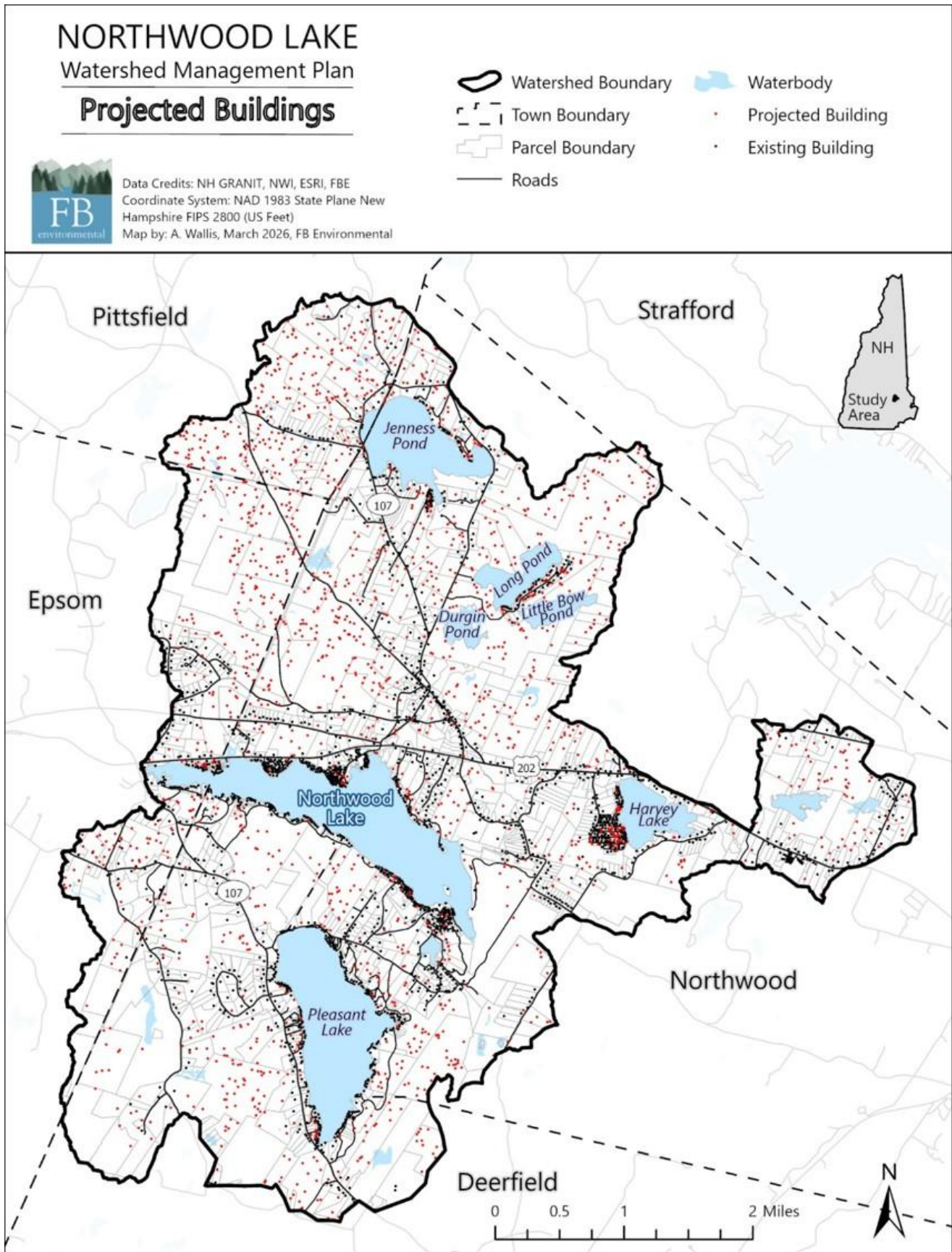


Figure 21. Existing and projected buildings within the Northwood Lake watershed.

A TimeScope Analysis applies historical compound annual growth rates (CAGR) to the number of projected buildings to project the rate of new development into the future. The TimeScope Analysis presented here projects four different growth rates for the watershed towns, representing the past 10, 20, 30, and 50 years of decadal census data (from 2010-2020, 2000-2020, 1990-2020, and 1970-2020) (Table 9). It is important to note that future growth rates may vary from historical growth rates.

Table 9. Compound annual growth rates (CAGR) for the towns in the Northwood Lake watershed, used for the TimeScope Analysis. Data from the U.S. Census Bureau.

Town Populations	50 Year CAGR (1970-2020)	30 Year CAGR (1990-2020)	20 Year CAGR (2000-2020)	10 Year CAGR (2010-2020)
<i>New Hampshire (for reference)</i>	1.26%	0.72%	0.54%	0.45%
Northwood	2.25%	1.33%	1.22%	0.91%
Deerfield	2.87%	1.48%	1.40%	1.27%
Epsom	2.41%	1.00%	0.92%	0.57%
Pittsfield	0.97%	0.32%	0.18%	-0.08%
Strafford	3.00%	1.19%	0.77%	0.58%
Towns Combined	2.19%	1.59%	1.82%	0.66%

For the Northwood Lake watershed, full build-out is projected to occur in 2128 at the 10-year CAGR, 2064 at the 20-year CAGR, 2069 for the 30-year CAGR, and 2058 for the 50-year CAGR. This analysis showed that if the towns within the watershed continue to grow at the rates identified, and current zoning and other development constraints remain the same, full build-out could occur within this century.

Note that the growth rates used in the TimeScope Analysis are based on town-wide census statistics but have been applied here to a portion of the towns. If areas closer to the lakes within each town develop faster than more upland areas, watershed full build-out conditions may occur sooner. Also note that the population growth rate in these towns is decreasing, so the 20- or 10-year estimates are likely more accurate than the 50-year estimate. Using census data to project population increase and/or development has inherent limitations. For instance, the building rate may increase at a different rate than population, due to factors such as commercial versus residential development and number of people per household. As such, the TimeScope Analysis might over or underestimate the time required for the study area to reach full build-out. Numerous social and economic factors influence population change and development rates, including policies adopted by federal, state, and local governments. The relationships among the various factors may be complex and therefore difficult to model.

2.4 WATER QUALITY GOAL AND OBJECTIVES

2.4.1 Water Quality Goal

A water quality goal was developed based on the data and modeling above and with input from project partners and stakeholders during a meeting with the Northwood Lake Association. The model results identify the largest contributing sources of phosphorus to the lake and the subsequent in-lake total phosphorus concentrations for a current condition scenario and a future conditions scenario. This indicates that Northwood Lake is currently being affected by existing development in the watershed and will likely be impacted by continued growth. These results provide a foundation for informed management decisions and establishing an appropriate water quality goal for Northwood Lake.

We recommend reducing the annual average total phosphorus concentration in Northwood Lake from a predicted 12.8 micrograms per liter to 12.1 micrograms per liter. This target represents a minimum of 5.7% reduction (42.65 kg/yr) in total phosphorus loading to the lake.

It is important to note that reducing phosphorus concentrations in the lake may not be sufficient to prevent cyanobacteria blooms, as external factors such as environmental variability can influence bloom dynamics. Additional data and continued evaluation of Northwood Lake's water quality response to environmental stressors are recommended to refine and, if necessary, adjust this water quality goal.

The goal of the Northwood Lake WMP is to improve water quality of that Northwood Lake such that the likelihood of harmful cyanobacteria blooms is reduced, assimilative capacity for total phosphorus is restored, and the lake's resiliency is increased moving into the future.

This goal will be achieved through the implementation of the following objectives. More detailed action items to achieve these objectives will be provided in the Action Plan as part of the WMP.

Objective 1

Reduce phosphorus loading from existing development by 5.7% (42.65 kg/yr) to Northwood Lake to decrease the predicted annual average total phosphorus concentration from 12.8 to 12.1 micrograms per liter.

Objective 2

Mitigate (prevent or offset) phosphorus loading from future development by a total of 105.6 kg/yr by 2036 to Northwood Lake to maintain the current predicted annual average total phosphorus concentration.

Reality Check

The watershed survey identified 52 sites impacting the lake. Remediating these sites could prevent up to 14.13 kg/yr of phosphorus from entering the lake. In addition, the shoreline survey identified 115 properties with medium to high shoreline disturbance scores. Treating these shoreline sites could reduce the phosphorus load to the lake by 20.82 kg/yr. Finally, upgrading the 77 shoreline septic systems older than 25 years is estimated to reduce the phosphorus load to the lake by 7.7 kg/yr.

In sum, treating existing pollutant sources identified as coming from the external watershed load could reduce the phosphorus load to Northwood Lake by 42.65 kg/yr, which meets 100% of

Objective 1. Non-structural stormwater control measures (SCMs) such as educating homeowners about residential stormwater management, fertilizer use, shoreline vegetated buffers, and septic system maintenance are essential tools for meeting Northwood Lake's water quality goals. These initiatives reduce phosphorus loading by preventing limiting nutrient runoff from lawns, and encouraging property-scale stormwater mitigation, and reducing undetected septic system failures.

Objective 2 may be achieved through town ordinance revisions that implement low impact development strategies and encourage cluster development, which helps protect forested space and maintains the watershed's natural character. Additionally, seeking opportunities to protect the vegetated shoreland zone and increase the conservation of forested areas can further safeguard the natural filtration processes that Northwood Lake relies on.

Establishing interim benchmarks for each water quality objective provides the necessary flexibility to reassess goals as new data becomes available and as development pressures evolve over the next decade (Table 10). By comparing modeled water quality trends against 'no-action' predictions, stakeholders can utilize an adaptive management approach to determine if current strategies are succeeding or falling short. This distinction is vital; for instance, if benchmarks are missed due to funding constraints rather than development outstripping mitigation efforts, the path for adjustment will differ. At each milestone, stakeholders should evaluate the latest water quality data alongside implementation progress, allowing them to recalibrate future benchmarks to reflect both environmental conditions and practical logistical limitations.

Table 10. Summary of interim benchmarks for tracking progress towards achieving the water quality objectives for Northwood Lake. Interim benchmarks are cumulative. kg/yr = kilograms per year.

Interim Goals / Benchmarks	2029	2032	2036
Objective 1 Reduce phosphorus loading from existing development by 5.7% (42.65 kg/yr) to Northwood Lake.	Achieve 1.4% (10.7 kg/yr) reduction in total phosphorus loading to Northwood Lake.	Achieve 2.9% (21.3 kg/yr) reduction in total phosphorus loading to Northwood Lake; re-evaluate water quality and track progress.	Achieve 5.7% (42.65 kg/yr) reduction in total phosphorus loading to Northwood Lake; re-evaluate water quality and track progress.
Objective 2 Mitigate (prevent or offset) phosphorus loading from future development by 105.6 kg/yr to Northwood Lake.	Prevent or offset 26.4 kg/yr in total phosphorus loading from new development to Northwood Lake.	Prevent or offset 52.8 kg/yr in total phosphorus loading from new development to Northwood Lake; re-evaluate water quality and track progress.	Prevent or offset 105.6 kg/yr in total phosphorus loading from new development to Northwood Lake; re-evaluate water quality and track progress.



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3 POLLUTANT SOURCE IDENTIFICATION

This section describes sources of excess phosphorus to Northwood Lake. Sources of phosphorus to lakes include stormwater runoff, shoreline erosion, construction activities, illicit connections such as sanitary pipes and sump pumps, failed or improperly functioning septic systems, boat discharges, fabric softeners and detergents in greywater, fertilizers, and animal waste from pets, livestock, and wildlife. These external sources of phosphorus to lakes can then circulate within them and settle on lake bottoms, contributing to internal phosphorus loads over time. Additional phosphorus sources can enter the lake from atmospheric deposition but are not addressed here because of limited local management options. Wildlife is mentioned as a potential source but largely for nuisance waterfowl such as geese or ducks that may be congregating in large groups because of human-related actions such as feeding or having easy shoreline access (i.e., lawns). More frequent and intense rainfall events with associated peaks in stormwater runoff is also not a direct source but can exacerbate the impact of the other phosphorus sources identified in this section and should be considered when striving to achieve the water quality objectives.

3.1 WATERSHED DEVELOPMENT

Nonpoint source pollution comes from many diffuse sources on the landscape and is more difficult to identify and control than point source pollution. Nonpoint source pollution can result from contaminants transported by overland runoff (e.g., runoff from suburban and rural areas and agricultural runoff), groundwater flow, or direct deposition of pollutants to receiving waters. Examples of nonpoint source pollution that can contribute nutrients to surface waters via runoff, groundwater, and direct deposition include erosion from disturbed ground or along roads, stormwater runoff from developed areas, malfunctioning septic systems, excessive fertilizer application, unmitigated agricultural activities, washing vehicles on driveways, pet waste, and wildlife waste.

3.1.1 Watershed Survey

Overview

FBE conducted a watershed survey in October 2025 to identify areas contributing to pollutant loads. Before fieldwork, input was gathered from NLWA, and aerial imagery and GIS data were analyzed to target likely problem sites such as unpaved roads, beaches, and impervious areas.

Fifty-two problem sites were identified, primarily involving road surfaces and shoulders (Figure 22; Figure 23). **Figure 23.** Map of NPS sites identified during the watershed survey.). Key findings from the survey are outlined below.

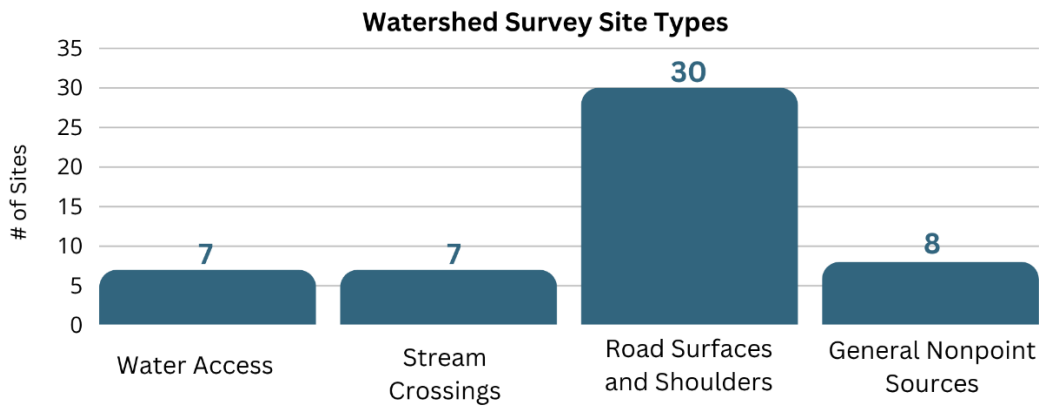


Figure 22. Watershed survey site types.

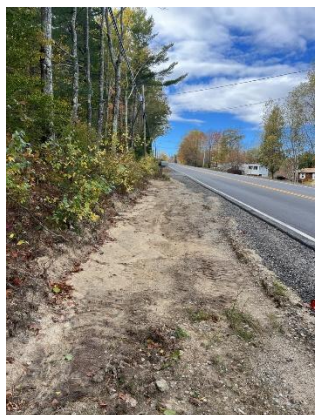
General Recommendations

The following recommendations were made for the watershed survey sites.



Regrade and Stabilize Unpaved Road Surfaces

Regrade, re-crown, or change road materials to hardpack gravel on unpaved roads and pathways to prevent tire rutting, stormwater scouring, and structural erosion.



Stabilize Eroded Road Shoulders and Banks

Use riprap, landscape fabric, netting, or engineered infiltration steps to lock down steep, exposed sandy embankments scoured by runoff.



Install Water Bars, Swales, or Berms

Construct formalized ditches, broad-based dips, rubber razors, swales, and water bars to redirect concentrated flow away from fragile roads and paths into vegetated buffers.



Clean and Maintain Drainage Culverts

Routinely clear out accumulated sediment, leaves, and debris from blocked or degrading culverts and catch basins, replacing damaged pipes where necessary to restore natural stormwater flow.



Install or Enhance Stormwater Basins and Infiltration Systems

Implement infiltration sumps, retention basins, rain gardens, or sediment forebays to capture, settle, and treat heavy stormwater inputs before they reach the lake.



Enhance Riparian Buffers, Vegetation, Community Outreach, and Public Education

Plant native shrubs and ground cover along shorelines and outlets to naturally filter surface runoff and stabilize loose soils.

Deploy educational signage and conduct targeted resident outreach focusing on pet waste management, waterfowl control, proper shoreline buffering, and overall lake health.

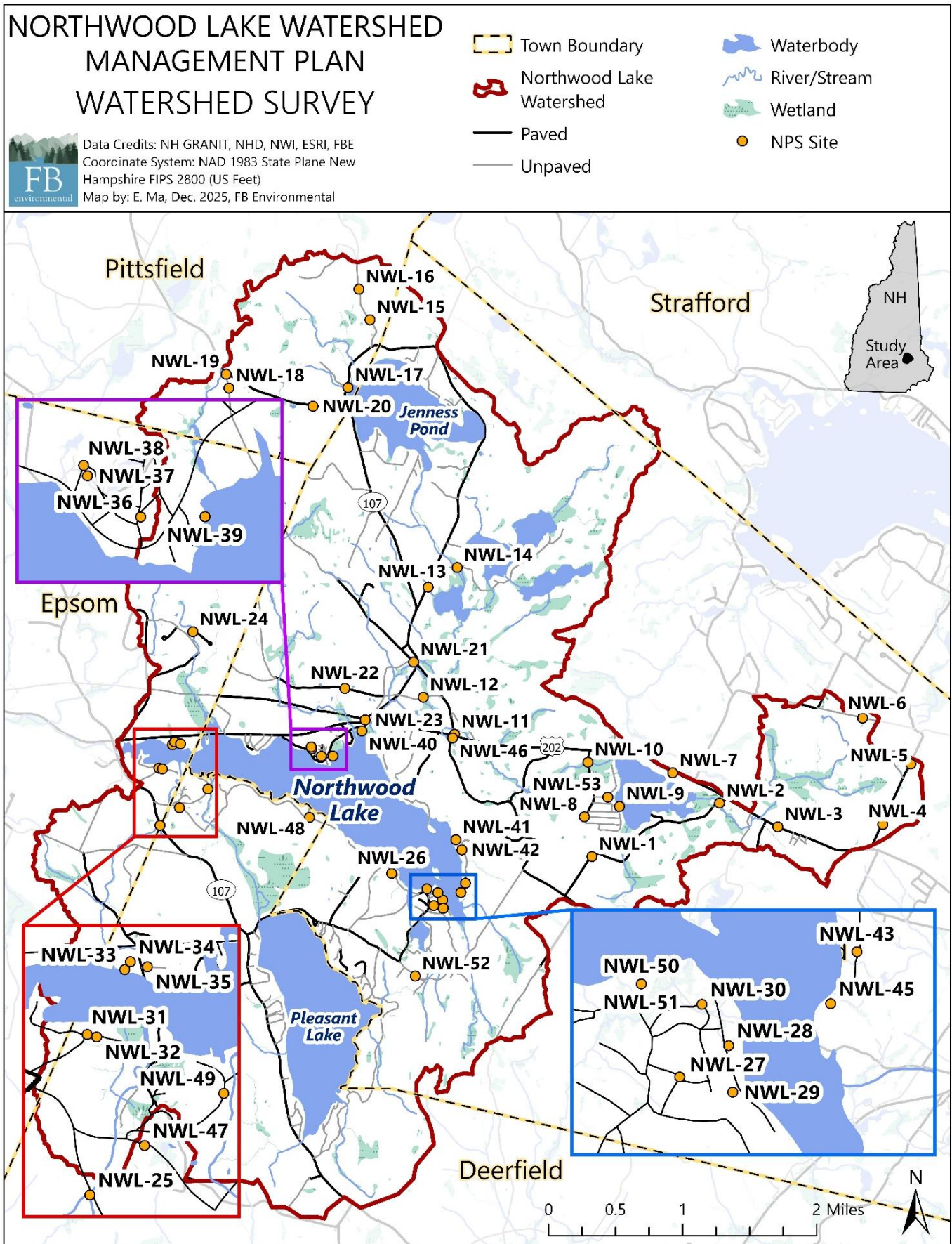


Figure 23. Map of NPS sites identified during the watershed survey.

Priority Sites

The six highest-priority sites, based on cost-effectiveness and phosphorus load reduction, are shown below. In addition, public and private road managers should apply best practices for installation and maintenance to protect water quality. More detail on these and other sites, including pollutant load reductions and cost estimates for all recommended fixes, are summarized in the *Northwood Lake Watershed Survey Memo* (FBE, 2026c)



Unpaved Frary Road.

Priority Site #1 NWL-27: Frary Road (Northwood)

Location (latitude, longitude): 43.2034, -71.2445 Impact: Low

Observations: Frary Road (unpaved) is known to wash out frequently with rain events, causing a loss of surface material. Frary Road was resurfaced earlier in 2025, and there is a small drainage ditch on the eastern side of the road behind the houses that leads to the lake.

Recommendations: To prevent future washouts, consider installing water bars across Frary Road to direct stormwater runoff into the adjacent forested area.



The upgradient side of the culvert showing the large, eroded basin.

Priority Site #2 NWL-29: Lagoon Road – Stream Crossing (Northwood)

Location (latitude, longitude): 43.2031, -71.2431 Impact: Moderate

Observations: A small, intermittent stream crossing was observed on Lagoon Road. The stream channel leads to a culvert underneath Lagoon Road. The inlet area to the culvert has a large area of eroded soil and exposed tree roots indicating stormwater flows may be large and fast during heavy amounts of precipitation. A local resident noted that during heavy flows, stormwater often overtops the road.

Recommendations: Begin by stabilizing the inlet side of the culvert with the exposed tree roots. Add large rip rap stones to stabilize the edges and base. Stabilize the outlet side with rip rap as well. Consider installing check dams in the flow path that leads to this culvert to slow the speed of stormwater and stream flow and promote infiltration along the way.



Road surface erosion on Lynn Lane leading to Northwood Lake.

Priority Site #3 NWL-26: Lynn Lane (Northwood)

Location (latitude, longitude): 43.2069, -71.2507 Impact: High

Observations: Moderately sized erosion gullies were observed on Lynn Lane, carrying sediment directly to Northwood Lake.

Recommendations: Stormwater control measures such as a broad-based dip or water bars may be used to divert stormwater to road shoulders and other designated areas for infiltration. Assess if there are open space areas downhill (possibly private property) to infiltrate stormwater and filter sediment and nutrients. Consider removing excess impervious cover downhill if needed to accommodate an area to infiltrate stormwater.



Griffin Brook lacks a riparian buffer on an agricultural property.

Priority Site #4 NWL-25: Griffin Brook at Route 107 (Epsom)

Location (latitude, longitude): 43.2122, -71.2849 Impact: High

Observations: Griffin Brook lacks an adequately wide and dense riparian vegetated buffer on a private agricultural land near its crossing with Route 107 and Ritchie Road. Much of the riparian buffer is mowed grass. Where there are shrubs, the buffer is only as wide as one plant.

Recommendations: Consider improving the buffer to 20-50 feet on each side of the stream to allow agricultural runoff to be intercepted and nutrients retained by the plants rather than entering Griffin Brook. Use native plants and shrubs as recommended in the [Native Shoreland/Riparian Buffer Plantings for New Hampshire guide](#) to stabilize the soil and decrease nutrient laden runoff from entering Griffin Brook.



Priority Site #5 NWL-38 Wildwood Ave to Lakeshore Drive (Northwood)

Location (latitude, longitude): 43.2206, -71.2625 Impact: Medium

Observations: Wildwood Ave and Park Ave are the two most used roadways into this neighborhood off Lakeshore Dr. Wildwood Ave is unpaved and comprised of a more gravelly substrate than Park Ave. Uphill stormwater issues at sites NWL-36 and NWL-37 are contributing to the erosion occurring on Wildwood Ave, which has evidence of sheet flow erosion and channelization. The road was created less than 10 years ago and has not been maintained since.

Recommendations: Work with residents in this neighborhood to establish a road maintenance committee. In conjunction with addressing recommendations for sites NWL-36 and NWL-37, consider installing rubber razors across Maple Ln to direct stormwater flow into the vegetated area to the west.



Photos of Wildwood Ave (unpaved) from the intersection with Maple Ave to the intersection with Lakeshore Dr. (paved).



View of the beach area facing the entrance gates.

Priority Site #6 NWL-39: Northwood Town Beach (Northwood)

Location (latitude, longitude): 43.2196, -71.2593 Impact: High

Observations: Northwood Town Beach is enjoyed by many during the summer months and is used as an access point for activities on the ice in the winter. Members of the community noted that although dogs are not allowed, many are brought to the beach and pet waste has been an ongoing problem in addition to general trash disposal. Additionally, geese regularly congregate within this cove and likely influence the bacteria concentrations



View of the beach area as it slopes to the water's edge.



Side view of the sloping area to the shoreline.



Erosion gullies were observed between the beach area and the water's edge.

within the cove. The beach hosts a portable toilet in the summer which helps protect the lake, though not for 2026. The beach area is a large relatively flat plot of land that is mostly comprised of sand with scattered weeds and grass. The area adjacent to the lake slopes downward to the water and erosion gullies were observed through the sand.

Recommendations: Define pathways across high-traffic areas from the entrance gates using steppingstones spaced apart or interlocking permeable grid pavers. Observe the beach during heavy rainfall to note where flow paths are being created, then regrade the area as needed to divert stormwater flow into a rain garden or vegetated swale rather than continuing across the surface to the water. Reestablish vegetation (native grass, shrubs, groundcover) in all sandy areas that are not used for sand play. Install geese deterrents and revegetate the shoreline to the sides of the primary access point, as geese are less likely to congregate when their line of access between the water and shore is obstructed. To further address localized bacterial and phosphorus loading from the resident flock, specific management steps should include planting tall (24–30 inch) native shoreline buffers, installing low-profile temporary perimeter wire during summer molting periods, enforcing "Do Not Feed Waterfowl" signage, and letting turf grass grow taller near the water's edge to reduce attractive grazing habitat. This beach would also be an excellent location for a pollinator garden and educational signs about lake health.

3.1.2 Shoreline Survey

In September of 2025, FBE and volunteers through the NLWA conducted a shoreline survey of Northwood Lake. The condition of the shoreline was documented for each parcel using a scoring system that evaluates the vegetated buffer, presence of bare soil, extent of shoreline erosion, distance of structures to the lake, and slope. Scores were combined into a Shoreline Disturbance Score and a Shoreline Vulnerability Score, with higher values indicating poorer or more 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 in mid-summer every five years to evaluate changing conditions.

A total of 274 parcels were evaluated along the shoreline of Northwood Lake. The average Shoreline Disturbance Score for the lake is 6.1, with 42% of parcels (115) scoring 7 or higher, indicating potentially detrimental shoreline conditions such as inadequate buffers, exposed soil, and erosion. The average Shoreline Vulnerability Score was 3.6, with 71% of parcels (194) scoring 4 or higher, indicating most homes were built within 150 ft of the shoreline on moderate to steep slopes, which are more prone to erosion regardless of buffer quality (Table 11, Figure 24).

Table 11. Average scores for each evaluated condition criterion and the average Shoreline Disturbance Score and average Shoreline Vulnerability Score for Northwood Lake. Lower values indicate shoreline conditions that are effective at reducing erosion and keeping excess nutrients out of the lake.

Score Type	Evaluated Condition	Average Condition	Score Type Sum
Shoreline Disturbance Score (3-12)	Buffer (1-5)	3.6	6.1
	Bare Soil (1-4)	1.4	
	Shoreline Erosion (1-3)	1.1	
Shoreline Vulnerability Score (1-6)	Distance (0-3)	2.2	3.6
	Slope (1-3)	1.4	

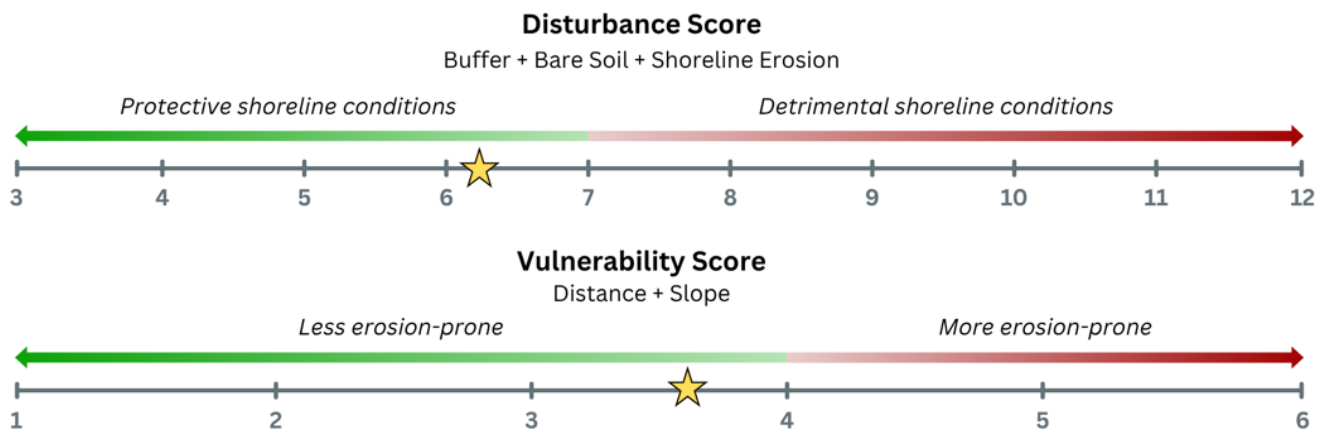


Figure 24. Northwood Lake shoreline survey disturbance and vulnerability scores.

Pollutant loading estimates are based on Shoreline Disturbance Scores. The 115 parcels with scores of 7–11 contribute an estimated 41.64 kilograms of phosphorus annually. Implementing SCMs at 50% efficiency on these properties could reduce phosphorus by 20.82 kilograms per year.

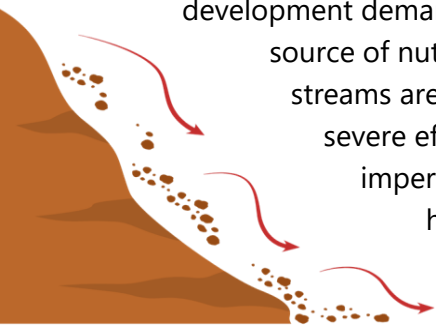
Some site characteristics, such as slope, naturally increase erosion risk, while others, such as the distance of structures from the lake, reflect historic development and are difficult to change. Shoreline buffers and exposed soil are more easily modified to improve shoreline resilience.

Overall, the lake's shoreline conditions are good (average disturbance score of less than 7). However, 42% of parcels (115) need runoff and erosion management. Many homes are close to shore on moderate to steep slopes, increasing erosion potential. Scores should guide remediation priorities, with recommendations focusing on establishing or maintaining vegetated buffers to reduce erosion and phosphorus and sediment inputs to the lake.

3.1.3 Soil and Shoreline Erosion

Erosion can occur when the ground or shoreline is disturbed by digging, construction, plowing, foot or vehicle traffic, or wildlife. Rain and associated runoff are the primary pathways by which eroded soil reaches lakes and streams. Once in surface waters, nutrients are released from the soil particles into the water column, causing excess nutrient loading to surface waters. This is termed cultural eutrophication, where accelerated lake aging is caused by human activities and stressors in the watershed. Since

development demand near lakes is high, construction activities in lake watersheds can be a large source of nutrients. Unpaved roads and trails used by motorized vehicles near lakes and streams are especially vulnerable to erosion. Stream bank erosion can also have a rapid and severe effect on lake water quality and can be triggered or worsened by upstream impervious surfaces like buildings, parking lots, and roads which send large amounts of high velocity runoff to surface waters. Maintaining natural vegetative buffers around lakes and streams and employing strict erosion and sedimentation controls for construction can minimize these effects.



3.1.3.1 Surficial Geology

The soils and rocks in the area tell a story millions of years in the making. Between 300–400 million years ago, the northeastern U.S. was covered by a shallow sea, leaving sedimentary layers of shale, sandstone, and limestone (Goldthwait, Goldthwait, & Goldthwait, 1951). Over time, the Earth's crust folded under high heat and pressure to change the sedimentary rocks into metamorphic rocks (quartzite, schist, and gneiss parent material). This metamorphic parent material has since been modified by bursts of molten material intrusions to form igneous rock, including granite for which New Hampshire is famous (Goldthwait, Goldthwait, & Goldthwait, 1951). Erosion has further modified and shaped this parent material over the last 200 million years.

The current landscape formed 12,000 years ago at the end of the Great Ice Age, as the mile-thick glacier over half of North America melted and retreated, scouring bedrock and depositing glacial till to create the deeply scoured basin of the region's lakes. The retreating action also eroded mountains and left behind remnants of drumlins and eskers from ancient stream deposits. The glacier deposited a layer of glacial till more than three feet deep. Glacial till is composed of unsorted material, with particle sizes

ranging from loose and sandy to compact silts and gravels. This material laid the foundation for vegetation and streams as the depression basins throughout the region began to fill with water (Goldthwait, Goldthwait, & Goldthwait, 1951).

According to the USGS Statewide Aquifer Transmissivity data layer provided through the NH Geographically Referenced Analysis and Information Transfer System, 516 acres (3%) of the Northwood Lake watershed is mapped as having high-yielding aquifers. This area spans between Pleasant Lake and Voydatch Pond, and beneath the Pleasant Lake outlet stream.

3.1.3.2 Soils and Erosion Hazard

The Northwood Lake watershed is composed of 12 different soil textures (excluding soils beneath waterbodies), with the five most prevalent being the following:

- 1** Slightly decomposed plant material (55.1% of watershed area).
- 2** Moderately decomposed plant material (20.0%).
- 3** Fine sandy loam (12.8%).
- 4** Mucky peat (7.1%).
- 5** Very fine sandy loam (2.8%).

All other soil texture each compose less than 1% of the watershed area. Most of the soil in the Northwood watershed has a high organic content (Figure 25). Because these organic soils naturally store large amounts of phosphorus and nitrogen, even undisturbed runoff carries a high baseline nutrient load into Northwood Lake. This natural background level makes the lake inherently sensitive, meaning any additional nutrient inputs from human activity or disturbance can easily tip the system toward excessive nutrient loading.

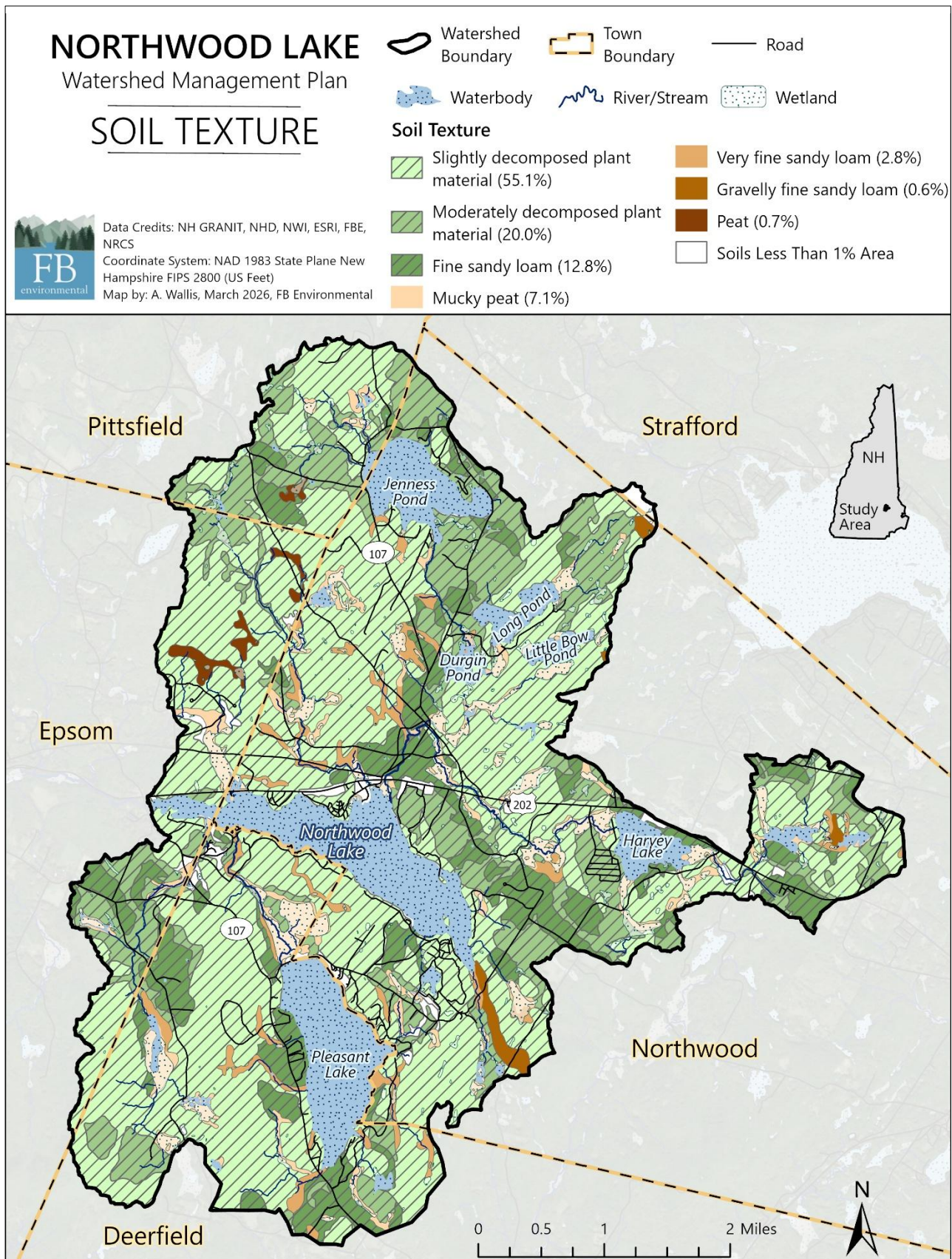


Figure 25. Soil texture as mapped by Natural Resources Conservation Service for the Northwood Lake watershed.

Soil erosion hazard is dependent on a combination of factors, including land slope, weather, soil texture, soil composition, permeability, and soil structure (O'Geen, Elkins, & Lewis, 2006). Soil erosion hazard should be a primary factor in determining the rate and placement of development within a watershed. Soils with negligible soil erosion hazard are primarily low-lying wetland areas near abutting streams. By contrast, steeper slopes tend to have a higher proclivity to erosion.

Soil erosion hazard is identified by four ratings within United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) soils data:

1. **Slight** – erosion is unlikely to occur under standard conditions.
2. **Moderate** – some erosion is likely and erosion-control measures may be required.
3. **Severe** – erosion is very likely and erosion-control measures and revegetation efforts are crucial.
4. **Very Severe** – significant erosion is likely, and control measures may be costly.

Erosion hazard throughout the watershed is 20% slight, 77% moderate, 0.9% severe, and 0.3% very severe. The remaining 2% is not rated (Figure 26; Figure 27).

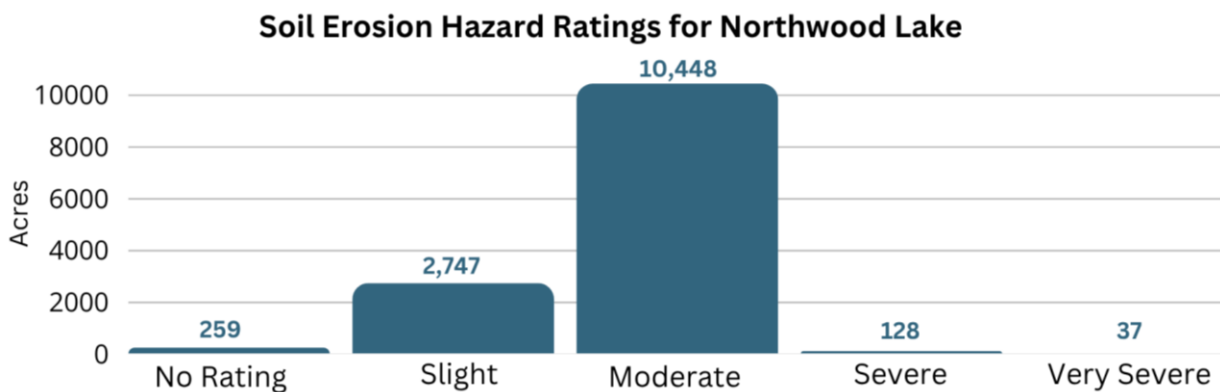


Figure 26. Soil erosion hazard ratings for the Northwood Lake watershed based on Natural Resources Conservation Service soil maps.

Development should be restricted in areas with severe and very severe erosion hazards due to their inherent tendency to erode at a greater rate than what is considered tolerable soil loss. Since a highly erodible soil can have a greater negative impact on water quality, more effort and investment are required to maintain its stability and function within the landscape, particularly with SCMs that protect steep slopes from development and prevent stormwater runoff from reaching water resources.

3.1.3.3 Shoreline Erosion

Lake levels naturally fluctuate over both short and long timescales due to environmental changes, precipitation patterns, and human activity. Rapid or repeated changes in water level can physically erode shorelines, wash away vegetation, and release nutrients like phosphorus from inundated soils, which can fuel algal blooms and reduce water clarity (Leira & Cantonati, 2008; Zohary & Ostrovsky, 2011). These fluctuations also impact habitat availability for fish, amphibians, and other wildlife, alter nesting locations, and change the distribution of food sources.

Some properties along Northwood Lake's shoreline are particularly vulnerable to shoreline erosion because the homes are close to the water's edge and sit on moderate to steep slopes. The impacts are compounded by human activity such as boating, shoreline modification, and storms or droughts that alter water levels rapidly. Managed by a dam at its outlet, Northwood Lake undergoes an annual fall drawdown that serves several important purposes. Lowering the water creates exciting white-water conditions for paddlers downstream on the Little Suncook River while creating vital storage space to absorb heavy spring snowmelt. Just as importantly, it exposes variable milfoil to the air to dry out, and safeguards shoreline properties from winter ice damage. By pulling the water away from the banks, ice sheets are prevented from gripping the shore or pressing against the land, eliminating the severe shoreline erosion caused by winter freeze-thaw cycles.

Frequent shoreline disturbance can create a cycle of erosion, where exposed soil leads to more sediment runoff during storms, which then further destabilizes the shoreline. Maintaining or restoring vegetated buffers is critical, as plants stabilize soil, absorb runoff, and trap sediment before it reaches the lake. Other management strategies include minimizing impervious surfaces near the shoreline, constructing stabilized access points for boats, and implementing green infrastructure measures such as swales or rain gardens to capture and slow runoff before it reaches the water. Together, these measures help protect water quality, preserve habitat, and maintain recreational opportunities on the lake.

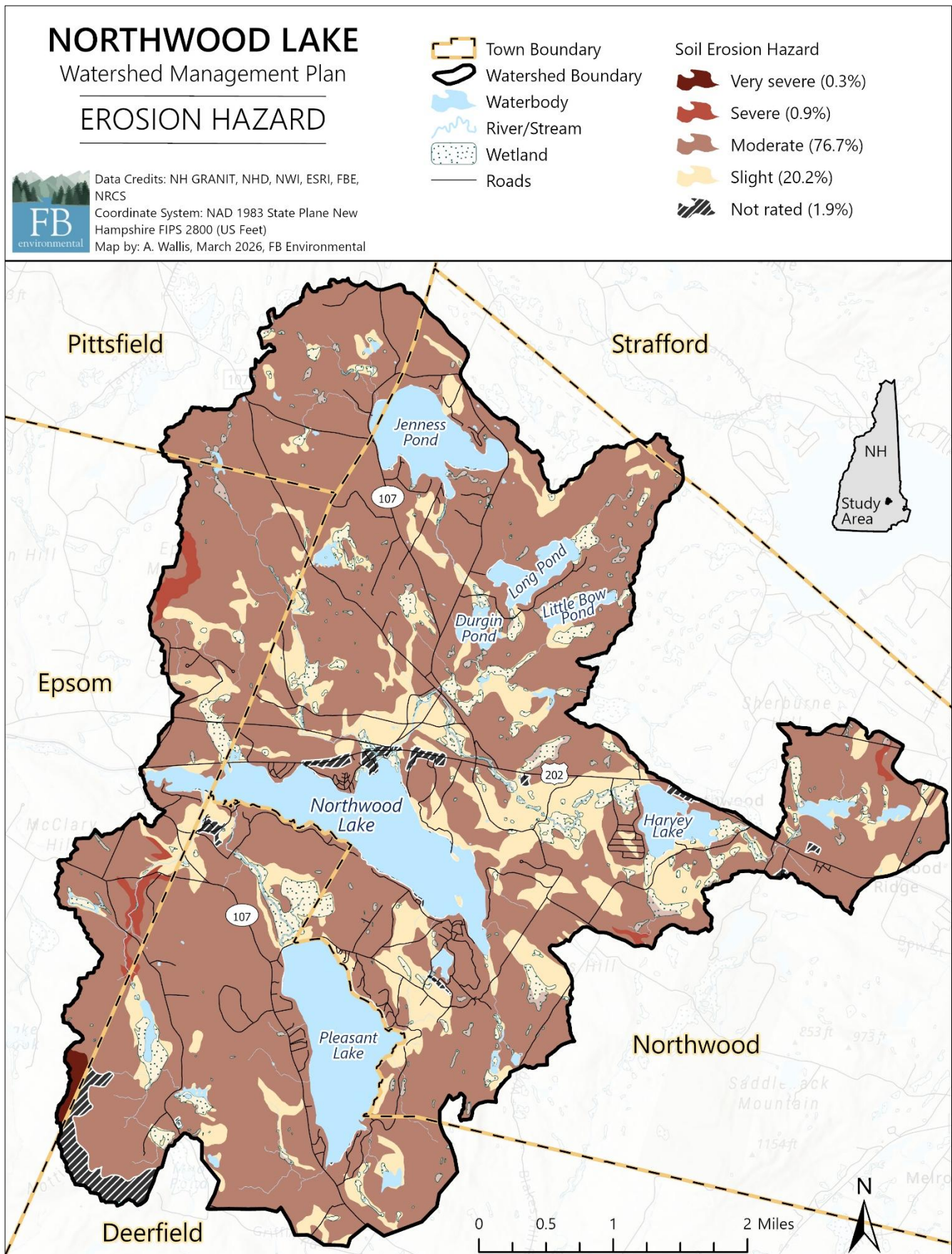
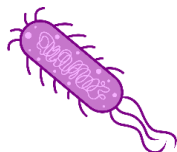


Figure 27. Soil erosion hazard in the Northwood Lake watershed.

3.1.4 Wastewater

3.1.4.1 Septic Systems

All houses in the Northwood Lake watershed treat wastewater with on-site septic systems. Septic systems take wastewater from the house, filter out the solids in the septic tank, then discharge the effluent through the leachfield for natural filtration of pollutants such as pathogens, nitrogen, and phosphorus in the soil. When properly designed, installed, operated, and maintained, septic systems reduce pollutants to varying degrees of effectiveness.



Pathogens in wastewater include bacteria, viruses, protozoa, and parasites. Their presence is most often determined by measuring fecal indicator bacteria (*Enterococcus* or *E. coli*), though viruses and other types of bacteria can persist for longer in soil. Pathogens are treated in the leachfield primarily through adsorption to soil particles; poor pathogen treatment can occur in systems which are shallow to groundwater or coarse soils with preferential flow pathways such as macropores or fractured bedrock.



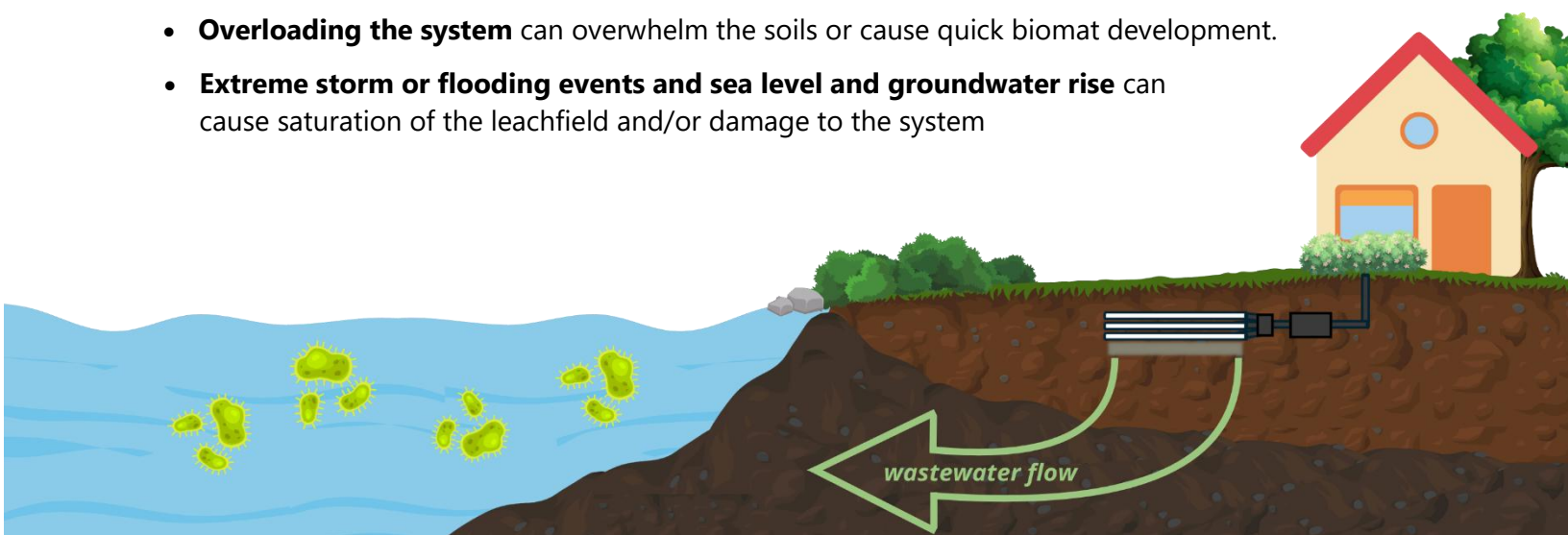
Nitrogen in wastewater can be removed into gaseous form through denitrification. Native soils beneath the leachfield are not effective at removing nitrogen (typically <40% removal), though additional denitrification can occur in groundwater, especially if anoxic conditions exist. Advanced septic systems technologies exist to remove nitrogen before wastewater enters the leachfield.



Phosphorus in wastewater can be almost entirely retained (>90% removal) in suitable soil conditions by adsorbing to soil particles or forming solid compounds with iron, aluminum, and calcium. Retention can be poor in systems shallow to groundwater or bedrock, soils with preferential flow pathways such as fractured bedrock, and high alkalinity soils low in iron and aluminum.

Failing or malfunctioning septic systems can release pollutants directly into surface waters. When a septic system fails, it may break out onto the leachfield surface (ponding), which can run off the property via a flow channel or during storms. Septic system failure can occur in several ways.

- **Old age** can cause the biomat, a layer of organic material that forms beneath the leach field, to become too thick and block flow, which then causes wastewater to pond on the surface.
- **Poor maintenance** can lead to clogging and system back up.
- **Overloading the system** can overwhelm the soils or cause quick biomat development.
- **Extreme storm or flooding events and sea level and groundwater rise** can cause saturation of the leachfield and/or damage to the system



Regular septic tank pumping is essential for maintaining system functionality and protecting the surrounding environment. Components like distribution boxes and lateral lines should also be regularly inspected and maintained as needed. Over time, solid waste accumulates, increasing the risk of blockages, backups, and system failure. Sludge and scum buildup can hinder waste breakdown, leading to odors and potential contamination of soil and groundwater. Distribution boxes may clog or become unlevel, causing localized overloading of the leach field. Routine maintenance helps prevent costly repairs, extends system lifespan, and ensures effective wastewater management while safeguarding public health and the environment.

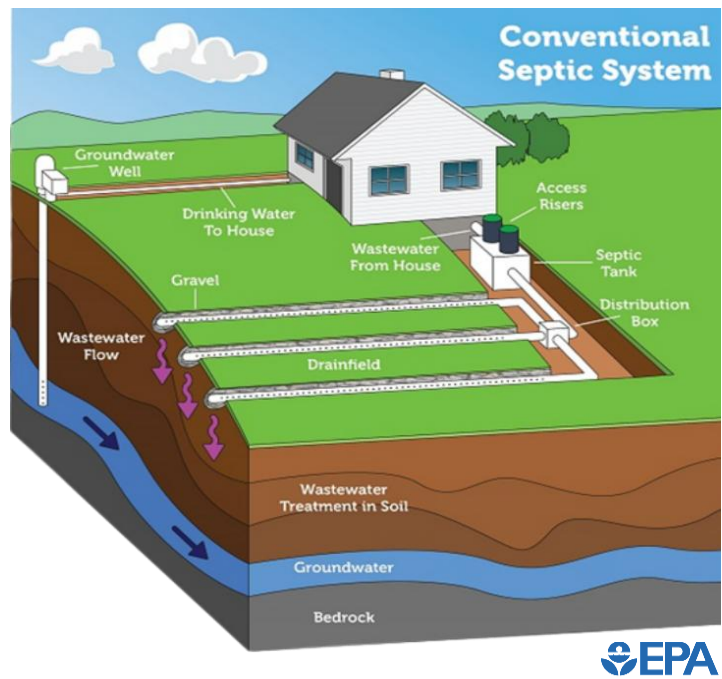


Diagram of a septic system and the wastewater flow through the ground to reach surface waters.

In 2024, [RSA 485 A:39](#) was updated to change the requirements for septic systems assessments during real estate transactions of waterfront properties. This change went into effect on September 1, 2024, and shifts the responsibility of septic inspection from the sellers to the buyers. If any part of the septic system lies within 250 feet of lakes, ponds greater than ten acres, coastal waters, or major rivers, the buyer must ensure a septic system inspection is complete prior to property transfer. The change was introduced in response to increasing cyanobacteria outbreaks in the state, with the goal of reducing phosphorus runoff from failing systems. If a septic system is deemed to be failing, it must be repaired or replaced within 180 days of the property transfer, with costs negotiated between the buyer and seller.

In Northwood, septic systems within 250 feet of shorelines must be pumped every 3-5 years and property owners must provide evidence of pumping to the town upon request. The regulation also mandates that septic systems that do not have an NHDES approval on record must have a written evaluation completed to verify that the system is not failing or polluting the waterbody.

Septic systems must have a 100-foot setback from waterbodies, except on dimensionally nonconforming lots on which septic systems have a required 75-foot setback from surface waters. For more information, see Section 4.2.2, Table 12. Prior to and during development of this watershed plan, information on septic system practices was gathered from properties within 300 feet of the Northwood Lake shoreline using a Google Form survey. The questionnaire was distributed by a student with Unity Environmental University and included information about type of system, age of system, pumping frequency, property use (year-round or seasonal), number of occupants, and distance to the waterbody (O'Donnell, 2024). The Google Form was supplemented with a mailed paper version of the questionnaire. Of the estimated 225 properties with septic systems, 128 septic surveys were completed. Results indicated that 83% of homes along the shoreline have traditional septic systems, 14% have holding tanks, and the remaining 3% use outdated technologies (O'Donnell, 2024). There were 32% of respondents that have a system installed

within the past ten years, 27% of respondents have systems between 11 and 24 years old, and 17% have old (>25 years old) systems. Notably, 24% of respondents did not know the age of their septic system. Septic systems older than 25 years old and those where the age is unknown may need attention and, unknowingly, may be contributing excess phosphorus to a nearby stream or lake. FBE extrapolated the results of the septic system survey to all estimated 225 shoreline properties with septic systems and estimated that there are 77 systems over 25 years old. See section 4.2.4 for septic system management strategies.

3.1.5 Fertilizers

When lawn and garden fertilizers are applied in excessive amounts, in the wrong season, or just before heavy precipitation, they can be transported by rain or snowmelt runoff to lakes and other surface waters where they can promote cultural eutrophication and impair the recreational and aquatic life uses of the waterbody. Many states and local communities are beginning to set restrictions on the use of fertilizers by prohibiting their use altogether or requiring soil tests to demonstrate a need for any phosphate application to lawns. See section 0 for fertilizer management strategies.

3.1.6 Agriculture



Stormwater runoff can pick up farm animal waste from sources such as manure and silage storage facilities and livestock grazing and barnyard areas and carry bacteria and nutrients to waterways. Farm activities like plowing, livestock grazing, vegetation clearing, and vehicle traffic can also result in soil erosion and associated nutrient pollution through direct or indirect contact with surface waters.

Excessive or ill-timed fertilizer application or poor storage increases the potential for these nutrients and bacteria to wash away with precipitation, reducing both water quality and crop benefits. The key to fertilizer application is to apply the right type and amount at the right time. When used appropriately, synthetic fertilizers or animal manure can fertilize crops, restore nutrients to the land, and minimize pollution. When improperly managed, pollutants can easily enter waterways.

Agriculture in the Northwood Lake watershed primarily includes cropland, hayfields, and grazing areas. The LLRM results showed that agriculture covers 4% of the watershed and contributes 16% of the total phosphorus load from land uses (Figure 15). See section 4.2.6 for agricultural management strategies.

3.1.7 Pets

Fecal matter from pets can be a significant contributor of bacteria and nutrients to surface waters.



Dogs are estimated to produce 200 grams of feces per day each, which contain concentrated amounts of bacteria estimated at 4.6 billion fecal coliform bacteria (Van der Wel, 1995). Phosphorus comprises an estimated 3.2% of dog waste by weight.



Cats can also contaminate surface waters. A 2007 study detected cat-sourced *E. coli* in stormwater (Ram, et al., 2007). Phosphorus comprises an estimated 2.0% of cat waste by weight.

If pet feces are not properly disposed of (e.g., dog waste left outside or cat litter dumped outside), these bacteria and nutrients can be washed off the land and transported to surface waters by stormwater runoff. Pet feces can also enter surface waters by direct deposition of fecal matter from pets standing or swimming in surface waters. See section 4.2.7 for pet waste management strategies.

3.1.8 Future Development

Understanding population growth, and ultimately development patterns, provides critical insight into watershed management, particularly as it pertains to lake water quality. The population in Northwood has increased by an estimated 3,115 residents from 1970 to 2020, a 2.25% CAGR (Figure 28). All four other watershed towns, Deerfield, Epsom, Pittsfield, and Strafford, have followed a similar trajectory.

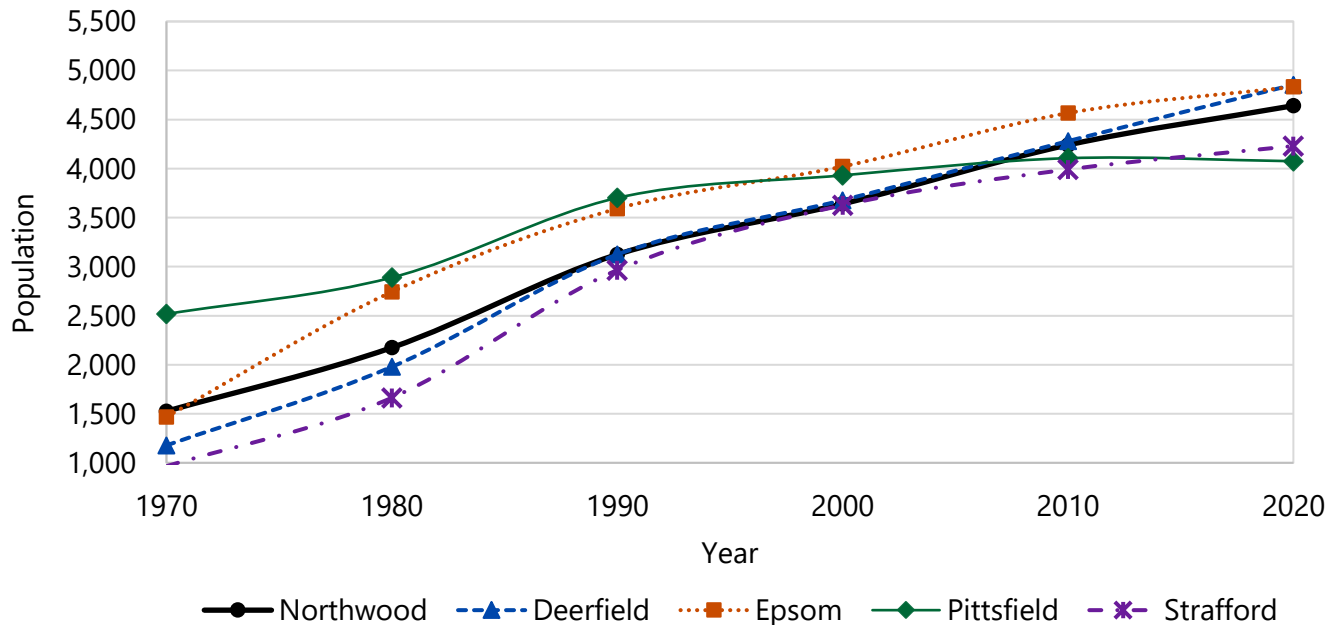


Figure 28. Population of watershed towns. Data from the U.S. Census Bureau.

The Northwood Lake area has long been treasured as a recreational haven for both seasonal visitors and year-round residents. Located less than an hour from the seacoast in New Hampshire, the lake offers fishing, boating, sailing, canoeing, kayaking, and swimming during the summer, as well as ice fishing, snowshoeing, and snowmobiling throughout the winter. The natural appeal of Northwood Lake and its

surrounding communities will likely drive continued population growth in the coming years. Regional growth projections suggest that all five watershed towns must proactively manage the impacts of municipal land use, particularly impervious cover limits, to protect local water resources. As development expands across the watershed, increased runoff and water temperatures from hardened surfaces and erosion from disturbed land pose an ongoing threat to Northwood Lake's water quality.

3.2 POTENTIAL CONTAMINATION SOURCES

Point source pollution can be traced back to a specific source such as a discharge pipe from an industrial facility, municipal wastewater treatment plant, or a permitted stormwater outfall, making this type of pollution relatively easy to identify and reduce. Section 402 of the Clean Water Act requires all such discharges to be regulated under the National Pollutant Discharge Elimination System program to control the type and quantity of pollutants discharged. National Pollutant Discharge Elimination System is the national program for regulating point sources through issuance of permit limitations or conditions specifying monitoring, reporting, and other requirements under Sections 307, 318, 402, and 405 of the Clean Water Act.

NHDES operates and maintains the OneStop database and data mapper, which house data on potential contamination sources within the State of New Hampshire. Identifying the types and locations of potential contamination sources within the watershed may help identify sources of pollution and areas to target for restoration efforts.

Based on this database, potential point sources in the watershed include above and underground storage tanks, solid waste facilities, hazardous waste sites, local potential contamination sources, air facilities, and remediation sites (Figure 29).

3.2.1 Above and Underground Storage Tanks

Above and underground storage tanks include permitted containers with oil and hazardous substances such as motor fuels, heating oils, lubricating oils, and other petroleum and petroleum-contaminated liquids. There are four aboveground storage tanks within the Northwood Lake watershed, all within the Town of Northwood. Two are located along the First NH Turnpike, one on Route 107, and one on Route 4. There are 19 underground storage tanks within the Northwood Lake watershed, one located in Epsom and the rest in Northwood. Fourteen of these underground storage tanks are located along the First NH Turnpike. Seven are associated with gas stations, four with the Coe Brown Northwood Academy, two with NH DOT, and the rest are assorted. Ownership of the underground storage tanks across the watershed includes commercial industries, gas stations, schools, state government, contractors, residences, and farms.

3.2.2 Solid Waste Facilities

There is one solid waste facility within the Northwood Lake watershed, which is located on Old Dump Road. This is the former Northwood municipal landfill and septage lagoon site, which is unlined and no longer operational.

3.2.3 Hazardous Waste Sites

Hazardous waste generating facilities are identified through the EPA's Resource Conservation and Recovery Act (RCRA) and require federal or state regulation. Only one of the 14 hazardous waste generating facilities within the Northwood Lake watershed is listed as active; the remaining facilities are classified as either inactive (eight), declassified (four), or no data (one).

3.2.4 Local Potential Contamination Sources

Local potential contamination sources are sites that may represent a hazard to drinking water quality supplies due to the use, handling, or storage of hazardous substances. There may be overlap between local potential contamination sources and other potential contamination sources identified in this section. Of the eight local potential contamination sources within the Northwood Lake watershed, six are located along the First NH Turnpike and the remaining two are along Route 4.

3.2.5 Automobile Salvage Yards

There are two automobile salvage yards in the Northwood Lake watershed, one along Route 4 and one on the First NH Turnpike. Both are currently active.

3.2.6 Remediation Sites

The 63 remediation sites present within the Northwood Lake watershed include formerly leaking underground storage tanks, sites with chlorinated solvents and other non-petroleum hazardous waste, ether contamination sites, non-hazardous and non-sanitary holding tanks, initial spill response sites, historical dump sites, former residential or commercial heating oil releases, oil or hazardous material spill and release sites, septage lagoons, underground injection control wastewater disposal systems, wastewater treatment facilities, vehicle-related contamination sites, non-drinking water program sites, or sites evaluated for potential environmental contamination.

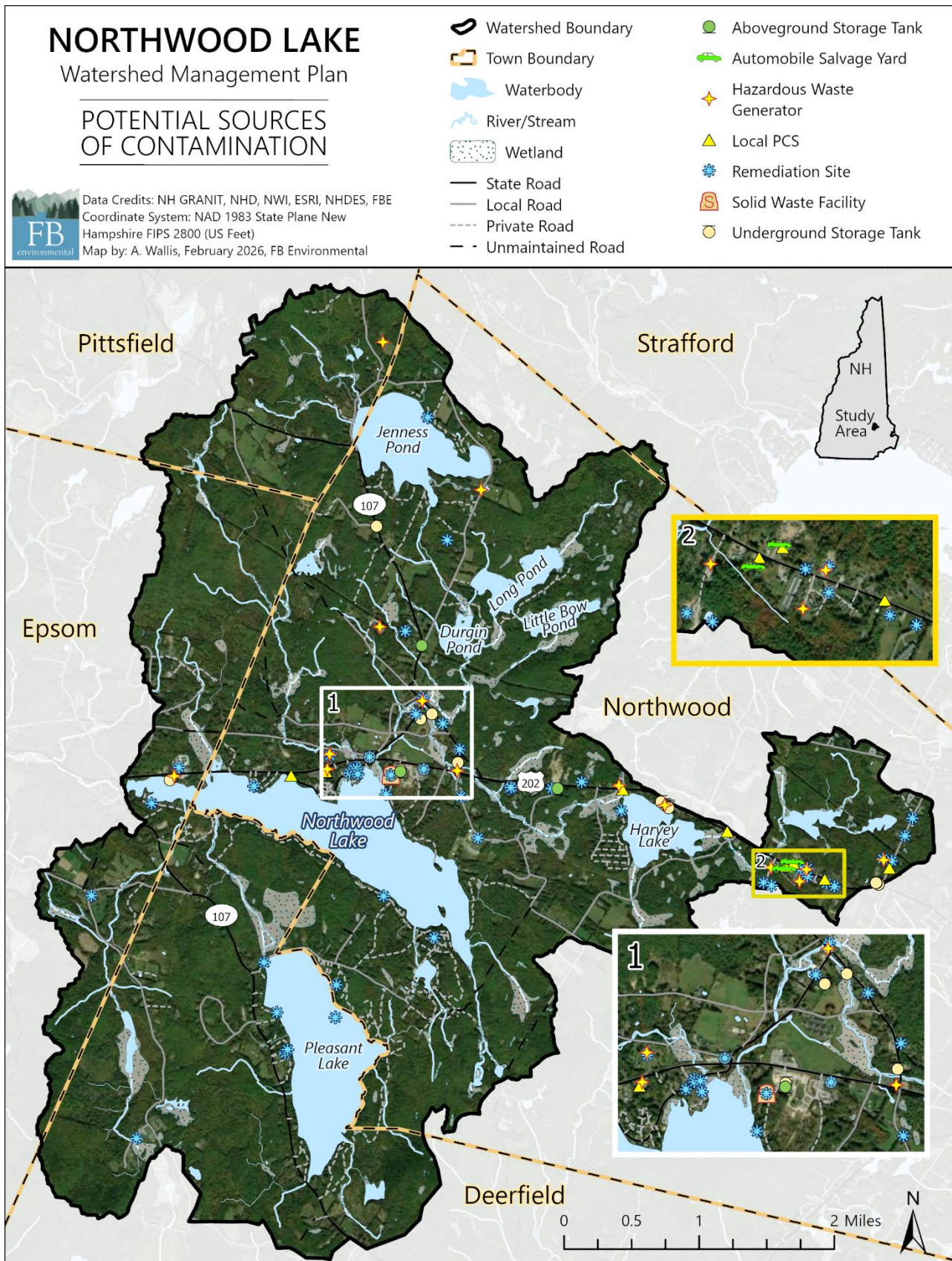


Figure 29. Potential contamination sources in the Northwood Lake watershed.

3.3 WILDLIFE

Fecal matter from wildlife such as geese, gulls, ducks, and beaver may be a significant source of nutrients in some watersheds. This is particularly true when human activities, including the direct and indirect feeding of wildlife and habitat modification, result in the congregation of wildlife (CWP, 1999).



Geese, gulls, and ducks are of particular concern because they often deposit feces near or directly into surface waters. High-risk areas include large, mowed fields and parking lots adjacent to lakes and streams, as well as the undersides of bridges with pipes or joists that attract pigeons and other birds. Congregations of geese have regularly been seen at the Northwood Town Beach and in the cove between the town beach and the State boat ramp. This area corresponds with two water quality (bacteria) sampling locations that often exceed the state thresholds. Refer to section 2.1.11 for more information on water quality data.

Studies show that geese inhabiting riparian areas increase soil nitrogen availability (Choi, et al., 2020). When submerged in water, the droppings from geese and gulls quickly release nitrogen and phosphorus into the water column, contributing to eutrophication in freshwater ecosystems (Mariash, Rautio, Mallory, & Smith, 2019). The LLRM estimates that waterfowl are likely contributing 16.0 kg/yr or 2% of the total phosphorus load to Northwood Lake.

Similarly, beaver impoundments can increase concentrations of bacteria, nitrogen, ammonia, and dissolved organic carbon downstream compared to streams without beaver activity in New England (Bledzki, Bubier, Moulton, & Kyker-Snowman, 2010).

3.4 REGIONAL TEMPERATURE AND PRECIPITATION TRENDS

Over the last century, New England's air temperature has risen faster than the rest of the continental U.S., making it one of the fastest warming regions in the world (Karmalkar & Horton, 2021). Comparing the period of 1900–1904 to 2020–2024, New England's mean annual temperature rose by 2.5°C, with an even more pronounced increase of 4.1°C during the winter months (Young & Young, 2025). The IPCC (2021) projects with high confidence that these temperature trends will continue through the end of the century, fundamentally changing New England's hydrologic processes (Scholl, McCabe, Olson, & Powlen, 2025).

Changes in Ice and Snow Dynamics

Rising winter temperatures are significantly shortening the "ice-in" duration for New England lakes. Compared to the 1800s, lakes are freezing later and thawing earlier as a warming atmosphere accelerates snowpack and ice melt (Scholl, McCabe, Olson, & Powlen, 2025). This earlier "ice-out" date extends the biological growing season, which can increase the duration of anoxia in bottom waters. Within the

available dataset, 2017–2025, Northwood Lake experienced its earliest ice-out in 2024 (Figure 30). Additionally, Hill et al. (2014) projected U.S. stream temperatures to rise by 0.6°C ($\pm 0.3^{\circ}\text{C}$) per 1°C increase in local air temperature, although the exact increase depends on cool groundwater influence, the presence of impoundments, stream flow, and level of urbanization (Letcher, et al., 2016). Warmer streams will experience reduced dissolved oxygen levels and increased biological activity.

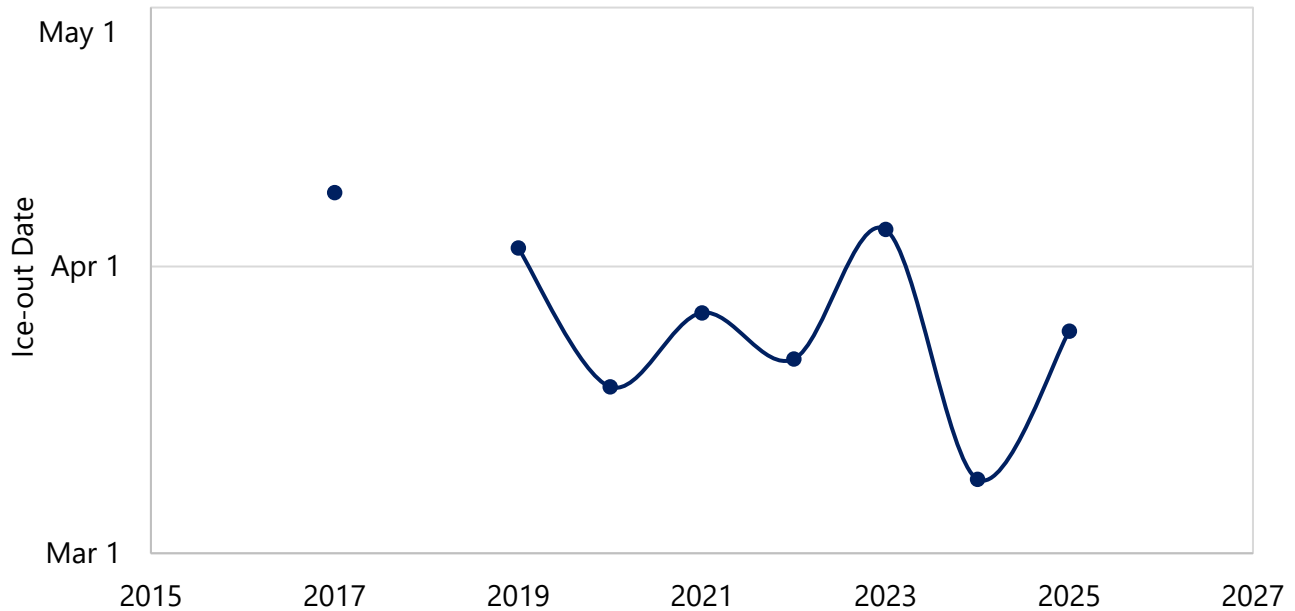
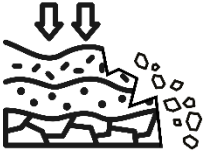


Figure 30. Ice out dates for Northwood Lake from 2017 through 2025.

Snow cover is also in sharp decline. When comparing 2000–2004 to 2020–2024, snow cover days decreased by 30–40% in southern New England and by 10–15% in northern New England (Young & Young, 2025). Along with higher winter air temperatures, reductions in snow cover are also driven by a shift in winter precipitation, with more moisture falling as rain rather than snow (IPCC, 2021; Scholl, McCabe, Olson, & Powlen, 2025). Research indicates a 20-day increase over the past century in winter days with bare ground and above-freezing daytime temperatures (Contosta, et al., 2019). Timber harvesting and heavy equipment operations frequently rely on frozen ground to protect vegetation, roots, and wet soils from compaction and erosion (Rittenhouse & Rissman, 2015; Toot, et al., 2025). Conducting logging operations during these warm intervals can damage soil structure and root systems, leaving them highly vulnerable to erosion during the spring thaw and snowmelt.

An additional consequence of this warming is the increased frequency of rain-on-snow events. Data from the Mount Washington Observatory (2023) and recent observations across New Hampshire (Aldrich, 2025) indicate a statistically significant increase in rain-on-snow days. These events destabilize and weaken the snowpack, leading to earlier melting. For forested watersheds in New England, this loss of snowpack creates the following two primary watershed management concerns.



Soil Erosion and Compaction

A thick snowpack acts as a buffer to impacts from winter logging operations.

Reduced snow cover combined with partially thawed soils leads to an increased risk of soil compaction and erosion from heavy machinery and log skidding (Toot, et al., 2025).



Forest Health

Without the insulating effect of snow, soils are subject to deeper freezing, which damages root systems. Experiments at Hubbard Brook Experimental Forest in New Hampshire show a 40% decline in the weight of living sugar maple trees following reduced snowpack treatments, with projections suggesting sugar maple canopy cover could decline by up to 95% by 2099 under high-emissions scenarios (Reinmann, Susser, Demaria, & Templer, 2019).

Precipitation and Streamflow Extremes

The Northeast has experienced a consistent rise in annual precipitation since 1960, a trend the IPCC (2021) predicts with very high confidence will continue. Most notably, the number of extreme precipitation events has increased by 60% since the 1950s in the Northeast (USGCRP, 2023), the region with the greatest increase in the nation. The combination of more intense rainfall and earlier snowmelt has shifted regional hydrology toward earlier peak flows and increased river flood discharge volumes and frequencies (IPCC, 2021; Scholl, McCabe, Olson, & Powlen, 2025). Increasing storm frequencies will flush more nutrients to surface waters, which may trigger algal blooms under warmer air temperatures. These weather trends, along with increased land development throughout the region, will continue to impact water quality in New England over the coming decades.

4 MANAGEMENT STRATEGIES

The following section details management strategies for achieving the water quality goal and objectives using a combination of structural and non-structural restoration techniques, as well as outreach and education and an adaptive management approach. A key component of these strategies is the idea that existing and future development can be remediated or conducted in a manner that sustains environmental values. All stakeholder groups have the capacity to be responsible watershed stewards, including citizens, businesses, the government, and others. Specific action items are provided in the Action Plan (Section 5).

4.1 STRUCTURAL NONPOINT SOURCE RESTORATION

Structural nonpoint source restoration techniques are engineered infrastructure designed to intercept stormwater runoff, often allowing it to soak into the ground, be taken up by plants, harvested for reuse, or released slowly over time to minimize flooding and downstream erosion. These SCMs often incorporate some mechanism for pollutant removal, such as sediment settling basins, oil separators, filtration, or microbial breakdown. They can also consist of removing or disconnecting impervious surfaces, which in turn reduces the volume of polluted runoff generated, minimizing adverse impacts to receiving waters.

4.1.1 Watershed and Shoreline Stormwater Control Measures

A total of 52 sites were identified in the 2025 watershed survey, and 15 sites remain to be addressed from the 2015 Pleasant Lake watershed survey. There are 23 high/medium impact rated shoreline properties from the 2025 shoreline survey. The total of 67 watershed sites and 23 high/medium impact shoreline sites were documented to have some impact on water quality through the delivery of phosphorus-laden sediment (refer to Section 3.1.1–3.1.2). As such, structural SCMs to reduce the external watershed phosphorus load are a necessary and important component for the protection of water quality in the watershed.

The following series of SCM implementation action items are recommended for achieving Objective 1:

- Address the top five priority sites identified during the 2025 watershed survey. Address remaining sites as opportunity (funding, capacity, etc.) arises. The sites were ranked based on phosphorus load reduction and waterbody proximity. The full prioritization matrix with recommended improvements is provided in Appendix B. The watershed survey SCM sites have the potential to

reduce total phosphorus load to the lake by 14.13 kg/yr. The top five sites alone account for one third of the total potential phosphorus reduction.

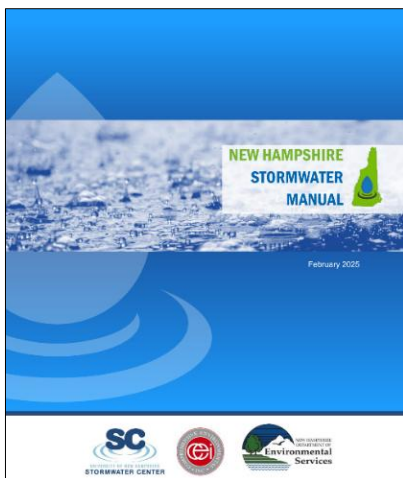
- Provide technical assistance and/or implementation cost sharing to the three high impact shoreline properties identified during the 2025 shoreline survey on Northwood Lake. Encourage landowners to implement SCMs on the 20 medium impact shoreline properties identified during the 2025 shoreline survey. Workshops and tours of demonstration sites can help encourage landowners to utilize SCMs on their own property. Conduct regular shoreline surveys to continue prioritizing properties for technical follow-up.

For the proper installation of structural SCMs in the watershed, the NLWA and other stakeholders should work with experienced professionals on sites that require a high level of technical knowledge (engineering). Whenever possible, pollutant load reductions should be estimated for each SCM installed, and the total overall watershed load reductions tracked. More specific and additional recommendations are included in Section 5. For helpful tips on implementing SCMs, see Additional Resources.

4.2 NON-STRUCTURAL NONPOINT SOURCE RESTORATION

Non-structural nonpoint source restoration techniques refer to a broad range of behavioral practices, activities, and operational measures that contribute to pollutant prevention and reduction. The following section highlights important restoration techniques for several key areas, including pollutant reduction best practices, zoning and ordinance updates, land conservation, septic system regulation, fertilizer use prohibition, agricultural practices, pet waste management, and nuisance wildlife controls.

4.2.1 Pollutant Reduction Best Practices



Pollutant reduction best practices include recommendations and strategies for improving road management and municipal operations for the protection of water quality. Following standard best practices for road maintenance and drainage management protects both infrastructure and water quality through the reduction of sediment and other pollutant transport. Refer to the [New Hampshire Stormwater Manual](#) (UNH Stormwater Center, Comprehensive Environmental Inc., & NH Department of Environmental Services, 2025) for standard road design and maintenance best practices.

Even though none of the watershed towns are required to comply with the six minimum control measures under the New Hampshire Small Municipal Separate Storm Sewer Systems (MS4) General Permit, each town could consider instituting the permit's key measures, such as street sweeping, catch basin cleaning, and road/ditch maintenance, if not already in place. Research and recommendations on street sweeping to reduce water pollution have been recently developed for New Hampshire (PREP & UNHSC, 2022). The MS4 permit also covers illicit discharge detection and elimination plans (and ordinance inclusion), source control and pollution/spill prevention protocols, and education/outreach and training

for residents, municipal staff, and stormwater operators, all of which are aimed at minimizing polluted runoff to surface waters.

4.2.2 Zoning and Ordinance Updates

Regulation through municipal zoning and other ordinances, such as requiring low impact development strategies that prevent polluted runoff from new and re-development projects in the watershed, are equally important as implementing structural SCMs to improve existing development. In fact, local land use planning and zoning ordinances can be the most critical components of watershed protection. FBE completed a preliminary ordinance review of natural resource protections for the municipalities of Northwood, Deerfield, Epsom, and Pittsfield (Table 12). These municipalities comprise the Northwood Lake watershed and therefore play a critical role in influencing land use, shoreline development, and water quality conditions within the lake. These municipalities have incorporated several important regulations into their local ordinances, including wetlands protections, floodplain regulations, setback requirements, and SCMs, though the level of detail, consistency, and enforcement mechanisms vary between the communities. The municipalities should consider the staffing capacity and administrative support necessary to effectively enforce both existing and proposed regulations, and make adjustments as needed to ensure the water quality protection intended is in fact being realized.



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Table 12. Ordinance review of regulatory and non-regulatory tools for natural resource protection in the towns of Northwood, Deerfield, Epsom, and Pittsfield.

Regulatory Tools

Strategy	Northwood	Deerfield	Epsom	Pittsfield
Zoning districts addressing environmental protection.	Existing: Wetlands Conservation Overlay District, Conservation Area Overlay District, Agricultural Soils Overlay District, Wellhead Protection Overlay District, Steep Slope Protection Overlay District. Recommendation: Consider establishing a "Northwood Lake Watershed Overlay District" where more stringent standards may apply that would not be applicable to all of Northwood. May include stricter standards for development or sewage disposal.	Existing: Pleasant Lake Watershed Overlay District, Wetland Conservation District, Groundwater Protection District. Recommendation: Consider extending the Pleasant Lake Watershed Overlay District boundaries to encompass the full Northwood Lake watershed area in Deerfield.	Existing: Groundwater Protection District. Recommendation: Consider establishing wetland and steep slope protection overlay districts.	Existing: None identified. Recommendation: Consider establishing wetland, groundwater, and steep slope protection overlay districts.
Shoreland zoning.	Existing: 50 ft building setback from waterbodies, 100 ft septic system setback on undeveloped lot from waterbody. Northwood does not have local shoreland regulations beyond those required by the New	Existing: No building permit will be issued for any structure having a setback of less than 75 feet from any river, stream, lake, or pond. Recommendation: Consider establishing a dedicated Shoreland Protection Zone. This	Existing: None identified; shoreland zoning regulated by the SWQPA. Recommendation: Consider establishing a dedicated Shoreland Protection Zone. This zone would set clear, consistent standards for setbacks, vegetation buffers, and impervious surface limits within 250	Existing: None identified; shoreland zoning regulated by the SWQPA. Recommendation: Consider establishing a dedicated Shoreland Protection Zone. This zone would set clear, consistent

Strategy	Northwood	Deerfield	Epsom	Pittsfield
	Hampshire Shoreland Water Quality Protection Act. Recommendation: Consider establishing a dedicated Shoreland Protection Zone. This zone would set clear, consistent standards for setbacks, vegetation buffers, and impervious surface limits within 250 feet of surface waters, complementing existing wetland protections and reducing the impacts of shoreline development.	zone would set clear, consistent standards for setbacks, vegetation buffers, and impervious surface limits within 250 feet of surface waters, complementing existing wetland protections and reducing the impacts of shoreline development.	feet of surface waters, complementing existing wetland protections and reducing the impacts of shoreline development.	standards for setbacks, vegetation buffers, and impervious surface limits within 250 feet of surface waters, complementing existing wetland protections and reducing the impacts of shoreline development.
Subdivision of waterfront parcels.	Existing: None identified. Recommendation: Consider adopting subdivision standards specific to waterfront parcels, such as minimum shoreline frontage requirements and limits on linear or flag lot divisions. These standards would help preserve shoreline character, protect water quality, and reduce the cumulative impact of development along surface waters.	Existing: None identified, although waterfront access provisions are specified for the Pleasant Lake Watershed District. Recommendation: Consider adopting subdivision standards specific to waterfront parcels, such as minimum shoreline frontage requirements and limits on linear or flag lot divisions. These standards would help preserve shoreline character, protect water quality, and reduce the cumulative impact of development along surface waters.	Existing: None identified. Recommendation: Consider adopting subdivision standards specific to waterfront parcels, such as minimum shoreline frontage requirements and limits on linear or flag lot divisions. These standards would help preserve shoreline character, protect water quality, and reduce the cumulative impact of development along surface waters.	Existing: None identified. Recommendation: Consider adopting subdivision standards specific to waterfront parcels, such as minimum shoreline frontage requirements and limits on linear or flag lot divisions. These standards would help preserve shoreline character, protect water quality, and reduce the cumulative impact of development along surface waters.

Strategy	Northwood	Deerfield	Epsom	Pittsfield
Cluster development and/or open space provisions for subdivisions.	Existing: 33% of land set aside for open space in cluster developments. Required in Agricultural Soils and Wellhead Protection Overlay Districts. Open space should be a single contiguous area of substantial size and must not be a thin strip surrounding the subdivision or a lot to buffer abutters. Recommendation: None identified.	Existing: No cluster development ordinance. Open Space Development Ordinance for lots >12 acres: total area of open space must equal at least 50% of the development's gross tract area. Not more than 50% of the open space may consist of lands within the Wetlands Conservation District or have >20% slopes. Recommendation: Explicitly encourage cluster development in the ordinance.	Existing: Allows cluster development on lots 15 acres or larger. Lot sizes and frontages can be 50% smaller than what is usually allowed for the underlying zone. 30% of land must be preserved for open space. Recommendation: Implement recommendations in the Housing chapter of the 2021 Master Plan. Specific recommendations related to environmental protection include providing clarity on what can be done in planned open spaces, and the possible addition of density bonuses that could be granted for different types of open space.	Existing: Cluster developments are allowed if approved by Board of Adjustment and Planning Board. No open space provisions mentioned, except for senior citizen housing developments. Recommendation: Require at least 30% of the lot to be set aside for open space and specify land use options for this open space.
Protection of wetlands.	Existing: Wetlands Conservation Overlay District: 100 ft building setback for high-priority wetlands, 50 ft setback for all other wetlands. Recommendation: Consider establishing maximum allowable impervious area for parcels within the overlay zone and extending setbacks to 100 feet for all wetlands.	Existing: 100-foot buffer for any wetland; 75-foot for pre-existing lots as of March 2006. 100-foot buffer zone must be maintained along any tributary discharging to Pleasant Lake and along edge of any wetlands associated with tributaries. Recommendation: Consider establishing maximum allowable impervious area for parcels within the overlay zone.	Existing: 50-foot setback for all wetlands. Recommendation: Extend the setback distance to 100 feet. Consider establishing a wetlands protection overlay zone and regulating maximum allowable impervious area per lot within this overlay.	Existing: None identified. Recommendation: Consider establishing a wetlands protection overlay zone and regulating setback distances (100 feet) and maximum allowable impervious area per lot within this overlay.
Protection of groundwater.	Existing: The Wellhead Protection Overlay District safeguards groundwater by enforcing standards for	Existing: The Groundwater Protection District is an overlay district that requires a stormwater management plan	Existing: The Groundwater Protection District aims to protect two stratified drift aquifers. It includes provisions for	Existing: None identified. Recommendation: Establish a groundwater

Strategy	Northwood	Deerfield	Epsom	Pittsfield
	impervious area, development pattern, and housing density, as well as restricting chemical storage and high-risk land uses. Recommendation: None identified.	for development with >15% or >10,000 square feet of impervious cover. It also provides standards for storage of fertilizers and regulated substances. Recommendation: None identified.	chemical storage and prohibits uses harmful to groundwater quality. Recommendation: Implement the recommendations of the 2021 Master Plan: 1) Require performance standards within the aquifer areas for commercial activities that produce liquid waste. 2) Identify minimum Water Systems Protection Areas for domestic wells and public water supplies and require performance standards within the WSPAs. Incorporate maintenance, testing, and inspection standards.	protection overlay district and set land use and developments standards for these areas.

Strategy	Northwood	Deerfield	Epsom	Pittsfield
Protection of steep slopes.	Existing: The Steep Slope Protection Overlay District applies to all areas with slopes >20% and totaling more than 2,000 square feet of contiguous area, with further restrictions for areas with >25% slopes. For 20-25% slopes, special exception is required for placement of roads, structures, etc. Recommendation: Consider removing the 2,000 square feet condition or reducing the definition of a steep slope to 15%.	Existing: No town-wide ordinance identified. Recommendation: As recommended in the Master Plan, consider the establishment of a steep slopes ordinance to restrict and/or prohibit development in areas which may have high risk of erosion and mud slides (e.g. >15% slope).	Existing: Slopes >25% are considered non-buildable. Recommendation: Consider the establishment of a steep slopes ordinance to restrict and/or prohibit any development in areas which may have high risk of erosion and mud slides (e.g. >15% slope).	Existing: None identified. Recommendation: Consider the establishment of a steep slopes ordinance to restrict and/or prohibit any development in areas which may have high risk of erosion and mud slides (e.g. >15% slope).
Septic pump-out ordinance or regulation of septic systems.	Existing: 100-foot setback from waterbodies; for nonconforming lots: 75-foot setback from waterbodies and wells and 50-foot setback from hydric B soils for; septic systems within 250 feet of a waterbody must be pumped every 3 years and provide documentation to the Town. Recommendation: Ensure enforcement and follow-up with homes not adhering to the ordinance or requiring maintenance or upgrades.	Existing: 100-foot setback from wetlands, 75-foot for lots developed before 3/2006; test pit and percolation test data required in Pleasant Lake Watershed Overlay District; no pump-out ordinance identified. Recommendation: Require septic pump outs and inspections within an overlay district, require inspections at point of sale or home expansion, require certain design criteria in sensitive areas, such as advanced treatment	Existing: New or replacement of sewer and septic systems in a special flood hazard area requires approval from Selectboard/zoning control officer. No pump-out ordinance identified. Recommendation: Require septic pump outs and inspections within an overlay district, require inspections at point of sale or home expansion, require certain design criteria in sensitive areas, such as advanced treatment systems and increased system capacity.	Existing: None identified. Recommendation: Require septic pump outs and inspections within an overlay district, require inspections at point of sale or home expansion, require certain design criteria in sensitive areas, such as advanced treatment systems and increased system capacity.

Strategy	Northwood	Deerfield	Epsom	Pittsfield
		systems and increased system capacity.		
Nutrient loading analysis required for fresh waterbodies.	Existing: None identified. Recommendation: Require stormwater management plans or phosphorus control plans to quantify nutrient loading from planned developments and the estimated load reductions from SCMs and Low Impact Development (LID) techniques.	Existing: None identified. Recommendation: Require stormwater management plans or phosphorus control plans to quantify nutrient loading from planned developments and the estimated load reductions from SCMs and LID techniques.	Existing: None identified. Recommendation: Require stormwater management plans or phosphorus control plans to quantify nutrient loading from planned developments and the estimated load reductions from SCMs and LID techniques.	Existing: None identified. Recommendation: Require stormwater management plans or phosphorus control plans to quantify nutrient loading from planned developments and the estimated load reductions from SCMs and LID techniques.
Low impact development requirements and standards.	Existing: None identified. Recommendation: Incorporate LID standards into site plan and subdivision regulations to promote stormwater infiltration, reduce runoff, and protect water quality. Require developers to integrate practices such as rain gardens, vegetated swales, and permeable pavements where feasible.	Existing: Defined in Section 330 - Pleasant Lake Watershed Protection Ordinance. SCMs are also encouraged in this section to remove pollutants from runoff before reaching waterbodies. Recommendation: Incorporate LID standards into site plan and subdivision regulations to promote stormwater infiltration, reduce runoff, and protect water quality. Require developers to integrate practices such as rain gardens, vegetated swales, and permeable pavements where feasible.	Existing: None identified. Recommendation: Incorporate LID standards into site plan and subdivision regulations to promote stormwater infiltration, reduce runoff, and protect water quality. Require developers to integrate practices such as rain gardens, vegetated swales, and permeable pavements where feasible.	Existing: None identified. Recommendation: Incorporate LID standards into site plan and subdivision regulations to promote stormwater infiltration, reduce runoff, and protect water quality. Require developers to integrate practices such as rain gardens, vegetated swales, and permeable pavements where feasible.

Strategy	Northwood	Deerfield	Epsom	Pittsfield
Environmental Ordinances (e.g. green building codes, green infrastructure, tree preservation, limits on impervious surface cover).	Existing: In the Wellhead Protection Overlay District, impervious area may not exceed 20% of the lot size. Recommendation: Consider adopting provisions that promote green building practices, green infrastructure, and tree preservation, including performance standards or incentives that reduce impervious cover, manage stormwater on-site, and protect existing trees where practicable.	Existing: Buildings may not cover >25% of a lot. Impervious cover limited to 30% in the Watershed Protection Overlay District; impervious driveways cannot be within 75 feet of wetlands and waterbodies in this overlay Recommendation: Consider adopting provisions that promote green building practices, green infrastructure, and tree preservation, including performance standards or incentives that reduce impervious cover, manage stormwater on-site, and protect existing trees where practicable.	Existing: Any use that will render impervious more than 15% or 2,500 square feet of any lot in the Groundwater Protection District requires a Conditional Use Permit. Recommendation: Consider adopting provisions that promote green building practices, green infrastructure, and tree preservation, including performance standards or incentives that reduce impervious cover, manage stormwater on-site, and protect existing trees where practicable.	Existing: None identified. Recommendation: Consider adopting provisions that promote green building practices, green infrastructure, and tree preservation, including performance standards or incentives that reduce impervious cover, manage stormwater on-site, and protect existing trees where practicable.
Fertilizer and/or pesticide ordinances.	Existing: None identified. Recommendation: Implement a fertilizer ordinance. This may be town-wide or within an overlay district. Stipulations may be made such that natural fertilizers may be allowed, or special types of fertilizers may be used for agricultural purposes, but not residential.	Existing: Fertilizer use is prohibited in the Wetlands Conservation District. Recommendation: Add this provision to the Pleasant Lake Watershed and Groundwater Protection districts.	Existing: The sale, transportation, and use of pesticides is explicitly exempted in the Groundwater Protection District, provided it meets state and federal regulations. No fertilizer ordinances identified. Recommendation: Implement a fertilizer ordinance. This may be town-wide or within an overlay district. Stipulations may be made such that natural fertilizers may be allowed, or special types of fertilizers may be used for agricultural purposes, but not residential.	Existing: None identified. Recommendation: Implement a fertilizer ordinance. This may be town-wide or within an overlay district. Stipulations may be made such that natural fertilizers may be allowed, or special types of fertilizers may be used for agricultural purposes, but not residential.

Strategy	Northwood	Deerfield	Epsom	Pittsfield
Implement and enforce a stormwater management plan.	Existing: Stormwater control standards provided in the Northwood Site Plan Regulations (2022). Recommendation: Ensure the plan requirements align with the 2025 New Hampshire Stormwater Manual.	Existing: Required for development that will result in 20% or more than 2,500 square feet (whichever is greater) impervious surface of the entire lot, consistent with the latest NH Stormwater Manual, in the Watershed Protection Overlay District. The same for the Groundwater Protection District, but 15% or 10,000 square feet. Recommendation: Consider adding this provision to the Wetland Conservation District.	Existing: None identified. Recommendation: Ensure the Site Plan Regulation requirements for Stormwater Management Plans align with the 2025 New Hampshire Stormwater Manual.	Existing: None identified. Recommendation: Ensure town ordinances align with the 2025 New Hampshire Stormwater Manual.



Conservation Funding Strategies

Strategy	Northwood	Deerfield	Epsom	Pittsfield
Conservation impact fees.	Existing: None identified. Recommendation: Implement conservation impact fee regulated by the Northwood Conservation Commission.	Existing: None identified. Recommendation: Implement a conservation impact fee similar to the impact fee for the Capitol Improvements Program.	Existing: None identified. Recommendation: Implement conservation impact fee regulated by the Epsom Conservation Commission.	Existing: None identified. Recommendation: Implement conservation impact fee regulated by the Pittsfield Conservation Commission.
Wetland mitigation funds.	Existing: The 2024 Master Plan mentions the following protentional funding sources for stream and wetland restoration: Aquatic Resource Mitigation Fund (NHDES), Piscataqua Region Environmental Planning	Existing: None identified in the Master Plan, but the Town can apply for state and federal grant programs. Recommendation: The Deerfield Conservation	Existing: None identified in the Master Plan, but the Town can apply for state and federal grant programs. Recommendation: The Epsom Conservation Commission	Existing: None identified in the Master Plan, but the Town can apply for state and federal grant programs. Recommendation: The Pittsfield Conservation

Strategy	Northwood	Deerfield	Epsom	Pittsfield
	Assessment Grant, North American Wetlands Conservation Act Grant (USFWS), National Fish Passage Program (USFWS), and New England Forest and River Grant Program (NFWF). Recommendation: The Northwood Conservation Commission should apply for wetland mitigation funding when opportunities arise.	Commission should apply for wetland mitigation funding when opportunities arise, including ARM.	should apply for wetland mitigation funding when opportunities arise, including ARM.	Commission should apply for wetland mitigation funding when opportunities arise, including ARM.
Fee in lieu of land dedication.	Existing: None identified. Recommendation: Implement a fee in lieu of land dedication.	Existing: None identified. Recommendation: Implement a fee in lieu of land dedication.	Existing: None identified. Recommendation: Implement conservation impact fee.	Existing: None identified. Recommendation: Implement conservation impact fee.
Stormwater utility district.	Existing: None identified. Recommendation: Implement a stormwater utility fee within a Stormwater Utility District. The fee is often a single rate charged to each homeowner within the district at the same time as their property taxes. The fees can generate funds for stormwater infrastructure maintenance, replacement, green infrastructure, and more to prevent or mitigate localized flooding, or infrastructure failure. Lot fees can be reduced or eliminated when property owners implement LID practices	Existing: None identified. Recommendation: Implement a stormwater utility fee within a Stormwater Utility District. The fee is often a single rate charged to each homeowner within the district at the same time as their property taxes. The fees can generate funds for stormwater infrastructure maintenance, replacement, green infrastructure, and more to prevent or mitigate localized flooding, or infrastructure failure. Lot fees can be reduced or eliminated when property owners implement LID practices	Existing: None identified. Recommendation: Implement a stormwater utility fee within a Stormwater Utility District. The fee is often a single rate charged to each homeowner within the district at the same time as their property taxes. The fees can generate funds for stormwater infrastructure maintenance, replacement, green infrastructure, and more to prevent or mitigate localized flooding, or infrastructure failure. Lot fees can be reduced or eliminated when property owners implement LID practices	Existing: None identified. Recommendation: Implement a stormwater utility fee within a Stormwater Utility District. The fee is often a single rate charged to each homeowner within the district at the same time as their property taxes. The fees can generate funds for stormwater infrastructure maintenance, replacement, green infrastructure, and more to prevent or mitigate localized flooding, or infrastructure failure. Lot fees can be reduced or eliminated when property owners implement LID practices

Strategy	Northwood	Deerfield	Epsom	Pittsfield
	that fully infiltrate stormwater on-site, providing an incentive for on-site management.	that fully infiltrate stormwater on-site, providing an incentive for on-site management.	that fully infiltrate stormwater on-site, providing an incentive for on-site management.	that fully infiltrate stormwater on-site, providing an incentive for on-site management.
Open space or non-lapsing conservation fund.	Existing: According to the Master Plan, the Northwood Conservation Commission's conservation fund receives 50% of current use land use change tax. Recommendation: Continue to support the transfer of the Land Use Change Tax to support the Conservation Fund.	Existing: Yes, 50-100% of the land use change tax. Recommendation: Continue to support the transfer of the Land Use Change Tax to support the Conservation Fund.	Existing: The Town's Conservation Fund is an existing source that has been used to help fund the acquisition of conservation parcels and easements via the Land Use Change Tax. Recommendation: Continue to support the transfer of the Land Use Change Tax to support the Conservation Fund.	Existing: None identified. Recommendation: Establish a conservation fund if not already in place to acquire conservation properties and easements.
Has a land use change tax per RSA 79-A:25.	Existing: Yes. Recommendation: Allow 100% of land use tax revenue to go towards the conservation fund.	Existing: Yes. Recommendation: Continue to support the transfer of 100% of the Land Use Change Tax to support the Conservation Fund.	Existing: Yes. Recommendation: Allow 100% of land use tax revenue to go towards the conservation fund.	Existing: Yes. Recommendation: Allow a percentage of the land use tax revenue to go towards a conservation fund.
Participate or collaborate with a local watershed association.	Existing: Northwood Lake Watershed Association, Pleasant Lake Preservation Association, Harvey Lake Watershed Association, Jenness Pond Shore Owners Association, Bow Lake Camp Owners Association. Recommendation: Continue collaborating with these watershed associations.	Existing: Northwood Lake Watershed Association, Pleasant Lake Preservation Association. Recommendation: Continue collaborating with these watershed associations.	Existing: Northwood Lake Watershed Association. Recommendation: Continue collaborating with these watershed associations.	Existing: None identified. Recommendation: Collaborate with watershed associations whose watersheds overlap with Pittsfield.

Strategy	Northwood	Deerfield	Epsom	Pittsfield
Participate or collaborate with a local land trust.	Existing: Southeast Land Trust and Bear Paw Regional Greenways hold easements in Northwood. Recommendation: Continue collaborating with these regional land trusts and identify opportunities to collaborate with other land trusts.	Existing: Southeast Land Trust and Bear Paw Regional Greenways collaborate with the Deerfield Conservation Commission. Recommendation: Continue collaborating with these regional land trusts and identify opportunities to collaborate with other land trusts.	Existing: Southeast Land Trust and Bear Paw Regional Greenways hold easements in Epsom. Recommendation: Continue collaborating with these regional land trusts and identify opportunities to collaborate with other land trusts.	Existing: Yes, Southeast Land Trust and Bear Paw Regional Greenways. Recommendation: Continue collaborating with regional land trusts and identify opportunities to collaborate with other land trusts.



Non-regulatory Strategies

Strategy	Northwood	Deerfield	Epsom	Pittsfield
Open space plan.	Existing: Open space planning recommended as an action for the Northwood Conservation Commission in the Master Plan. Recommendation: Update ordinances to reflect current conservation priorities by incorporating storm resilience, habitat connectivity, and water resource protection into site design standards.	Existing: Yes (2007). Recommendation: Update open space plan every 10 years.	Existing: None identified. Recommendation: Develop a town-side open space plan, overseen by the Conservation Commission.	Existing: None identified. Recommendation: Develop a town-side open space plan, overseen by the Conservation Commission.

Strategy	Northwood	Deerfield	Epsom	Pittsfield
Master plan addresses natural resources and environmental protection.	Existing: Yes. Natural Resources and Water Resources Chapter in the 2024 Master Plan. Recommendation: Implement recommendations identified in this chapter.	Existing: Yes, although natural resources and open space do not have their own chapter. Recommendation: Update the 2009 Master Plan. Include a chapter on Natural Resources and Open Space.	Existing: Yes. Natural Features chapter in the 2021 Master Plan. Recommendation: Implement recommendations identified in this chapter.	Existing: The most recent (2018) Master Plan does not have a natural resources chapter, but the 2010 Master Plan does. Recommendation: Implement recommendations identified in the 2010 Master Plan, and ensure the next plan has a natural resources component.
A town-wide natural resources inventory.	Existing: No, but identified as a priority for the Northwood Conservation Commission in the Master Plan. Recommendation: Conduct a town-wide natural resources inventory.	Existing: The Town is currently conducting a natural resources inventory. Recommendation: None.	Existing: None identified. Recommendation: Conduct a town-wide natural resources inventory.	Existing: Central NH Regional Planning Commission is actively working on a town-wide natural resources inventory. Watershed-focused natural resources inventories have been completed for Gulf Brook, Flat Meadow Brook, and Wild Goose Pond. Recommendation: Upload the natural resources inventory to the Pittsfield Conservation Commission website when completed.
Smart Growth Plan.	Existing: None identified. Recommendation: Consider developing a Smart Growth Plan	Existing: None identified. Recommendation: Consider developing a Smart Growth Plan	Existing: None identified. Recommendation: Consider developing a Smart Growth Plan	Existing: None identified. Recommendation: Consider developing a Smart Growth Plan.
Stormwater system mapping.	Existing: None identified. Recommendation: Create a stormwater system map and share it on the Town's website.	Existing: None identified. Recommendation: Create a stormwater system map and share it on the Town's website.	Existing: None identified. Recommendation: Create a stormwater system map and share it on the Town's website.	Existing: None identified. Recommendation: Create a stormwater system map and share it on the Town's website.

Strategy	Northwood	Deerfield	Epsom	Pittsfield
Consistent public outreach and engagement / public education programs.	Existing: The Northwood Area Land Management Collaborative provides nature-based outreach and collaborates on stewardship projects. Other education and outreach recommendations are outlined in the Master Plan. Recommendation: Follow the Master Plan recommendations.	Existing: None identified, but the Bear-Paw Regional Greenways and the Northwood Area Land Management Collaborative conducts outreach and educational activities throughout the region. Recommendation: Continue collaborating with regional environmental groups to educate town residents about natural resource conservation.	Existing: None identified, but Bear-Paw Regional Greenways conducts outreach and educational activities throughout the region. Recommendation: The 2021 Master Plan includes the objective to promote public education on invasive species. Also consider collaborating with NALMC to extend education events to towns surrounding Northwood.	Existing: None identified, but Bear-Paw Regional Greenways conducts outreach and educational activities throughout the region. Recommendation: Continue collaborating with regional environmental groups to educate town residents about natural resource conservation.
Incentive-based programs for stormwater reduction efforts.	Existing: None identified but recommended in the 2024 Master Plan. Recommendation: Follow the Master Plan recommendations.	Existing: None identified. Recommendation: Implement incentive-based programs.	Existing: None identified. Recommendation: Implement incentive-based programs.	Existing: None identified. Recommendation: Implement incentive-based programs.
Have established conservation commission.	Existing: Yes. Recommendation: Continue the great work and follow the Master Plan recommendations.	Existing: Yes. Recommendation: Continue the great work and follow the Master Plan recommendations.	Existing: Yes. Recommendation: Continue the great work and follow the Master Plan recommendations.	Existing: Yes. Recommendation: Continue the great work and follow the Master Plan recommendations.
Incentivize and/or encourage property owners to implement low impact development	Existing: None identified but recommended in the 2024 Master Plan. Recommendation: Follow the Master Plan recommendations.	Existing: None identified. Recommendation: Consider incentivizing and encouraging low impact development through outreach programs,	Existing: None identified. Recommendation: Consider incentivizing and encouraging low impact development through outreach programs,	Existing: None identified. Recommendation: Consider incentivizing and encouraging low impact development through outreach programs, workshops, or financial incentives.

Strategy	Northwood	Deerfield	Epsom	Pittsfield
stormwater practices.		workshops, or financial incentives.	workshops, or financial incentives.	
Encourage property owners to put land into farmland/tree growth programs.	Existing: None identified beyond the Current Land Use program. Recommendation: Encourage landowners to take advantage of state agricultural and forestry programs through education and outreach events.	Existing: None identified. Recommendation: Encourage landowners to take advantage of state agricultural and forestry programs.	Existing: None identified. Recommendation: Encourage landowners to take advantage of state agricultural and forestry programs.	Existing: None identified. Recommendation: Encourage landowners to take advantage of state agricultural and forestry programs.

Local land use planning and zoning ordinances should consider incorporating resiliency strategies for protecting water quality and improving infrastructure based on temperature, precipitation, water levels, wind loads, storm surges, soil moisture, and groundwater levels (Ballesterio, Houle, Puls, & Barbu, 2017). There are nine strategies which can aid in minimizing the adverse effects associated with environmental stressors, including the following (McCormick & Dorworth, 2019), several of which are partially addressed within the current ordinances of the watershed municipalities but could be further strengthened and expanded. More details on ordinance recommendations and suggestions can be found in Table 12.

☛ ***Installing Green Infrastructure and Nature-Based Solutions***

Planning for greener infrastructure requires creating a network of interconnected natural areas and open spaces for groundwater recharge, pollution mitigation, reduced runoff and erosion, and improved air quality. Examples of green infrastructure and nature-based solutions include forest, wetlands, natural areas, riparian (banks of a water course) buffers, and floodplains; all of which already exist to various extents in the watershed and have minimized the damage created by intense storms. Other examples of engineered green infrastructure that apply concepts from nature to treat stormwater include Regenerative Stormwater Conveyance, bioswales, and infiltration tree trenches. As future development occurs, these natural barriers must be maintained or even increased to reduce runoff of pollutants into freshwater. See also Section 4.2.3: Land Conservation.

☛ ***Using Low Impact Development Strategies***

Replacing traditional approaches to stormwater management such as curbs, pipes, storm drains, gutters, and retention ponds with innovative approaches such as bioretention, vegetated swales, and permeable paving.

☛ ***Minimizing Impervious Surfaces***

Impervious surfaces such as roads, buildings, and parking lots should be minimized by creating new ordinances and building construction design requirements which reduce the imperviousness of new development. Property owners can increase the permeability of their lots by incorporating permeable driveways and walkways. In some cases, reducing mandatory minimum parking spaces for development may help achieve this goal.

☛ ***Encouraging Riparian Buffers and Maintaining Floodplains***

Municipal ordinances should forbid construction in floodplains, and in some instances, floodplains should be expanded to increase land area to accommodate larger rainfall events. Riparian buffers and filter strips along waterways should be preserved or created to slow runoff and filter pollutants.

☛ ***Protecting and Re-establishing Wetlands***

Wetlands are vital for preservation because wetlands hold water, reduce flooding, recharge groundwater, and mitigate water pollution.

☛ ***Encouraging Tree Planting***

Trees help manage stormwater by reducing runoff and mitigating erosion when adjacent to surface waters. Trees also provide critical shading and cooling to streams, lake shorelines, and land surfaces.

☛ ***Promoting Sustainable Landscaping Using Native Vegetation***

Landowners should promote the use of native vegetation in landscaping, and landscapers should become familiar with techniques which minimize runoff and the discharge of nutrients into waterbodies (Chase-Rowell, Davis, Hartnett, & Wyzga, 2012).

☛ ***Slowing Down the Flow of Stormwater***

To slow and infiltrate stormwater runoff, roadside ditches can be armored or vegetated and equipped with turnouts, settling basins, check dams, or infiltration catch basins. Rain gardens can retain stormwater, while water bars can divert water into vegetated areas for infiltration. Water running off roofs can be channeled into infiltration fields and drainage trenches.

☛ ***Coordinating Infrastructure, Housing, and Transportation Planning***

Coordinate planning for infrastructure, housing, and transportation to minimize impacts on natural resources. Critical resources, including groundwater, must be conserved and remain free of pollutants especially as future droughts may deplete groundwater supplies.

4.2.3 Land Conservation

Land conservation is essential to the health of a region, particularly for the protection of water resources, enhancement of recreation opportunities, vitality of local economies, and preservation of wildlife habitat. Land conservation is one of many tools for protecting water quality for current and future generations. For the Northwood Lake watershed, 9.7% (1,416 acres) of the watershed's area (not including Northwood Lake) has been classified as conservation land (Figure 31). Major conserved areas include NRCS WRP WaTutCa and Barton Properties, Wallman #1, Fogs/Shores Memorial Forest, Katharyn Williams Easement, Olsen/Villnave, and Coe-Brown Academy Forestry Lots. Many of the conservation areas are concentrated in the southern and eastern portions of the watershed.

As land conservation is essential to the future of this region, local groups should continue to pursue opportunities for land conservation in the Northwood Lake watershed based on the highest valued habitat identified by the New Hampshire Fish and Game Department. The New Hampshire Fish and Game Department ranks habitat based on value to the State, biological region (areas with similar climate, geology, and other factors that influence biology), and supporting landscape. These habitat rankings are published in the State's [2025 Wildlife Action Plan](#), which serves as a blueprint for prioritizing conservation actions to protect Species of Greatest Conservation Need in New Hampshire (NHFG, 2025). The Northwood Lake watershed is located in the Worcester Monadnock Plateau ecological region (NHFG, 2025). Approximately 2,296 acres (15%) of the Northwood Lake watershed are considered Highest Ranked Habitat in New Hampshire, and 3,858 acres (25%) are classified as the highest ranked habitat in the biological region (Figure 32).

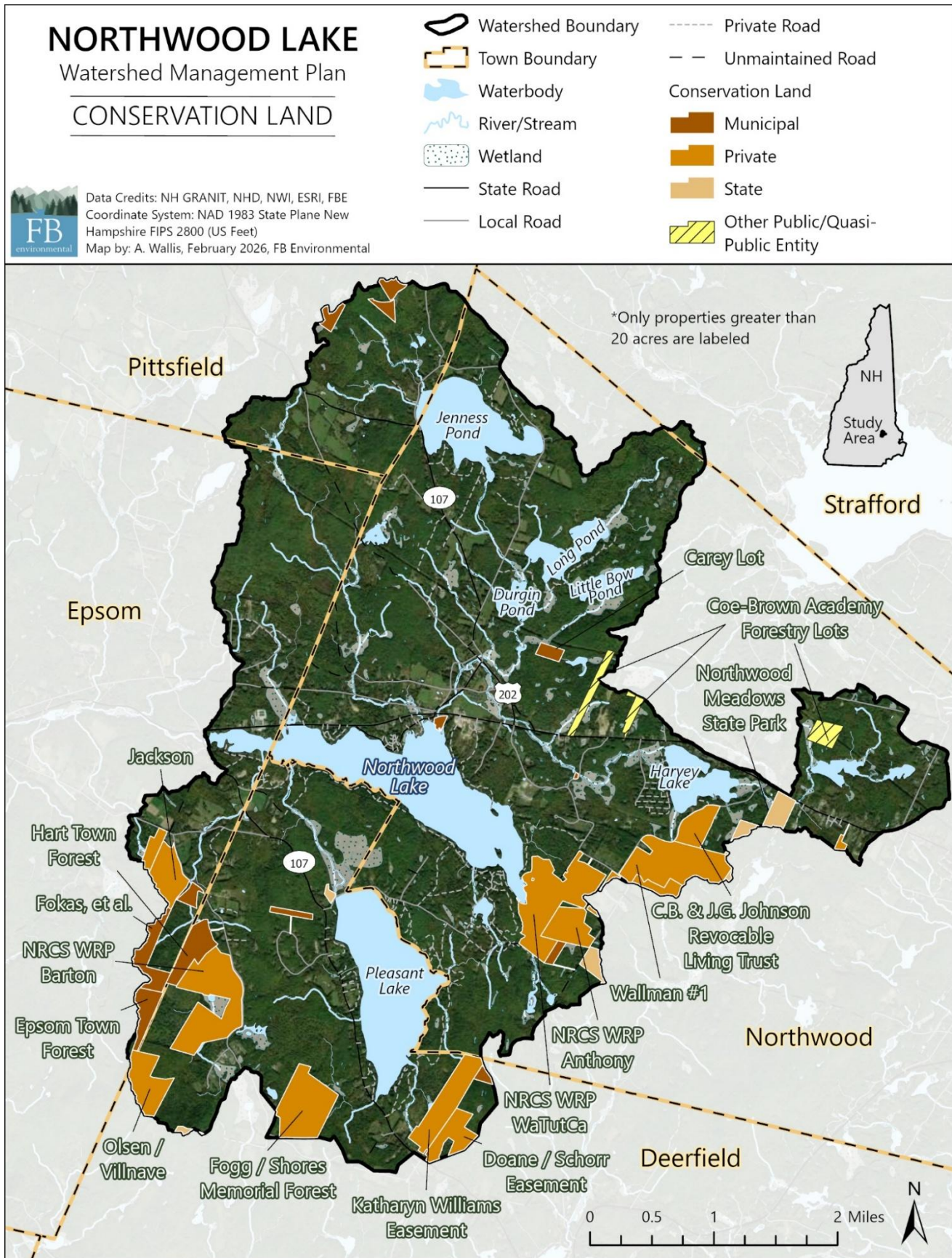


Figure 31. Conserved land by owner type in the Northwood Lake watershed.

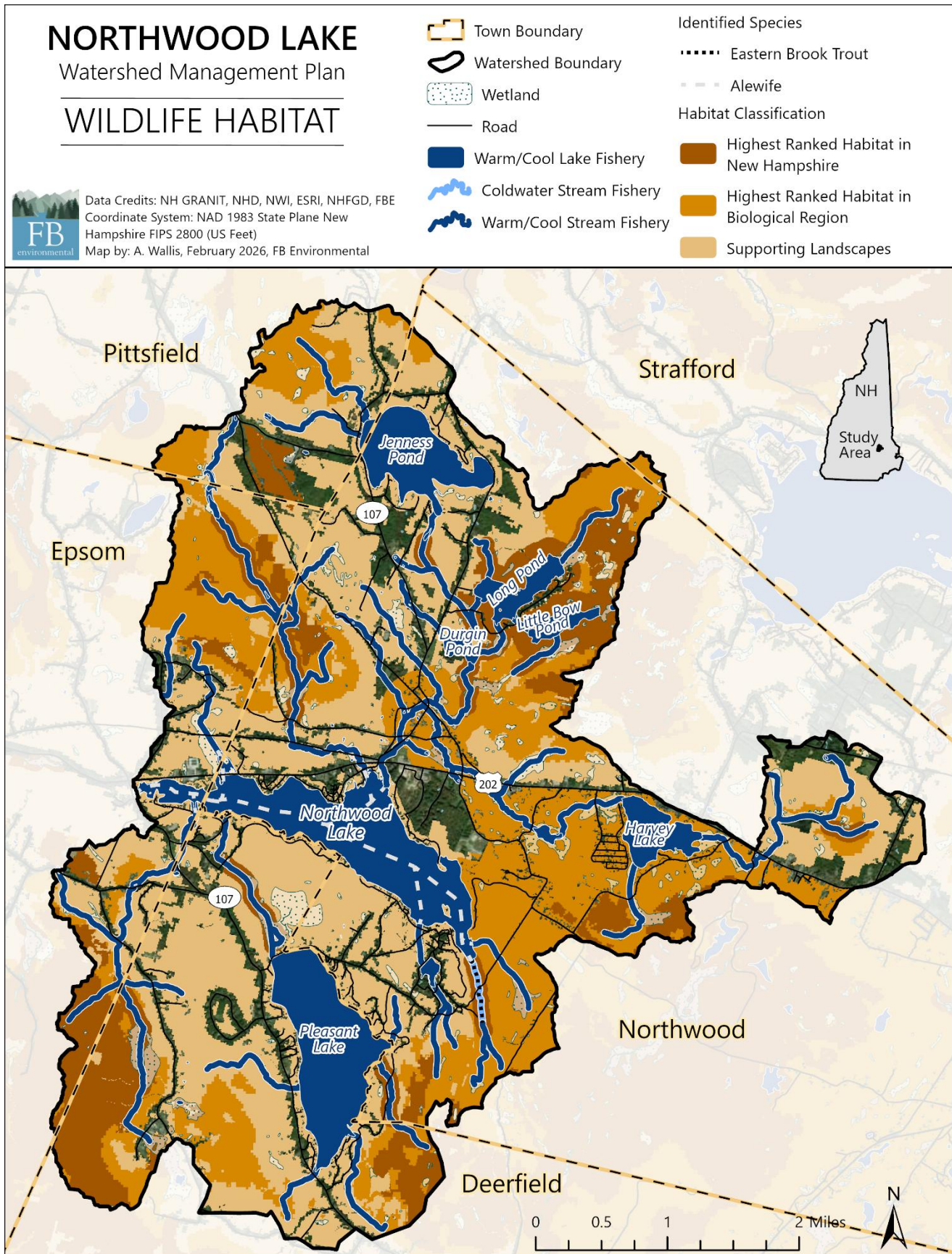


Figure 32. High value habitat in the Northwood Lake watershed according to the 2025 NH Wildlife Action Plan.

4.2.4 Septic System Regulation

When properly designed, installed, operated, and maintained, septic systems can treat residential wastewater and reduce the impact of excess pollutants in ground and surface waters. It is important to note, however, that traditional septic systems are designed for pathogen removal from wastewater and not specifically for other pollutants such as nutrients. The phosphorus in wastewater is “removed” only by binding with soil particles or being recycled through plant growth but is not removed entirely from the watershed system. Achieving nutrient removal may require advanced or alternative septic systems, which are more expensive than conventional systems. These systems can reduce nitrogen and phosphorus inputs to surface waters significantly, but cost considerations should be factored into any overlay district requirements or incentive programs.

Local regulations play a key role in enforcing proper system oversight in the Town of Northwood. Local zoning and health ordinances work alongside state rules such as the NHDES Subsurface Systems Bureau and the Shoreland Water Quality Protection Act to manage septic impacts through several key requirements:

- ☛ New or expanded septic leach fields on properties within the Shoreland Protection Zone (within 250 feet of waterbodies like Northwood Lake) must be set back at least 75 to 125-feet depending on soil percolation rates (RSA 483-B).
- ☛ If a waterfront property (within 250 feet) is sold, a state-licensed septic evaluator must inspect the system. If the system is found to be failing, the buyer must replace it within 180 days of closing (2024 NH House Bill 1113, which amended RSA 485-A:2, I; RSA 485-A:29, IV; RSA 485-A:39).
- ☛ Building permit approvals for expanding living space, adding bedrooms, or converting a seasonal cottage to year-round use require valid NHDES Construction and Operational Approvals on file.
- ☛ The municipal Health Officer has the direct authority under RSA 147 to investigate failing systems or surfacing effluent and order immediate remedies ranging from mandatory pumping to total system replacement within 90 days.

Proper design, installation, operation, maintenance, and replacement considerations include:

- A. **Proper design** includes adequate evaluation of soil conditions, seasonal high groundwater or impermeable materials, proximity of sensitive resources (e.g., drinking water wells, surface waters, wetlands, etc.). For shoreline systems, confirming at least 2 to 4 feet of unsaturated soil below the leachfield is critical. Without this soil volume, bacterial and phosphorus filtration is much less effective, or fails. Evaluating a design also relies on pre-inspection record checks through state databases and municipal records to verify original approvals, system age, and soil data.
- B. **Proper siting and installation** mean that the system is installed in conformance with the approved design and siting requirements (e.g., setbacks from waterways).
- C. **Proper operation** includes how the property owner uses the system. While most systems excel at treating normal domestic sewage, disposing of some materials, such as toxic chemicals, paints, personal hygiene products, oils and grease in large volumes, and garbage, can adversely

affect the function and design life of the system, resulting in treatment failure and potential public health threats. Proper operation also includes how the property owner protects the system. For example, allowing vegetation with extensive roots to grow above the system can result in clogs or leaks, and driving large vehicles over the system may crush or compact piping or leaching structures.

- D. **Proper maintenance** means having the septic tank pumped at regular intervals to eliminate accumulations of solids and grease in the tank. It may also mean regular cleaning of effluent filters, if installed. The frequency of septic pumping depends on the use and total volume entering the system. A typical three-bedroom, 1,000-gallon tank should be pumped every three to four years.
- E. **Proper replacement** of failed systems may include programs or regulations to encourage upgrades of conventional systems, or cesspools and holding tanks, to more innovative alternative technologies.

Management strategies for reducing water quality impacts from septic systems (as well as cesspools and holding tanks) start with education and outreach to property owners so that they are better informed and able to properly operate and maintain their systems. Other management strategies include setting local regulations to enforce proper maintenance and inspection of septic systems and establishing funding mechanisms to support replacement of failing systems, prioritizing cesspools and holding tanks.

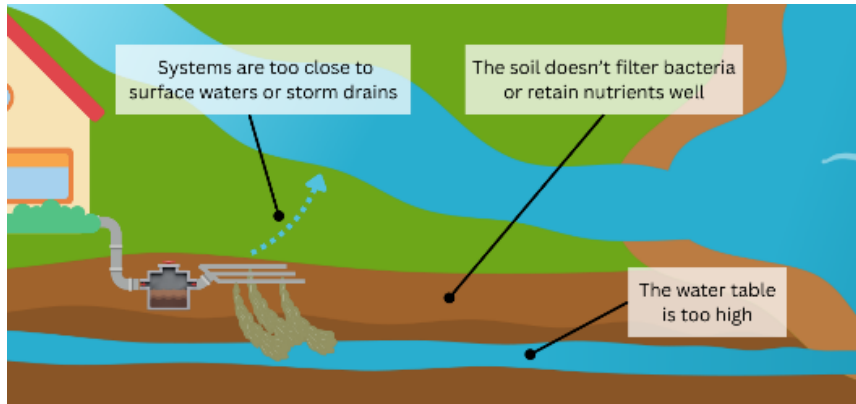
A simple “flush test” or visual glance is insufficient for identifying hidden environmental failures like slow phosphorus leaching. To be truly effective, septic inspections require specific checks, including:

- ☛ **Structural and Physical Diagnostics:** opening and inspecting the tank before and after pumping to identify structural cracks, groundwater intrusion, or failing inlet/outlet baffles. This also includes effluent load testing to ensure the absorption field handles peak daily capacity and that the distribution box has equal flow across all leach trenches.
- ☛ **Environmental and Hydrogeological Checks:** Conducting core soil or auger sampling down-gradient of the leach field to detect breakout, anaerobic scum layers, or biomat clogging.

The cost of these evaluations varies depending on the thoroughness required. A standard real estate or transfer inspection typically includes a visual inspection, dye or flow tests, and checking the tank levels. This typically costs between \$300-\$600. A full diagnostic inspection including tank pumping includes heavy-flow load testing, inspecting baffles, and video-scoping line integrity along with tank pumping. This typically costs between \$600-\$900. A technical environmental assessment for high-risk systems requires a permitted NHDES Septic Designer to conduct the inspection. This inspection includes digging test pits, soil morphology analysis, and determining the leaching field’s distance above the seasonal high-water table. This typically costs between \$1,000-\$2,500.

As an alternative to individual onsite systems, community septic systems have been implemented in other lakefront settings in New Hampshire to reduce nutrient loading and improve long-term maintenance and reliability. Under this approach, multiple homes are served by a shared treatment and leachfield system rather than individual septic systems. A key advantage is that system operation and maintenance are managed by a designated entity, such as a homeowner’s association or municipal body,

reducing the risk of system neglect or failure by an individual property owner. If properly designed, sited, and maintained, community septic systems can improve treatment performance and reduce phosphorus loading to surface waters.



Reasons that septic systems fail

However, siting considerations remain critical and need to ensure adequate phosphorus attenuation by maximizing separation from the shoreline, prioritizing soils with strong structure and higher iron and aluminum content and incorporating raised or engineered soil treatment areas whenever advisable.

4.2.4.1 Protecting Drinking Water Through Septic Infrastructure Management

To better understand local wastewater risk and support municipal planning, the Town of Northwood partnered with the Strafford Regional Planning Commission (SRPC) to conduct a targeted [septic infrastructure assessment](#) around Northwood Lake and Harvey Lake. Funded through a Local Source Water Protection Clean Water Grant by NHDES, this project informed the development of a proposed municipal Septic Ordinance for Northwood.

The SRPC mapping framework synthesized property records, environmental constraints, and system age to map nutrient loading risks. Parcel vulnerability was quantified through three distinct scoring metrics derived from three distinct metrics: (1) environmental risk score – proximity to surface waters, wetlands, groundwater, and soil leaching potential; (2) septic system infrastructure risk score – physical risk based on system age or lack of filed permits; (3) composite risk index – integrates soil limitations, environmental scores, and septic risk scores into a single visual model to prioritize areas.

By compiling soil constraints with system age, this mapping exercise enables the Town of Northwood and NLWA to protect high-vulnerable or poorly functioning soils relative to septic load and treatment to guide future remediation, inspections, and landowner outreach.

4.2.5 Fertilizer Use Prohibition

Management strategies for reducing water quality impacts from residential, commercial, and municipal fertilizer application start with education and outreach to property owners. New Hampshire law prohibits the use of fertilizers within 25 feet of a surface water. Outside of 25 feet, property owners can have their soil tested before considering application of fertilizers to their lawns and gardens to determine whether nutrients are needed and if so in what quantity or ratio. A soil test kit can be obtained through the [UNH Cooperative Extension](#). Many state and local governments are beginning to set restrictions on the use of fertilizers by prohibiting their use altogether or requiring soil tests to demonstrate a need for any phosphate application to lawns. The watershed municipalities could consider a similar prohibition, at the very least within a watershed zoning overlay for major lakes, ponds, and tributaries. In 2024, HB1293 was passed by the legislature to prohibit the sale of fertilizer with a phosphate content level greater than 0.67%.



4.2.6 Agricultural Practices

Manure and fertilizer management and planning are the primary tools for controlling nutrient runoff from agricultural areas. Direct outreach and education should be conducted for small farms and any larger-scale operations in the watershed. Agricultural best practices aim to reduce nutrient, sediment, and bacteria load into waterbodies while ensuring agricultural productivity; however, the selection of practices should consider local conditions such as climate, soil type, hydrology, land use, funding, and other factors to maximize effectiveness (EPA, 2004).

NRCS is a key resource for farmers and landowners in developing and implementing agricultural practices to improve water quality. Through various programs, the NRCS provides both financial and technical assistance for projects aimed at reducing runoff and improving soil health (Levy, 2023). In New Hampshire, the most implemented practices (by acre application) between 2005 and 2023 were cover cropping (31.8%) and conservation crop rotation (29%), which continue to be the two most popular practices to date (USDA, 2023a). Larger-scale agricultural operations can work with the NRCS to complete a Comprehensive Nutrient Management Plan. These plans address soil erosion and water quality concerns of agricultural operations through setting proper nutrient budgets, identifying the types and amount of nutrients necessary for crop production, and ensuring the appropriate storage and handling of manure. Manure should be stored or applied to fields properly to limit runoff of solids containing high concentrations of nutrients. Manure and fertilizer management involve managing the source, rate, form, timing, and placement of nutrients. Writing a Comprehensive Nutrient Management Plan is an ongoing process because it is a working document that changes over time. The Environmental Quality Incentives Programs (EQIP) through NRCS is one of their flagship programs with the highest rates of implementation in 2023 (64%). Other notable programs include the Conservation Program and Conservation Technical Assistance (USDA, 2023b).

These programs offered by the NRCS can serve as an essential resource for farmers, particularly in addressing environmental concerns in agricultural watersheds (USDA NRCS, 2024). Through continued

collaboration with the NRCS and other stakeholders, farmers in the Northwood Lake watershed can play a pivotal role in enhancing water quality while maintaining agricultural productivity, thus supporting two essential natural resources for community well-being in the region.

NRCS

Rockingham County Office

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Epping, NH 03042

[\(603\) 679-1587](tel:(603)679-1587)

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Concord, NH 03301

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To access the technical and financial support offered through these programs, it is recommended that farmers and landowners contact their local NRCS office. Information on agricultural best practices have been published in section 1 of the NRCS [Field Office Technical Guide](#) for New Hampshire, under the “NH Ag BMPs” section. In this document, agricultural practices are sorted into three main sections: manure, agricultural compost, and chemical fertilizer (Figure 33). These classifications support the initial identification of appropriate practices for each farm, field, or site, depending on local needs. Once the relevant practices are identified, producers can better understand which NRCS practices will support best practices implementation. A full list of NRCS practices are available in Section 4 of the [Field Office Technical Guide](#), with practices relevant to water quality highlighted in Table 13.

Many of the programs offered by the NRCS are implemented confidentially on private lands, and no public information was available regarding practices within the Northwood Lake watershed. Because of this confidentiality, there may be established agricultural best practices and/or current projects underway within the region not documented here. Nutrient load reductions from agricultural best practices were not calculated as part of the watershed survey and therefore not factored into the loads needed to reach the water quality goal. Any load reductions made on agricultural lands will therefore provide an extra margin of safety help the community reach their water quality goal.

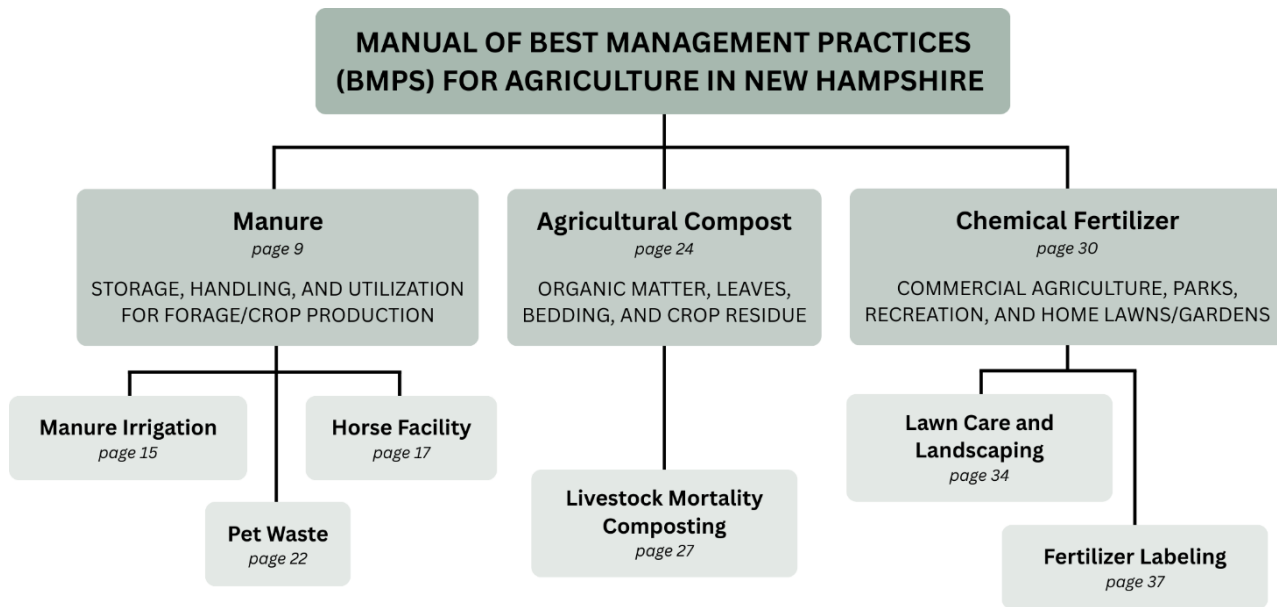


Figure 33. The major topics covered in the *Manual of BMPs for Agriculture in New Hampshire*, to orient producers to relevant sections. Relevant page numbers from the document are listed in each box.

Table 13. Conservation Practices covered by the Natural Resources Conservation Service (NRCS). Adapted from the *USDA Conservation Choices; Water Quality Practices*. The table is adjusted to meet current NH NRCS practices (USDA NRCS, 2022). A “Y” indicates that the conservation practice is effective in addressing the pollutant or resource concern; “n” indicates it is not. N = nitrogen. P = phosphorus. Sed = sediment.

Conservation Practice	Descriptions	N	P	Sed	NRCS Practice #
Cover Crop	Crops, including grasses and legumes for seasonal cover, conservation, and soil health.	Y	Y	Y	340, 328
Drainage Water Management	Water control structure to keep water in the root zone to support excess nutrient uptake before draining.	Y	Y	Y	587
Filter Strip	Strip of vegetation near water to remove pollutants from runoff and wastewater.	Y	Y	Y	393, 327, 386, 390
Manure Management	Manure storage until conditions are appropriate for field application.	Y	Y	n	318, 313
No-Till/Strip-Till	Reducing soil tillage to support soil health.	Y	Y	Y	329, 345, 346
Nutrient Management	Managing the amount, source, placement, and timing of plant nutrients and soil amendments.	Y	Y	n	590
Prescribed Grazing	Managing the harvest of vegetation by rotating grazing animals.	Y	Y	Y	528
Riparian Forest Buffer	Vegetation planted along streams or rivers to reduce nutrients and other pollutants in surface runoff.	Y	Y	Y	342, 391, 612
Wetlands	Marshy area with saturated soils to filter out nutrients, sediments, and other pollutants.	Y	Y	Y	659, 657

4.2.7 Pet Waste Management

Pet waste collection as a pollutant source control involves a combination of educational outreach and enforcement to encourage residents to clean up after their pets. Public education programs for pet waste management are often incorporated into a larger message of reducing pollutants to improve water quality. Signs, posters, brochures, and newsletters describing the proper techniques to dispose of pet waste can be used to educate the public and create a cause-and-effect link between pet waste and water quality (EPA, 2005). Adopting simple habits, such as carrying a plastic bag on walks and properly disposing of pet waste in dumpsters or other refuse containers, can make a difference. It is recommended that pet owners do not put dog and cat feces in a compost pile because it may contain parasites, bacteria, pathogens, and viruses that are harmful to humans and may or may not be destroyed by composting. "Pooper-scooper" ordinances are often used to regulate pet waste disposal. These ordinances generally require the removal of pet waste from public areas, other people's properties, and occasionally from personal property, before leaving the area. Fines are typically the enforcement method used to encourage compliance with these ordinances.



4.2.8 Nuisance Wildlife Controls

Human development has altered the natural habitat of many wildlife species, restricting wildlife access to surface waters in some areas and promoting access in others. Minimizing the impact of wildlife on water quality generally requires either reducing the concentration of wildlife in an area or reducing their proximity to a waterbody. There are a couple of options for combatting this:

Prohibit Feeding – Leverage educational outreach to discourage feeding of waterfowl or other wildlife. Consider developing an ordinance that prohibits the feeding of these animals.

Wildlife Repellent – Use scarecrows, kites, a daily human presence, or modification of habitat through plantings to reduce attractiveness of an at-risk area. Providing closed trash cans near waterbodies, as well as discouraging wildlife from entering surface waters by installing fences, pruning trees, or making other changes to landscaping, can reduce water quality impacts.

4.3 OUTREACH AND EDUCATION

Awareness through education and outreach is a critical tool for protecting and restoring water quality. Most people want to be responsible watershed stewards and not cause harm to water quality, but many are unaware of best practices to reduce or eliminate contaminants from entering surface waters.

The NLWA is the primary local entity for education and outreach campaigns in the watershed and for the development and implementation of the plan. The NLWA has remarkable local capacity to carry out protection efforts with four association officers and five directors, along with ___ volunteers and ___ members.

The NLWA should continue all aspects of their outstanding and robust education and outreach strategies, including the Lake Host program, educational workshops, parades, paddles, picnics, and annual meetings, and should consider developing new ones or improving existing ones to reach more watershed residents (refer to Section 5: Action Plan). Examples include providing educational materials to existing and new property owners, as well as renters, by distributing them at various locations. Materials may be distributed through many channels, including websites, newsletters, social media, community events, or community gathering locations. Additionally, the NLWA should continue to engage with local stakeholders such as conservation commissions, land trusts, municipalities, businesses, and landowners. Educational campaigns should include raising awareness of water quality, septic system maintenance, fertilizer and pesticide use, pet waste disposal, waterfowl feeding, invasive aquatic species, boat pollution, shoreline buffer improvements, gravel road maintenance, and stormwater runoff controls. Educational tools such as interactive story maps, QR-code enabled signs, youth programs, and the development of watershed boundary signs on roads entering the watershed can aim to deepen public understanding of watershed issues. The NLWA should collaborate with other local lake and watershed groups, such as the Bow Lake Camp Owner's Association, the Pleasant Lake Protective Association, NH Lakes, and others to combine forces on outreach and education initiatives. Below are photos of outreach by the NLWA.



4.4 ADAPTIVE MANAGEMENT APPROACH

Establishing formal NLWA subcommittees to coordinate an adaptive management approach is strongly recommended. This approach enables stakeholders to implement restoration actions in phases, using the best available information. Ongoing watershed and water quality monitoring help assess effectiveness of actions, allowing for strategy adjustments before the next restoration phase. Adaptive management ensures efficient resource use through SCM performance testing and monitoring while maintaining a continuous program with adequate funding, stakeholder guidance, and coordination to track long-term restoration progress. The adaptive management components for implementation efforts should include:



Maintaining an Organizational Structure

A diverse stakeholder group, including agencies, municipalities, businesses, and landowners, should coordinate watershed management actions, with a formal structure and clear communication.

Refer to Section 6.1 for more information on plan oversight.



Establishing a Funding Mechanism

A mix of grants, private donations, and municipal funding should be used to support implementation and management actions.

Refer to Section 6.3 for a list of potential funding sources.



Determining Management Actions

This plan provides a menu of restoration options which serve as a foundation for grant proposals. Once a funding mechanism is established, priority restoration projects can be designed and scheduled for implementation.

Refer to Section 5 for detailed management actions.



Continuing and Expanding the Community Participation Process

Plan development has actively involved a diverse group of stakeholders, and successful implementation will require their continued participation, along with expanded support, gathered through ongoing public awareness campaigns.

Refer to Section 4.3 for outreach recommendations.



Continuing the Long-Term Monitoring Program

A water quality monitoring program is necessary to track water quality and measure effectiveness of management practices.

Refer to Section 6.4 for monitoring options.



Establishing Measurable Milestones

A restoration schedule with milestones for actions and monitoring is essential for the plan's success. Environmental, social, and programmatic indicators have also been identified to track progress.

Refer to Sections 2.4 for the water quality goal and 6.5 for measurable milestones.

5 ACTION PLAN

5.1 ACTION PLAN

The Action Plan (Table 14) outlines the action items, responsible parties, approximate costs, an implementation schedule, and potential funding sources for each recommendation within the following major categories: (1) Watershed and Shoreline SCMs; (2) Road and Driveway Management; (3) Municipal Operations; (4) Municipal Land Use Planning and Zoning; (5) Land Conservation; (6) Septic System Management; and (7) Education and Outreach. The plan is designed to be implemented from 2026-2036 and is flexible to allow for new priorities throughout the 10-year implementation period as additional data are acquired.

Achieving long-term water quality goals cannot be accomplished by the Northwood Lake Watershed Association (NLWA) working in isolation; rather, success relies on building and strengthening vibrant partnerships with local stakeholders who share a commitment to natural resource protection (Figure 34). Because watershed boundaries transcend political lines, close collaboration with the towns of Northwood, Deerfield, Epsom, and Pittsfield is paramount. Engaging directly with local Boards of Selectmen, Planning Boards, Town Conservation Commissions, and Departments of Public Works ensures that watershed protection goals are directly woven into municipal ordinances, local land-use decisions, and infrastructure maintenance practices. This community-level effort is further enhanced by partnering with county conservation districts, specifically the Rockingham County Conservation District (RCCD) for Northwood and Deerfield, and the Merrimack County Conservation District (MCCD) for Epsom and Pittsfield, for broader conservation coordination and technical assistance. Similarly, cooperation with Regional Planning Commissions, including the Strafford Regional Planning Commission (SRPC) for Northwood, the Southern New Hampshire Planning Commission (SNHPC) for Deerfield, and the Central New Hampshire Regional Planning Commission (CNHRPC) for Epsom and Pittsfield, ensures that watershed goals are integrated into regional environmental planning. Protecting the shared waters and headwaters within the Northwood Lake watershed also means fostering strong networks with neighboring lake and neighborhood groups, such as the Pleasant Lake Preservation Association (PLPA), Lake Harvey Association (HLA), Jenness Pond Shore Owners Association (JPSOA), Long Pond Neighborhood/Road Associations, and the various Northwood Lake road associations for private roads. These groups are all critical for direct community outreach, education, action, and change. Finally, partnering with dedicated land conservation entities like the Northwood Area Land Management Collaborative (NALMC), the Southeast Land Trust, and Bear-Paw Regional Greenways leverages essential land protection and stewardship resources. By uniting these diverse partners, this action plan establishes a collective, resilient framework capable of effectively safeguarding water quality in Northwood Lake and throughout the watershed.

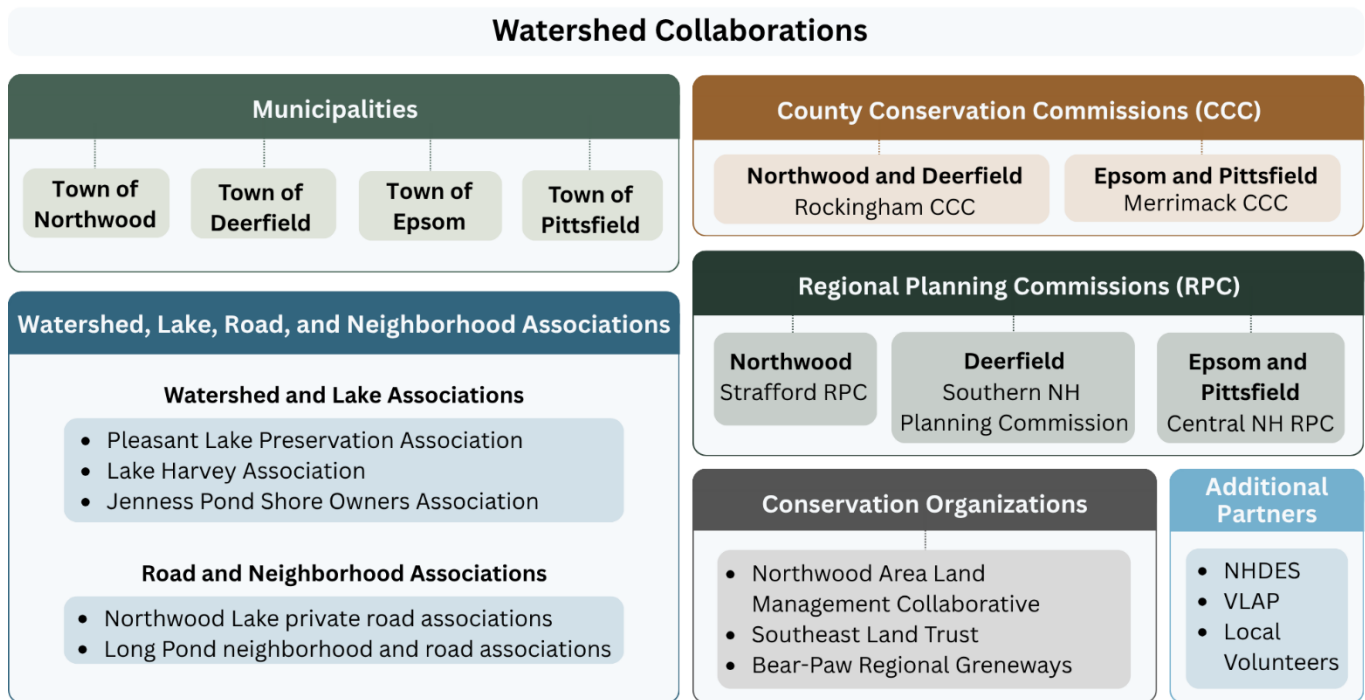


Figure 34. Organizations whose collaboration will help achieve the Water Quality Goal include municipalities; other watershed, lake, road, and neighborhood associations; county conservation districts; regional planning commissions; and conservation organizations.

Table 14. Action Plan for the Northwood Lake watershed.

Suggested Ranking	Category	Action Item	Responsible Party and Collaborations	Estimated Cost	Estimated Schedule	Potential Funding Sources
1	Education and Outreach	Form a collaborative or committee to take responsibility for this Action Plan. Recruit representatives from each organization in Figure 1 (and any other relevant stakeholders), and schedule regular meetings (e.g., quarterly or even once per year). An annual meeting over the winter may be beneficial so the group can review the year's WQ data. Additional meetings can be scheduled for targeted actions or goals (e.g., responding to a cyanobacteria bloom, seeking a grant, planning a workshop, etc.	NLWA, watershed towns, watershed associations, county conservation districts, regional planning commissions, land trusts, additional partners	None if done with existing staff or volunteers	2026-2036	None
2	Education and Outreach	Create flyers/brochures or other educational materials through printed or online mediums, regarding topics such as stormwater controls, road maintenance, buffer improvements, fertilizer and pesticide use, pet waste disposal, boat pollution, invasive aquatic species, waterfowl feeding, and septic system maintenance. Consider creating a "watershed homeowner" packet that covers these topics and is distributed (mailed separately or in tax bills or posted at community gathering locations or events) to existing and new property owners, as well as renters. Hold 1-2 informational workshops per year to update the public on restoration progress and ways that individuals can help. Cost is highly variable.	NLWA, other watershed associations, watershed towns, county conservation districts	\$6,000-\$35,000	2026-2036	Grants (319), CWSRF, watershed towns

Suggested Ranking	Category	Action Item	Responsible Party and Collaborations	Estimated Cost	Estimated Schedule	Potential Funding Sources
3	Education and Outreach	Share additional/dynamic information on watershed town webpages or a social media platform for the NLWA, such as water quality data, loon updates, weather conditions, and webcam, to generate more traffic to the NLWA website.	NLWA, watershed towns	None if done with existing staff or volunteers	2026-2036	None
4	Education and Outreach	Continue to provide resources for the Lake Host Program. Ensure there is a Lake Host on duty at the state boat at a minimum of every weekend throughout the summer season. Promote messages of “clean, drain, and dry” before boats enter or leave Northwood Lake to reduce the spread of invasive aquatic plants and animals.	NLWA, Town of Northwood	\$10,000	2026-2036	Grants (NHDES AIPC), Town of Northwood
5	Municipal Land Use Planning and Zoning	Present WMP recommendations to Select Board and Planning Board in Northwood and Deerfield (Epsom and Pittsfield as opportunities arise) and discuss the connection between municipal land use planning and water quality.	NLWA, watershed towns and regional planning commissions	\$1,000	2026-2027	Grants (319), CWSRF
6	Municipal Land Use Planning and Zoning	Incorporate WMP recommendations into municipal master plans and encourage regular review of the WMP Action Plan.	Watershed towns	None if done with existing staff. \$10,000-\$25,000 for consultant	2026-2036	Watershed towns

Suggested Ranking	Category	Action Item	Responsible Party and Collaborations	Estimated Cost	Estimated Schedule	Potential Funding Sources
7	Watershed and Shoreline SCMs	Complete design and construction of SCMs at the top ten highest ranked watershed survey sites. Achieves 15% (6.49 kg/yr P of 42.65 kg/yr P) of Objective 1 for Northwood Lake.	Watershed towns, other watershed lake associations, private landowners, and roadway associations	\$221,000-\$365,000	2026-2029	CWSRF, Grants (319, Moose Plate, NFWF 5-Star, ILFP), Watershed towns, private landowners
8	Watershed and Shoreline SCMs	Provide technical assistance and/or implementation cost sharing to watershed/shoreline property owners to install SCMs such as rain gardens and buffer plantings. Prioritize high impact properties identified during the shoreline survey. Cost assumes technical assistance and implementation cost sharing provided to the three high impact shoreline properties. Achieves 4% (1.73 kg/yr P of 42.65 kg/yr P) of Objective 1.	NLWA, Town of Northwood, RCCD	\$6,000-\$15,000	2026-2027	Grants (319, Moose plate), CWSRF, Landowners
9	Road and Driveway Management	Review practices for road and drainage maintenance currently used by public and private entities/groups and determine areas for improvement.	Watershed towns, county conservation districts, regional planning commissions	\$4,000	2027-2028	Watershed towns, Grants (CWSRF, Moose Plate, NFWF 5-Star)
10	Road and Driveway Management	Develop and/or update a written protocol for road maintenance best practices for both public and private roads. Incorporate water quality considerations and strategies into roadway evaluations and action plans. Consult action items here relating to road salt practices.	Watershed towns, NLWA, private road associations, county conservation districts	\$20,000	2027-2030	Watershed towns, Grants (Moose Plate, NFWF 5-Star), CWSRF

Suggested Ranking	Category	Action Item	Responsible Party and Collaborations	Estimated Cost	Estimated Schedule	Potential Funding Sources
11	Education and Outreach	Combine educational and outreach efforts among the NLWA, neighboring watershed associations, and local town conservation commissions to pool resources, generate larger audiences, and engage new homeowners. In partnership with NH Lakes and NHDES, coordinate and implement up to ten workshops and training sessions focused on water quality and ecosystem protection. Key Elements to Include: a) LakeSmart Program: Promote evaluations and certifications through NH Lakes to teach property owners lake-friendly practices (e.g., revegetating shoreline buffers with native plants, minimizing large grassy lawns, and raising mower blade heights to four inches). b) NHDES Soak Up the Rain NH: use this program's documents to support outreach. c) Property and System Management: Provide guidance on proper septic system maintenance and navigating municipal environmental regulations. d) Long-Term Sustainability: Cycle and repeat these core workshop topics every few years to continuously capture and educate new members and residents entering the watershed.	NLWA, watershed town conservation commission, other watershed lake associations	\$5,000-\$10,000	2027-2036	NH Lakes, Grants (319, Moose plate), CWSRF, watershed towns
12	Education and Outreach	Collaborate with NH LAKES on legislative or advocacy issues for NH Lakes.	NLWA, NH Lakes	None	2026-2036	None
13	Septic System Management	Look into whether any septic pumping companies would give a quantity or members discount to incentivize septic system pumping.	NLWA	None	2026-2027	None

Suggested Ranking	Category	Action Item	Responsible Party and Collaborations	Estimated Cost	Estimated Schedule	Potential Funding Sources
14	Septic System Management	Distribute educational materials to property owners about septic system function and maintenance.	Watershed towns, NLWA	\$3,000	2027, 2031, 2036	Watershed towns, Grants (319), CWSRF
15	Watershed and Shoreline SCMs	Provide technical assistance and/or implementation cost sharing to watershed/shoreline property owners to install SCMs such as rain gardens and buffer plantings. Prioritize the 20 moderate impact properties identified during the shoreline survey. Cost assumes technical assistance and implementation cost sharing provided to the twenty moderate impact shoreline properties. Achieves 14% (5.78 kg/yr P of 42.65 kg/yr P) of Objective 1.	NLWA, Towns of Northwood, Deerfield, and Epsom, regional planning commissions	\$50,000 - \$100,000	2028-2029	Grants (319, Moose plate), CWSRF, Landowners
16	Education and Outreach	Educate private property owners on questions to ask hired landscaping companies to ensure they are complying with shoreland fertilizer rules.	NLWA	\$1,000	2027-2036	Grants (319), CWSRF
17	Education and Outreach	Educate contractors and municipal staff about erosion and sediment control practices required on building plans. Work with watershed towns to ensure that there are sufficient resources to enforce permitting conditions.	Watershed towns, county conservation districts, regional planning commissions	\$4,000	2026-2036	Watershed towns, Grants (319), CWSRF
18	Road and Driveway Management	Contact the watershed towns regarding decreasing their road salt usage on town roads within the watershed due to worsening trends in water quality. Discuss reduced salt areas and low-salt approaches.	Watershed towns, NLWA	None	2027-2030	Watershed towns

Suggested Ranking	Category	Action Item	Responsible Party and Collaborations	Estimated Cost	Estimated Schedule	Potential Funding Sources
19	Road and Driveway Management	Participate in Green SnowPro training. Become Green SnowPro Certified once program rules for watershed towns have been adopted. The program works to educate, train, and certify "winter maintenance professionals in salt reduction practices that improve water quality while protecting public safety."	Watershed towns (Public Works/Road/Highway Departments)	\$150-\$250 per person per year	2027-2030	Watershed towns
20	Municipal Operations	Review and update winter operations procedures to be consistent with Green SnowPro best management practices for winter road, parking lot, and sidewalk maintenance. Continue practicing low salt application practices in the watershed.	Watershed towns (Public Works/Road/Highway Departments)	None	2027-2030	Watershed towns
21	Road and Driveway Management	Hold informational workshops on proper road/driveway management and winter maintenance and provide educational materials for homeowners about winter maintenance and sand/salt application for driveways and walkways. Cost assumes up to five workshops.	NLWA, watershed towns, county conservation districts, other watershed associations	\$5,000-\$10,000	2027, 2031	Grants (Moose Plate, NFWF 5-Star), CWSRF
22	Education and Outreach	Encourage private property and road owners to hire Green SnowPro certified commercial salt applicators.	NLWA, watershed towns, other watershed associations	None	2027-2036	None
23	Watershed and Shoreline SCMs	Complete design and construction of SCMs at the next fifteen highest ranked watershed survey sites as opportunities arise. Achieves 10% (4.41 kg/yr P of 42.65 kg/yr P) of Objective 1.	NLWA, Towns of Northwood and Pittsfield, other watershed lake associations, private landowners and roadway associations	\$393,000-\$680,000	2028-2031	CWSRF, Grants (319, Moose Plate, NFWF 5-Star, ILFP), watershed towns, private landowners, and associations
24	Septic System Management	Develop and maintain a watershed-wide septic inventory database to facilitate code enforcement of any septic system ordinances.	Watershed towns	\$5,000 per town.	2030-2036	Watershed towns, CWSRF

Suggested Ranking	Category	Action Item	Responsible Party and Collaborations	Estimated Cost	Estimated Schedule	Potential Funding Sources
25	Municipal Land Use Planning and Zoning	Meet with municipal staff to review recommendations to improve or develop ordinances addressing setbacks, buffers, lot coverage, low impact development, and open space. Refer to the Ordinance Review section for specific recommendations.	NLWA, watershed towns and regional planning commissions	\$4,000	2028-2036	Watershed towns, Regional Planning Commissions, Grants (319), CWSRF
26	Municipal Land Use Planning and Zoning	Adopt/strengthen zoning ordinance provisions and enforcement mechanisms to: 1) promote conservation sub divisions to allow development but also set aside land for conservation; 2) establish a lake protection overlay zoning ordinance that prohibits erosion from sites in sensitive areas (e.g., lake shorefront, along lake tributaries, steep slopes); 3) promote low impact development practices and reduce impervious areas; 4) require stormwater regulations that align with MS4 Permit requirements; 5) promote or require vegetative buffers around lake shore and tributary streams; 6) require shorefront “tear down and replace” home construction to be no more non-conforming than existing structures; 7) require shorefront seasonal to year-round conversions of homes to demonstrate no additional negative impacts to lake water quality; 8) enhance performance standards for unpaved roads to prevent erosion and protect lake water quality.	Watershed towns, regional planning commissions	None	2028-2032	Watershed towns

Suggested Ranking	Category	Action Item	Responsible Party and Collaborations	Estimated Cost	Estimated Schedule	Potential Funding Sources
27	Road and Driveway Management	Establish a routine street sweeping program for municipal paved roads at least twice in the springtime after snow melt and once in the summer/fall following heavy storms, while also encouraging homeowners to sweep their impervious surfaces after each snowmelt. Consider purchasing a street sweeper with neighboring towns to sweep up road salt and sand in dry weather periods between winter storms as our winters see more rain between snow events.	Watershed towns, private landowners	TBD	2028-2036	Watershed towns
28	Watershed and Shoreline SCMs	Work with NRCS to implement soil conservation practices such as stormwater control, manure storage, cover crops, no-till methods, timing of manure applications, and other agricultural BMPs which reduce erosion and nutrient pollution to surface waters from agricultural activities.	NRCS, watershed farm owners	TBD	2028-2036	NRCS
29	Road and Driveway Management	Establish inspection and maintenance agreements for private unpaved roads. Cost does not include the implementation of proper road maintenance by private landowners.	NLWA, watershed towns	\$4,000	2028-2032	Watershed towns, private landowners, Grants (319)
30	Watershed and Shoreline SCMs	Complete design and construction of SCMs at the remaining twenty-eight lower ranked watershed survey sites as opportunities arise (refer to Appendix B for complete list). Achieves 8% (3.22 kg/yr P of 42.65 kg/yr P) of Objective 1.	Watershed towns, other watershed lake associations, private landowners and roadway associations	\$579,000-\$925,000	2030-2036	CWSRF, Grants (319, Moose Plate, NFWF 5-Star, ILFP), watershed towns, private landowners
31	Land Conservation	Create and map a priority list of watershed areas that need protection based on the towns NRIs and Master Plans.	Watershed towns, county conservation districts, land trusts, NLWA	\$6,000-\$12,000	2031-2036	Grants (NFWF NEFRG, NAWCA), CWSRF, watershed towns

Suggested Ranking	Category	Action Item	Responsible Party and Collaborations	Estimated Cost	Estimated Schedule	Potential Funding Sources
32	Land Conservation	Maximize conservation of intact forest and other ecologically important properties through education, zoning, and public or private conservation.	Watershed towns, county conservation districts, land trusts, private landowners	TBD	2031-2036	Grants (Moose Plate, LCHIP, RCPP, NAWCA, LWCF, ACEP, CSP, EQIP, NFWF NEFRG), watershed towns, private landowners
33	Land Conservation	Enhance community education regarding private land conservation easements. Host workshops educating landowners on the benefits.	Watershed towns, county conservation districts, land trusts, NLWA	TBD	2031-2036	Grants (Moose Plate, LCHIP, RCPP, NAWCA, LWCF, ACEP, CSP, EQIP, NFWF NEFRG), watershed towns, private landowners
34	Land Conservation	Inspect wetlands for Prime Wetland Designations and survey for vernal pools within the watershed.	Watershed towns, county conservation districts	TBD	2031-2033	Watershed towns
35	Land Conservation	Identify potential conservation buyers and property owners interested in easements within the watershed. Use available funding mechanisms, such as the Regional Conservation Partnership Program (RCPP) and the Land and Community Heritage Investment Program (LCHIP), to provide conservation assistance to landowners.	Watershed towns, county conservation districts, land trusts, NLWA	TBD	2031-2036	Grants (Moose Plate, LCHIP, RCPP, NAWCA, LWCF, ACEP, CSP, EQIP)
36	Education and Outreach	Offer workshops for landowners with ten acres or more for NRCS assistance with land conservation. Cost assumes up to two workshops.	NLWA, NRCS	\$5,000	2031-2036	Grants (RCPP, ACEP, CSP, EQIP)

Suggested Ranking	Category	Action Item	Responsible Party and Collaborations	Estimated Cost	Estimated Schedule	Potential Funding Sources
37	Municipal Operations	Review and attain MS4 management standards for towns (regardless of MS4 designation), including infrastructure mapping, erosion and sediment controls, illicit discharge programs, and good housekeeping practices such as regular catch basin cleaning.	Watershed towns (Public Works/Road/Highway Departments)	TBD	2032-2036	Watershed towns
38	Municipal Operations	Identify best practice design standards for stormwater control measures, including deep sump catch basins.	Watershed towns (Public Works/Road/Highway Departments)	None	2032-2036	None
39	Watershed and Shoreline SCMs	Repeat the shoreline surveys in 5-10 years, and especially when updating the WMP. Use the results to target education and technical assistance for high impact sites. Cost assumes hired consultant for survey and summation of shoreline survey results.	NLWA	\$5,000-\$10,000	2031, 2036	Grants (Moose plate), CWSRF
40	Municipal Land Use Planning and Zoning	Increase municipal staff capacity through code enforcers/building inspectors for inspections and enforcement of stormwater regulations on public and private lands.	Watershed towns	TBD	2030-2036	Watershed towns
41	Septic System Management	Institute a minimum pump-out/inspection interval and develop an ordinance or health regulation to implement it for shorefront septic systems (e.g., once every 3-5 years). Pump-outs (~\$300-\$500 per system) are the responsibility of the owner.	Towns of Northwood, Deerfield, and Epsom	None	2030-2036	None
42	Septic System Management	Expand the regulations pertaining to certain subsurface wastewater disposal systems require all property sales to have a septic system inspection on file within the past three years. Require upgrades and repairs if needed.	Watershed towns	\$5,000-\$15,000	2030-2036	None

Suggested Ranking	Category	Action Item	Responsible Party and Collaborations	Estimated Cost	Estimated Schedule	Potential Funding Sources
43	Septic System Management	Evaluate locations of older and/or noncompliant septic systems (including cesspools or holding tanks) to identify clusters where conversion to community septic systems might be desirable.	NLWA, Towns of Northwood, Deerfield, and Epsom	TBD	2030-2036	CWSRF, watershed towns
44	Septic System Management	Conduct a septic system risk assessment to identify areas in town which may be more susceptible to septic system malfunction due to high groundwaters, soil filtering capacity, risk of flooding, and age of infrastructure.	Watershed towns	\$20,000	2030-2036	Watershed towns
45	Road and Driveway Management	Continue providing education and training to contractors and municipal staff on protocols for road maintenance best practices. Assumes one workshop.	Watershed towns, NLWA, other watershed associations, private road associations	\$2,000	2034-2036	Watershed towns, Grants (Moose Plate, NFWF 5-Star), CWSRF
46	Land Conservation	Ensure towns maintain up to date (<10 years old) Natural Resource Inventories (NRIs) that are adapted into their master plans. Northwood (2024, Natural Resources and Water Resources chapter in the master plan), Deerfield (standalone document update in progress), Epsom (2024, Natural Resources chapter in Master Plan), and Pittsfield (standalone document in progress). Cost estimated at \$25,000 per town.	Watershed towns	\$100,000	2034-2036	Watershed towns, Grants (NFWF NEFRG), CWSRF

5.2 POLLUTANT LOAD REDUCTIONS

Objective 1 of the water quality goal for Northwood Lake is a phosphorus load reduction of 14.13 kg/yr to achieve an in-lake total phosphorus concentration of 12.1 ppb. Doing so reduces predicted chlorophyll-*a* concentrations and the likelihood of cyanobacteria blooms in the lake. The following opportunities to achieve Objective 1 were identified in the watershed based on field and desktop analyses:

- 1** Remediating the 52 watershed survey sites prevents an estimated **14.13 kg/yr** of phosphorus from entering Northwood Lake.
- 2** Treating shoreline sites could reduce the phosphorus load to Northwood Lake by **20.82 kg/yr** for the 115 parcels identified as having an impact on Northwood Lake.
- 3** Upgrading the 77 shorefront septic systems older than 25 years is estimated to reduce the phosphorus load by **7.7 kg/yr**.

Total potential load reduction for Northwood Lake = 42.65 kg/yr
(meets 100% of reductions needed to achieve Objective 1 for Northwood Lake; Table 15)

Non-structural SCMs such as educating homeowners about septic system maintenance, fertilizer use, and residential stormwater management may also contribute to reducing phosphorus loading to Northwood Lake beyond what has been identified through field surveys and desktop analyses (watershed survey, shoreline survey, and septic system inventory), helping to meet the water quality goal. Preventing septic system failures, reducing residential lawn fertilizer use, and improving stormwater management at the property scale were not included in the goal attainment scenario above.

Objective 2 is preventing or offsetting additional phosphorus loading from anticipated new development. That objective can be met through ordinance revisions that implement low impact development strategies and encourage cluster development with open space protection and together with conservation of key parcels of forested and open land.

It is important to note that while the objectives focus on phosphorus, treating stormwater and sediment erosion will reduce many other pollutants to the lake. These pollutants would likely include:



Other nutrients
(e.g., nitrogen)



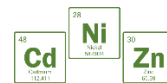
Petroleum products



Bacteria



Road salt/sand



Heavy metals
(cadmium, nickel, zinc, etc.)

Without a monitoring program in place to measure these other pollutants, it will be difficult to track the success of efforts that reduce these other pollutants. However, there are various spreadsheet models available that can estimate reductions in these pollutants depending on the types of SCMs installed.

These reductions can be tracked to assess long-term response. If additional monitoring funds are available, chloride (road salt), bacteria, and nitrogen sampling would be useful additions.

Table 15. Breakdown of phosphorus load sources and modeled water quality for current and target conditions to meet the water quality goal (Objective 1) and that reflect all field identified reduction opportunities in the watershed. Reduction percentages are based on the modeled current condition value for each parameter. kg/yr = kilograms per year. ppb = parts per billion.

Parameter	Unit	Modeled Current Condition	Modeled Target Condition	Reduction (unit, % change)
Total phosphorus load (all sources) ¹	kg/yr	753.9	711.3	-42.65 (6%)
(A) Background phosphorus load ²	kg/yr	183.0	183.0	0 (0%)
(B) Disturbed (human) phosphorus load ³	kg/yr	570.9	528.3	-42.65 (7%)
(C) Developed land use phosphorus load	kg/yr	511.7	476.8	-34.95 (7%)
(D) Septic system phosphorus load	kg/yr	29.9	37.6	7.7 (-29%)
(E) Internal phosphorus load	kg/yr	29.4	29.4	0 (0%)
In-lake total phosphorus*	ppb	12.8	12.1	-0.7 (5%)
In-lake chlorophyll- <i>a</i> ⁴	ppb	4.3	4.0	-0.3 (7%)
In-lake Secchi disk transparency*	meters	3.3	3.4	0.1 (-3%)
In-lake bloom probability*	days	26.0	19.0	-7 (27%)

¹ Total phosphorus load (all sources) = A + B

² Sum of forested/water/natural land use load, waterfowl load, and atmospheric load

³ Sum of developed land use load, shorefront septic system load, and internal load (B = C+D+E)

⁴ Observed mean chlorophyll-*a* concentrations are 3.6 ppb. A reduction of -0.3 ppb would produce a target condition of 3.3 ppb.

* Water quality parameters were sourced from the model and represent average annual (not summer) conditions.

6 IMPLEMENTATION AND EVALUATION

The following section outlines the oversight structure, estimated implementation costs, and funding strategy for the recommended items in the Action Plan (Section 5), along with the monitoring plan and performance indicators to track progress over time.

6.1 PLAN OVERSIGHT

Successful implementation of this plan will depend on the continued strong coordination led by NLWA and supported by a diverse group of partners including municipal boards, conservation commissions, state and federal agencies, non-profits, land trusts, schools, businesses, and local landowners. Regular meetings and collaboration among these groups will be essential to fund, implement, and track progress on management actions. The Action Plan (Section 5) identifies the stakeholder groups responsible for each action. It should be updated every 2, 5, and 10 years to track measurable milestones such as SCM installations, volunteer engagement, and secured funding.

Roles and Responsibilities

NLWA	Continue to lead plan oversight, water quality monitoring, outreach, and fundraising for stewardship and restoration projects. Provide administrative and grant support for SCM implementation and education/outreach efforts.
Municipalities	Continue to address nonpoint source pollution, maintain roads using best practices, and consider adopting ordinances that protect water quality.
Conservation Commissions	Continue to collaborate with municipal staff to help implement recommended actions.
NHDES	Offer technical assistance, permit approval, and the opportunity for financial assistance through EPA Section 319 of the Clean Water Act that supports the NHDES Watershed Assistance Grant Program and other funding programs.
Private Landowners	Increase awareness and adopt land management practices that minimize pollutant runoff.

Reducing nutrient loading across the watershed will require a sustained, community-wide effort. Because phosphorus inputs come from many diffuse sources, such as development, roads, and septic systems, continued collaboration, adaptability, and commitment will be key to long-term water quality improvement.

6.2 ESTIMATED COSTS

Achieving the water quality goals and objectives outlined in Section 2.4 will depend on available funding and labor resources. The strategy focuses on reducing phosphorus loading through a combination of targeted actions, including phosphorus source control, continued water quality monitoring, and expanded education and outreach. Additional measures, though harder to quantify, such as revising local ordinances to require low impact development practices for new development, identifying and replacing failing septic systems, maintaining roads properly, and improving agricultural practices, will also be critical (see Section 5: Action Plan for details).

With a dedicated stakeholder group in place and with the help of grant or local funding, it is possible to achieve the target phosphorus reductions and meet the established water quality goal for Northwood Lake in the next ten years. **Successful implementation is estimated to cost over a million dollars over the next ten or more years** (Table 16). These estimates will need to be refined as new information becomes available and do not include costs borne by private landowners, such as septic upgrades or private road maintenance.

Table 16. Estimated total phosphorus load reduction and total and annual costs for implementation of the Action Plan. Actions 1, 4, and 6 are necessary to achieve the water quality goal. The other actions are also important, but it is more challenging to quantify their total phosphorus reduction and costs. kg/yr = kilograms per year.

Planning Action	Total Phosphorus Reduction (kg/yr)	Estimated Total Cost	Estimated Annual Cost
1. Watershed and Shoreline SCMs	34.95	\$1,254,000 - \$2,095,000	\$125,400 - \$209,500
2. Road and Driveway Management	<i>TBD</i>	\$35,450 - \$40,750	\$3,545 - \$4,075
3. Municipal Operations	<i>TBD</i>	<i>TBD</i>	<i>TBD</i>
4. Municipal Land Use Planning and Zoning	105.6*	\$15,000 - \$30,000	\$1,500 - \$3,000
5. Land Conservation	<i>Included in land use planning and zoning</i>	\$106,000 - \$112,000	\$10,600 - \$11,200
6. Septic System Management	7.70	\$48,000 - \$58,000	\$4,800 - \$5,800
7. Monitoring	<i>TBD</i>	<i>TBD</i>	<i>TBD</i>
8. Education and Outreach	<i>TBD</i>	\$31,000 - \$65,000	\$3,100 - \$6,500
Total Phosphorus Reduction from Current Conditions	42.65	\$1,489,450 - \$2,400,750	\$148,945 - \$240,075

* Estimated increase in phosphorus load from future development in the next ten years to be avoided through changes to land use planning and zoning which better protect water quality. Not included in total.

6.3 FUNDING STRATEGY

It is important that NLWA develop a strategy to collect the funds necessary to implement the recommendations listed in the Action Plan (Section 5). Funding to cover ordinance revisions and third-party review could be supported by municipalities through tax collection (as approved by majority vote by town residents). Monitoring and assessment funding could come from a variety of sources, including state and federal grants, municipalities, or donations. Funding to improve septic systems, roads, and shoreland zone buffers would likely come from private landowners. As the plan evolves into the future, the establishment of a funding subcommittee will be a key part in how funds are raised, tracked, and spent to implement and support the plan. Listed below are state and federal funding sources that could assist NLWA with future water quality and watershed work for Northwood Lake.

Funding Options



Water Quality and Wastewater Infrastructure

- **EPA Clean Water Act Section 319 Grants (NHDES Watershed Assistance Grants)**
\$50,000–\$150,000 for two-year projects to reduce nonpoint source pollution and restore impaired waters. Restoration priorities are identified in the NH Nonpoint Source Management Program Plan (NHDES, 2024). These grants are only available for the implementation of WMPs.
- **NHDES Cyanobacteria Mitigation Fund**
The Cyanobacteria Mitigation Fund was established by the New Hampshire legislature in 2023 to help defray the costs of implementing nutrient control practices aimed at reducing chronic and extended cyanobacteria blooms. Municipalities, community water systems, and non-profit lake and river watershed associations are eligible to apply for Cyanobacteria Mitigation Fund assistance. Funding supports projects that implement strategies outlined in watershed management or lake protection plans, with the goal of improving water quality and mitigating harmful algal blooms. Applicants should refer to Administrative Rule Env-Wq 2300 for eligibility requirements and application procedures.
- **Clean Water State Revolving Fund (CWSRF)**
Low-interest loans for wastewater system upgrades and stormwater improvements for nonpoint source pollution prevention and watershed protection and restoration. While CWSRF implementation loans are available, they are more limited in scope. Interested parties should consult with NHDES staff to explore potential opportunities.

- **National Fish and Wildlife Foundation Five Star and Urban Waters Restoration Grants (NFWF 5-Star)**

Funds for wetland, riparian, in-stream and/or coastal habitat restoration; design and construction of green infrastructure SCMs; water quality monitoring/assessment; outreach and education which address water quality issues in priority watersheds, such as erosion due to unstable streambanks, pollution from stormwater runoff, and degraded shorelines caused by development.

- **USDA Water and Waste Disposal Loan and Grant Program**

Supports drinking water, stormwater, and sewage systems in rural towns of less than 10,000 residents.

- **EPA Sewer Overflow and Stormwater Reuse Municipal Grants**

Funds sewer and stormwater infrastructure upgrades, including inspection technologies.

- **Aquatic Invasive Plant Control, Prevention and Research Grants (NHDES AIPC)**

Funds are available each year for projects that prevent new infestations of exotic plants, including outreach, education, Lake Host Programs, and other activities.



Land Conservation and Habitat Protection

- **Land and Community Heritage Investment Program (LCHIP)**

Matching funds for preserving natural, historical, and cultural resources.

- **Aquatic Resource Mitigation Fund**

Compensatory mitigation funding for wetland and stream restoration/enhancement.

- **North American Wetlands Conservation Act (NAWCA) Grants**

Matching funds for wetland and upland habitat conservation benefiting migratory birds.

- **National Park Service Land and Water Conservation Fund Grant Program (LWCF)**

Funds for acquisition of parkland or conservation land; creation of new parks; renovations to existing parks; and development of trails.

- **National Fish and Wildlife Foundation Northeast Forest and River Fund (NFWF NEFRF)**

\$50,000-\$200,000 for projects that restore and sustain healthy forests and rivers through habitat restoration, fish barrier removal, and stream connectivity such as culvert upgrades.



Agriculture, Forestry, and Land Stewardship

- **US Department of Agriculture Conservation Stewardship Program (CSP)**

Supports conservation activities on working agricultural and forest lands.

- **US Department of Agriculture Environmental Quality Incentives Program (EQIP)**
Technical and financial support for agriculture and non-industrial forestry projects that improve environmental health.
- **Agricultural Conservation Easement Program (ACEP)**
Protects farmland, restores wetlands, and maintains grazing land conservation values.
- **Nutrient Management Loan Program**
Assists farms with projects like composting, irrigation, and treatment facilities.
- **Regional Conservation Partnership Program (RCPP)**
Funds collaborative land management, restoration, and conservation projects on agricultural land or non-industrial private forest land to achieve conservation benefits and address natural resource challenges.



SCMs, Planning, and Flood Resilience

- **New Hampshire State Conservation Committee Moose Plate Grants**
Up to \$40,000 for projects including SCMs, flood resilience, water quality, conservation planning, and land conservation.

6.4 MONITORING PLAN

Northwood Lake has an impressive amount of water quality data. Continued monitoring to evaluate the effectiveness of the plan is important. At a minimum, **NLWA should continue the excellent data collection occurring presently. Routine monitoring for temperature and dissolved oxygen, Secchi disk transparency, total phosphorus, conductivity, chloride, pH, and turbidity should remain a priority at all long-term monitoring locations such as NORNORED.** NLWA should continue to collaborate with the VLAP program and submit all data to the NHDES for review and incorporation into the state Environmental Monitoring Database each year. Given the available historic data summarized in this WMP, the following recommendations are identified to enhance existing monitoring efforts as resources and funding allow. Recommendations to enhance monitoring are prioritized below based on a combination of feasibility and importance.

1. Additional Dissolved Oxygen and Temperature Profiles

If NLWA has access to a dissolved oxygen and temperature meter, we recommend that profiles are collected at least monthly from May 15 to September 30 each year between the hours of 10am and 2pm. Additionally a dissolved oxygen and temperature profile should be collected whenever grab samples are collected from the deep spot, which can serve as the monthly profile. If resources allow, profiles may be collected as frequently as biweekly during this period. All data should be submitted to the NHDES VLAP program.

From 1979 through 2025, only 28 and 27 profiles were collected at the deep spot for dissolved oxygen and temperature respectively. It will be important to continue collecting dissolved oxygen and temperature profiles at the deep spot throughout the summer and into September when waters are at their warmest to assess whether the amount of water that is anoxic extends from its current location near the lake bed up into shallower depths.

2. Continue Routine Monitoring for Chloride, Specific Conductivity, Turbidity, and pH

Maintaining and expanding long-term datasets is a critical component of environmental assessments. We recommend NLWA continue monthly sampling (June-August) for chloride, specific conductivity, turbidity, and pH at the deep spot (NORNORED). Although current chloride and specific conductivity levels do not pose an immediate threat, they are steadily increasing and could eventually push the lake toward chronic chloride toxicity. Proactively reducing salt use and addressing erosion in the watershed will help protect Northwood Lake from future impacts. Additional sites may be sampled at lake inlet and outlet stream(s) as resources allow. Observations of weather conditions during the 72 hours prior to each sampling event should be recorded to help interpret results, particularly if sampling is conducted following storm events.

3. Continue Routine Monitoring for *E. Coli* at all Public Access Points and Beaches

Sampling for fecal contamination at public beaches and public access points should remain a priority for NLWA and the community. At a minimum, sampling should be conducted at the two public beaches and the WTC summer camp monthly throughout the summer season and following any large storm events. Though not a beach or public access point, sampling may continue at the Horse Farm site as funding allows. Stormwater may increase fecal contamination

in surface waters by transporting bacteria from animal waste on the land or raising ground water to aid in transporting bacteria from malfunctioning septic systems. Continue educating the public if concentrations remain elevated at public access points. Implement additional measures to reduce contamination including but not limited to waterfowl deterrents, pet waste signage and receptacles, and promoting proper septic system maintenance, and inspection/pump out schedules.

4. **Continue Routine Monitoring at Tributary Sites**

Tributaries play an important role in lake water quality and should also be routinely monitored. Many tributary sites around Northwood Lake have shown increasing (worsening) trends for specific conductivity and chloride concentrations. We recommend collecting grab samples for total phosphorus, chloride, and specific conductivity from primary tributaries to the lake during three wet and three dry weather conditions each year. This would help identify which tributaries are consistently contributing the most to the lake to help guide mitigation strategies.

5. **Phyto- and Zooplankton Analysis**

Due to the noted shift in zooplankton communities between the two trophic surveys and the dominance of cyanobacteria in the phytoplankton community, we recommend monthly (May - September) composite samples/plankton tows for phytoplankton and zooplankton analysis to evaluate biological composition over the season, if resources are available. This will also assist with monitoring cyanobacteria relative to other phytoplankton communities in Northwood Lake.

6.5 INDICATORS TO MEASURE PROGRESS

The following **environmental**, **programmatic**, and **social** indicators and associated milestones will help track progress toward meeting the water quality goal and objectives (Table 17). Milestones are set for short-term (2029), mid-term (2032), and long-term (2036) intervals, based on actions identified in the Action Plan (Section 5). These milestones support periodic plan updates, ensure ongoing relevance, and help NLWA determine whether adjustments are needed if targets are not being met.

Environmental indicators	directly measure conditions in the watershed and reflect the relationship between pollutant sources and water quality. They assume implementation of recommended actions from the Action Plan.
Programmatic indicators	track watershed protection and restoration activities that help to achieve the water quality goal.
Social indicators	measure shifts in community practices and behaviors that support management measures and water quality improvement.

For the Environmental Indicators in Table 17, the total phosphorus concentration steps down over a few years to meet Objective 1 of the water quality goal. Chlorophyll-*a* reductions were calculated as the difference between the modeled current chlorophyll-*a* concentration and the expected chlorophyll-*a*

concentration if the goal (a decrease of 0.3 ppb) is achieved; then this difference was applied to the current measured chlorophyll-*a* concentration. Similarly, the Secchi disk transparency (SDT) milestones were set as the difference between the modeled current SDT depth and the expected SDT depth if the goal (an increase of 0.1 meters) is achieved, then applying this difference to the current measured SDT depth. This approach accounts for the lower observed chlorophyll-*a* and deeper observed SDT depth than those that were modeled.

Table 17. Environmental, programmatic, and social indicators for the Northwood Lake WMP. Milestones are cumulative, starting at year 1 (2027). ppb = parts per billion.



Environmental Indicators

Milestone	2029	2032	2036
Achieve an average deep spot upper water total phosphorus concentration of 12.1 ppb or lower.	<12.8 ppb	<12.4 ppb	<12.1 ppb
Achieve an average deep spot upper water chlorophyll- <i>a</i> concentration of less than 3.3 ppb.	<3.6 ppb	<3.4 ppb	<3.3 ppb
Eliminate the occurrence of cyanobacteria or algal blooms in Northwood Lake (milestones based on NHDES-issued cyanobacteria warnings from 2023).	20 days per year	10 days per year	0 days per year
Achieve an average deep spot Secchi disk transparency (SDT) reading of greater than 3.7 meters.	3.6 meters+	3.7 meters+	3.7 meters+
Continue to control the spread of invasive aquatic species.	Minimal invasives	Minimal invasives	Absence of invasives

Table 17. Continued



Programmatic Indicators

Milestone	2029	2032	2036
Amount of funding secured from municipal/private work, fundraisers, donations, and grants.	\$500,000	\$1,000,000	\$1,500,000
Number of nonpoint source sites remediated.	12	25	50
Percentage of shorefront properties with LakeSmart certification.	25%	50%	75%
Number of watershed/shoreline properties receiving technical assistance for implementation cost sharing.	12	24	50
Number of workshops and trainings for stormwater improvements to residential properties (e.g., NH Lakes).	1	2	5
Number of updated or new ordinances that target water quality protection.	1	2	3
Number of new municipal staff for inspections and enforcement of regulations.	1	1	2
Number of voluntary or required septic system inspections (seasonal conversion and property transfer).	10	25	50
Number of septic system upgrades.	2	10	25
Number of informational workshops and/or trainings for landowners, municipal staff, and/or developers/landscapers on local ordinances, watershed goals, and/or best practices for road management and winter maintenance.	1	5	10
Number of parcels with new conservation easements or number of parcels put into permanent conservation.	1	2	5
Number of watershed-based educational materials distributed or articles published.	500	1,000	3,000
Number of new best practices for road management and winter maintenance implemented on public and private roads by the municipalities.	2	5	10
Number of municipalities fully implementing key aspects of the MS4 program (regardless of being required to do so).	1	2	3
Number of meetings and/or presentations to municipal staff and/or boards related to the WMP.	2	5	10
Number of Comprehensive Nutrient Management Plans completed or NRCS technical assistance provided for farms in the watershed.	1	2	3

Table 17. Continued

Social Indicators

Milestone	2029	2032	2036
Number of new association members.	10	25	50
Number of volunteers participating in educational campaigns.	25	50	75
Number of people participating in informational meetings, workshops, trainings, SCM demonstrations, or group septic system pumping.	100	250	500
Number of watershed residents installing conservation practices on their property and/or participating in LakeSmart.	30	75	150
Number of municipal Public Works staff receiving Green SnowPro training.	1	3	5
Number of groups or individuals contributing funds for plan implementation.	25	50	100
Number of newly trained water quality and invasive species monitors.	2	4	6
Percentage of residents making voluntary upgrades or maintenance to their septic systems (with or without free technical assistance), particularly those identified as needing upgrades or maintenance.	10%	25%	50%
Number of farmers working with NRCS or CCCD.	1	2	3
Number of weekly visitors to the NLWA website.	25	50	100

ADDITIONAL RESOURCES

[Buffers for wetlands and surface waters: a guidebook for New Hampshire municipalities.](#) Chase, et al. 1997. NH Audubon Society.

[Commercial Green SnowPro Certification.](#) New Hampshire Department of Environmental Services.

[Conserving your land: options for New Hampshire landowners.](#) Lind, B. 2005. Center for Land Conservation Assistance / Society for the Protection of New Hampshire Forests.

[Environmental Fact Sheet: Erosion Control for Construction within the Protected Shoreland.](#) New Hampshire Department of Environmental Services, SP-1, 2020.

[Gravel road maintenance manual: a guide for landowners on camp and other gravel roads.](#) Maine Department of Environmental Protection, Bureau of Land and Water Quality. April 2010.

[Gravel roads: maintenance and design manual.](#) U.S. Department of Transportation, Federal Highway Program. November 2000. South Dakota Local Transportation Assistance Program (SD LTAP).

[Innovative land use techniques handbook.](#) New Hampshire Department of Environmental Services. 2008.

[Landscaping at the water's edge: an ecological approach.](#) University of New Hampshire, Cooperative Extension. 2007.

[Municipal Green SnowPro Certification.](#) New Hampshire Department of Environmental Services.

[New Hampshire Homeowner's Guide to Stormwater Management: Do-It-Yourself Stormwater Solutions for Your Home.](#) New Hampshire Department of Environmental Services, Soak Up the Rain New Hampshire. Revised November 2019.

[New Hampshire Stormwater Manual.](#) University of New Hampshire Stormwater Center, Comprehensive Environmental, Inc., New Hampshire Department of Environmental Services. 2025.

[NHDES Fact Sheets on Watersheds, Low Impact Development, Snow and Ice, and Salt Reduction.](#) New Hampshire Department of Environmental Services.

[NHDES Road Salt Reduction.](#) New Hampshire Department of Environmental Services.

NRCS [Field Office Technical Guide \(FOTG\)](#) for New Hampshire to provide information regarding agricultural BMPs.

[Protecting water resources and managing stormwater.](#) University of New Hampshire, Cooperative Extension and Stormwater Center. March 2010.

NHDES Fact Sheets

[Cyanobacteria in New Hampshire Waters.](#) WD-WMB-10, 2023.

[Erosion Control for Construction within the Protected Shoreland.](#) SP-1, 2020.

[Lake Eutrophication.](#) WD-BB-3, 2019.

[Lawn Care within the Protected Shoreland](#). SP-2, 2020.

[New Hampshire Fish Consumption Guidelines](#). ARD-EHP-25, 2021.

[New Hampshire Volunteer Lake Assessment Program \(VLAP\)](#). WB-BB-26, 2019.

[Phosphorus: Too much of a good thing](#). WD-BB-20, 2019.



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APPENDIX A: ZONING ACRONYMS

Acronyms for town zoning districts.

Town	Acronym	Zoning District
Northwood	N-G	General District
	N-G_WPOD	Wellhead Protection Overlay District
Deerfield	D-AR	Agricultural-Residential District (AR)
Epsom	E-R/A	Residential/Agricultural Zone (R/A)
	E-R/C	Residential/Commercial Zone (R/C)
Pittsfield	P-RD	Rural District
Strafford	S-A/R	Agricultural/Residential

APPENDIX B: SCM MATRIX AND WATERSHED SURVEY

Site ID, location description, water quality impact, estimated load reduction, and implementation costs for the 53 nonpoint source sites identified in the Northwood Lake watershed. Pollutant load reduction and cost estimates are preliminary and are for planning purposes only. Cost estimates are based on pre-COVID19 ranges (adjusted for 2025 inflation), and thus actual construction costs could be highly variable at this time. Sites are priority ranked from 1-52 for lowest to highest cost per kilogram of phosphorus load reduced with remediation and weighted by impact.

Site ID	Location	Impact	Town	TP (kg/yr)	TN (kg/yr)	TSS (metric tons/yr)	Low Cost Est.	High Cost Est.	Avg. Cost Est.	Rank
NWL-27	Frery Road	Low	Northwood	0.42	1.08	1.60	\$4,000	\$5,000	\$4,500	1
NWL-29	Lagoon Road - Stream Crossing	Moderate	Northwood	0.46	1.18	1.74	\$5,000	\$10,000	\$7,500	2
NWL-26	Lynn Lane	High	Northwood	0.14	0.37	0.54	\$5,000	\$5,000	\$5,000	3
NWL-25	Griffin Brook at Route 107	High	Epsom	3.43	12.24	3.36	\$100,000	\$200,000	\$150,000	4
NWL-38	Wildwood Ave to Lakeshore Drive	Moderate	Northwood	0.18	0.00	0.08	\$3,000	\$5,000	\$4,000	5
NWL-39	Northwood Town Beach	High	Northwood	0.78	4.31	0.27	\$40,000	\$50,000	\$45,000	6
NWL-49	Sand Pit Avenue	High	Deerfield	0.05	0.42	0.04	\$1,000	\$5,000	\$3,000	7
NWL-51	Community beach southern gully	Low	Northwood	0.18	0.46	0.68	\$3,000	\$5,000	\$4,000	8
NWL-9	Harvey Lake Boat Launch	High	Northwood	0.57	1.93	1.59	\$40,000	\$50,000	\$45,000	9
NWL-21	Main Street Paved Swale	High	Pittsfield	0.30	1.64	0.10	\$20,000	\$30,000	\$25,000	10
NWL-53	Birch Street Road Shoulder	Moderate	Northwood	0.23	0.60	0.89	\$10,000	\$10,000	\$10,000	11
NWL-4	Ridge Road Ditch	Low	Northwood	0.17	0.44	0.65	\$1,000	\$10,000	\$5,500	12
NWL-41	Camp Road to Cabins (Camp Conrad)	Moderate	Northwood	0.40	1.04	1.53	\$20,000	\$30,000	\$25,000	13
NWL-46	Intersection of Blake's Hill Rd & Rte. 4	Low	Northwood	0.28	0.73	1.08	\$10,000	\$15,000	\$12,500	14
NWL-30	Pine Point Road	High	Northwood	0.12	0.30	0.44	\$15,000	\$25,000	\$20,000	15
NWL-20	Catamount Road #2	Moderate	Pittsfield	0.15	0.38	0.55	\$10,000	\$15,000	\$12,500	16
NWL-22	Ye Olde Canterbury Road	Moderate	Pittsfield	0.45	1.17	1.73	\$30,000	\$50,000	\$40,000	17
NWL-37	Driveway on Maple Avenue	Moderate	Northwood	0.04	0.09	0.14	\$2,000	\$5,000	\$3,500	18
NWL-23	School St & Rte. 4 at Heritage Market	High	Northwood	0.63	4.53	0.25	\$100,000	\$160,000	\$130,000	19
NWL-15	Clough Road #1	Moderate	Northwood	0.10	0.27	0.39	\$10,000	\$15,000	\$12,500	20
NWL-11	Route 4 Construction	Moderate	Northwood	0.16	0.21	0.10	\$15,000	\$25,000	\$20,000	21
NWL-36	Park Avenue	High	Northwood	0.26	0.68	1.00	\$50,000	\$80,000	\$65,000	22
NWL-7	Route 4 by School & Church	Moderate	Northwood	1.18	7.71	0.44	\$100,000	\$200,000	\$150,000	23
NWL-12	Olde Canterbury Road	Moderate	Northwood	0.11	0.29	0.43	\$10,000	\$20,000	\$15,000	24

Site ID	Location	Impact	Town	TP (kg/yr)	TN (kg/yr)	TSS (metric tons/yr)	Low Cost Est.	High Cost Est.	Avg. Cost Est.	Rank
NWL-16	Clough Road #2	Moderate	Northwood	0.11	0.28	0.42	\$10,000	\$20,000	\$15,000	25
NWL-13	Jenness Pond Road	Low	Northwood	0.08	0.20	0.30	\$5,000	\$10,000	\$7,500	26
NWL-28	End of Lagoon Road	Moderate	Northwood	0.14	0.36	0.54	\$15,000	\$30,000	\$22,500	27
NWL-47	Old Richie Road	Low	Deerfield	0.11	0.29	0.43	\$10,000	\$15,000	\$12,500	28
NWL-24	McEvoy Lane	Low	Epsom	0.25	1.33	0.08	\$20,000	\$40,000	\$30,000	29
NWL-1	Harmony Road	Low	Northwood	0.20	0.52	0.77	\$20,000	\$30,000	\$25,000	30
NWL-35	Lake Road Behind Boat Yard	Moderate	Epsom	0.27	1.37	0.08	\$40,000	\$65,000	\$52,500	31
NWL-8	Pine Street & Harvey Lake Road	Low	Northwood	0.10	0.00	0.05	\$10,000	\$15,000	\$12,500	32
NWL-32	Sleepy Hollow - Settling Basin	Low	Epsom	0.02	0.00	0.01	\$1,000	\$5,000	\$3,000	33
NWL-6	Range Road	Low	Northwood	0.28	0.73	1.06	\$25,000	\$50,000	\$37,500	34
NWL-40	Northwood Lake Boat Ramp	Moderate	Northwood	0.21	1.12	0.07	\$40,000	\$50,000	\$45,000	35
NWL-17	Jenness Pond Boat Launch	High	Pittsfield	0.10	0.52	0.00	\$40,000	\$50,000	\$45,000	36
NWL-33	Boat House	Low	Epsom	0.03	0.13	0.01	\$5,000	\$5,000	\$5,000	37
NWL-19	Catamount Road #1	Low	Pittsfield	0.07	0.19	0.27	\$10,000	\$20,000	\$15,000	38
NWL-2	Harmony Road - Tucker Brook	Low	Northwood	0.04	0.09	0.14	\$5,000	\$10,000	\$7,500	39
NWL-14	Long Pond Road	Low	Northwood	0.01	0.03	0.05	\$1,000	\$5,000	\$3,000	40
NWL-52	Voydatch Pond Roads	Moderate	Northwood	0.25	1.28	0.12	\$70,000	\$100,000	\$85,000	41
NWL-48	Baker Avenue	Moderate	Deerfield	0.05	0.13	0.20	\$15,000	\$20,000	\$17,500	42
NWL-3	Route 4 - Road Shoulder	Low	Northwood	0.03	0.07	1.06	\$5,000	\$10,000	\$7,500	43
NWL-42	Williams Lodge	Low	Northwood	0.13	0.41	0.00	\$30,000	\$50,000	\$40,000	44
NWL-18	Hill Road	Moderate	Pittsfield	0.16	1.12	0.00	\$60,000	\$90,000	\$75,000	45
NWL-31	Sleepy Hollow Intersection	Moderate	Epsom	0.05	0.12	0.04	\$20,000	\$30,000	\$25,000	46
NWL-43	Road to Boat House at Camp	Low	Northwood	0.10	0.52	0.04	\$30,000	\$40,000	\$35,000	47
NWL-45	Camp Boat House Area	Low	Northwood	0.06	0.25	0.02	\$25,000	\$40,000	\$32,500	48
NWL-10	Harvey Lake Road - Stream Crossing	Low	Northwood	0.02	0.05	0.08	\$15,000	\$25,000	\$20,000	49
NWL-5	Ridge Road - Stream Crossing	Low	Northwood	0.02	0.04	0.06	\$2,000	\$5,000	\$3,500	50
NWL-50	Community Beach	Low	Northwood	0.01	0.00	0.00	\$10,000	\$15,000	\$12,500	51
NWL-34	Side of Boat Yard	Low	Epsom	0.45	2.27	0.17	-	-	-	NA
TOTAL				14.13	55.54	25.67	\$1,143,000	\$1,870,000	\$1,506,500	

WATER ACCESS SITES

Site NWL-40: Northwood Lake Boat Ramp

Location: 43.2223, -71.2550 Impact: Medium Land use: State Boat Ramp

Observations: The Northwood Lake boat ramp is a frequently visited access point by many within the community and from day visitors. It is estimated that the ramp provides access to over 1000 boats each summer. The boat ramp is staffed five days per week, Thursday through Monday, with a Lake Host who inspects boats entering and exiting Northwood Lake for invasive aquatic plants. The boat ramp and access road are paved and the shoulders did not show any signs of stormwater scour resulting in gullies. The pavement ends before the lake, and trailers drive over the sandy substrate to launch and load boats. There are small shoulder areas to the ramp with minimal buffer, steep gradient changes, and exposed roots, indicating erosion occurring near the shoreline.

Recommendations: Continue to support the Lake Host program to monitor invasive aquatic plants that may enter or exit Northwood Lake. Redirect stormwater flow from the access road to the northern side of the access road via two broad based dips, one at the first bend in the road, and one halfway between the first and the end of the ramp area, into the northern shoulder and to the established wetland. Increase the vegetated buffer along the shoreline with native shrubs and trees where possible to stabilize the shoreline and encourage foot traffic to stay on the paved areas. Note that the lake water level was low during the time of the survey due to a drought.



(Left) Exposed roots and a steep drop off of the shoreline to the water's edge indicating erosion, (right) the end of the paved boat ramp where it meets the water.

Site NWL-39: Northwood Town Beach

Location: 43.2196, -71.2593 Impact: High Land use: Town Owned Beach

Observations: Northwood Town Beach is enjoyed by many during the summer months and is used as an access point for activities on the ice in the winter. Members of the community noted that although dogs are not allowed, many are brought to the beach and pet waste has been an ongoing problem in addition to general trash disposal. Additionally, geese regularly congregate within this cove and likely influence the bacteria concentrations within the cove. The beach hosts a portable toilet in the summer which helps protect the lake, though not for 2026. The beach area is a large relatively flat plot of land that is mostly comprised of sand with scattered weeds and grass. The area adjacent to the lake slopes downward to the water and erosion gullies were observed through the sand.

Recommendations: Define pathways across high-traffic areas from the entrance gates using steppingstones spaced apart or interlocking permeable grid pavers. Observe the beach during heavy rainfall to note where flow paths are being created, then regrade the area as needed to divert stormwater flow into a rain garden or vegetated swale rather than continuing across the surface to the water. Reestablish vegetation (native grass, shrubs, groundcover) in all sandy areas that are not used for sand play. Install geese deterrents and revegetate the shoreline to the sides of the primary access point, as geese are less likely to congregate when their line of access between the water and shore is obstructed. To further address localized bacterial and phosphorus loading from the resident flock, specific management steps should include planting tall (24–30 inch) native shoreline buffers, installing low-profile temporary perimeter wire during summer molting periods, enforcing "Do Not Feed Waterfowl" signage, and letting turf grass grow taller near the water's edge to reduce attractive grazing habitat. This beach would also be an excellent location for a pollinator garden and educational signs about lake health.



(Top left) View of the beach area facing the entrance gates, (top right) view of the beach area as it slopes to the water's edge, (bottom left) erosion gullies were observed between the beach area and the water's edge, (bottom right) side view of the sloping area to the shoreline.

Site NWL-45: Camp Boat House Area

Location: 43.2048, -71.2405 Impact: Low Land use: Private, Recreational

Observations: The Camp Boat House area is heavily used by campers throughout the summer. The camp staff have observed stormwater flows along the sides of the building and have installed a gutter along the roof line. Fencing keeps the water access to a defined area and fencing above the building keeps campers from walking down the northern slope to the water. Due to the slope of the land and foot traffic, stormwater and people travel to the lowest point, the break in the fence, and to the dock.

Recommendations: Direct gutter downspouts into a French drain for subsurface infiltration. Consider installing a broad-based dip across the primary access way (photo on the right) to direct any stormwater flow into the vegetated area on the lake side of the fence in a vegetated retention basin (or rain garden).



(Left) the evidence of erosion from roof runoff prior to gutter installation along with the white gutter downspout. (Right) the water access area sloping to the lake with fencing to define access points.

Site NWL-50: Community Beach

Location: 43.2052, -71.2455 Impact: Low Land use: Private, Recreational

Observations: A community beach is present at the end of Cole Road. This beach has a small parking area, a large sandy beach area, and a clubhouse. Many stormwater management initiatives have been completed at this site already and are quite effective, transforming a potentially high impact site into a low impact site. Stormwater flows down the paved and unpaved sections of Cole road to the fork with Pine Point Lane. At this intersection, a paved swale was created to direct stormwater runoff into the forested area between these two roads. Stormwater then is directed via a riprapped swale to a series of infiltration basins. It is evident that the retention basins are working due to the accumulation of sediment within them and lack of large break-through flow paths. Eventually, stormwater might make its way to the last retention basin near the clubhouse steps where it would travel through a grate (next to the orange cone in the photo) and through a pipe that outlets about 10 feet from the lake.

Recommendations: Continue maintaining the series of infiltration basins and check dams through the wooded area. To increase storage potential, periodically remove accumulated sand and debris from the retention basins and maintain as needed to the stabilizing edges. Deepen the last basin, closest to the lake, so the outlet serves as an overflow outlet rather than a drain. Consider adding water-tolerant plants this last basin as well to promote nutrient uptake. Consider adding an educational sign about the use of rain gardens for pollinators and stormwater/nutrient management for the lake.



(Left) View up Cole Road with the paved swale in the bottom right corner, (right) the paved swale entering the forest.



(Left) The first retention basin with lots of accumulated road surface material. (Right) No large erosion gullies were observed across the beach area.



(Left) a walkway leading to the club house with a tree trunk for stabilization. (Right) The last retention basin with the outflow grate next to the orange cone.

Site NWL-51: Community Beach Southern Gully

Location: 43.2052, -71.2455 Impact: Low Land use: Private, Recreational

Observations: A small shoulder road gully was observed along the western edge of the community beach access road, parking area, and beach. This gully originates higher up the road, above the residential property.

Recommendations: Add broad dip to across Pine Point Road about fifty feet down Pine Point road from the current paved swale that leads to the wooded area. Direct the new dip to the west and into the wooded area south of the residential home. Continue to look for signs of stormwater flowing down Pine Point Road towards the parking area by the beach and direct to infiltration areas as needed.



(Left) View of Pine Point Road shoulder facing the lake, (right) View of the road shoulder gully facing up hill, away from the lake.

Site NWL-17: Jenness Pond Boat Launch

Location (latitude, longitude): 43.2594, -71.2568 Impact: High Land use: Boat Ramp

Observations: The Jenness Pond boat shows signs of erosion, especially the unpaved portion. Stormwater can likely flow from the nearby road over the unpaved section and to the ramp, carrying sediment, associated nutrients, and material into the pond. A stream was also observed directly to the south of the boat ramp.

Recommendations: Engage an engineer to re-design the boat ramp and parking/driving area, which may include using interlocking permeable pavers to prevent erosion while also allowing stormwater to infiltrate. There may be areas where impervious cover may be removed from the site (to the south near the stream bank or to the north by the neighboring lawn) to further promote infiltration. Bare soil areas should be stabilized, and silt fences may be used as a temporary measure in shoreline areas that are not used for the boat ramp to prevent un-stabilized sediment from entering the pond.



(Top Left) A stream runs parallel to the south side of the boat ramp. (Top Right) The boat ramp parking/driving area is wide and unpaved. (Bottom Left) The boat ramp is mostly unpaved with a small, paved portion near the water's edge. (Bottom Right) There is moderate erosion at the bottom of the boat ramp; note that water levels were likely lower than typical at the time of the survey.

Site NWL-9: Harvey Lake Boat Launch

Location: 43.2140, -71.2170 Impact: High Land use: Boat Launch

Observations: The road uphill of the boat ramp is steeply sloped, as is the boat ramp itself. Sediment and organic material have accumulated at the bottom of the boat ramp, indicating that pollutants are reaching the lake over the paved boat launch. Once reaching the bottom of the pavement, there is a gully leading through the beach until the water's edge. There is a large break in the shoreline buffer to accommodate the boat ramp and beach.

Recommendations: Stabilize the gully with large, crushed stone and divert stormwater into the forested area by either re-crowning the road, using water bars, or creating a swale so that stormwater does not directly enter the lake. Reinstall the shoreline buffer in shoulder areas of the boat launch that are not used for recreation. Consider using cleared areas for a plunge pool for diverted stormwater or as a vegetated area for stormwater to infiltrate.



(Right) The steeply sloped paved area directs stormwater to the lake. (Left) A large gully has formed at the bottom of the boat launch.

STREAM CROSSING SITES

Site NWL-2: Harmony Road – Tucker Brook

Location: 43.2143, -71.2022 Impact: Low Land use: Stream Crossing, Town Road

Observations: Exposed soil was observed at the culvert inlet and outlet of the Tucker Brook stream crossing on Harmony Road. On both sides of the culvert, there are clear paths where stormwater has traveled down the bank, carrying stormwater and sediment from the road and road shoulder into the stream. Most of the culvert inlet is armored with rip rap, but the culvert outlet is not.

Recommendations: Armor the culvert outlet with additional rip rap to prevent bank erosion. Divert stormwater away from the site by using a berm along the road shoulder to direct water into the adjacent vegetated shoreline areas. Revegetate bare areas and assess with low growing shrubs or a ground cover if possible.



(Left) The bare road shoulder above the culvert outlet site, (middle & right) stormwater has eroded the shoreline, providing paths for stormwater to directly enter Tucker Brook.

Site NWL-5: Ridge Road – Stream Crossing

Location: 43.2184, -71.1739

Impact: Low Land use: Town Road

Observations: Though this is an intermittent headwater stream, the cross-road culvert on Ridge Road is partially blocked by a large stone and is filled in with leaves and sediment. This would likely cause stormwater to back up at the site and erode the backslope, which abuts the forest. Impacts to water quality are only minor at the site as the culvert outlet does not have a well-defined stream channel. Stormwater from the site would likely form the headwaters of Tucker Brook if a stream channel formed during high flows.



(Left) Road shoulder erosion leading to a catch basin. (Right) The catch basin is nearly completely buried in gravel.

Recommendations: Clean out the culvert and remove the large stone that is blocking it. Armor the culvert inlet, outlet and the backslope with rip rap.

Site NWL-10: Harvey Lake Road – Stream Crossing

Location: 43.2188, -71.2216 Impact: Low

Land use: Stream Crossing, Town Road

Observations: There is an undersized and cracked culvert on Harvey Lake Road that is contributing to minor bank erosion at the culvert outlet. The culvert currently restricts the natural flow of Kelsey Brook due to its size.

Recommendations: Enlarge or replace the culvert with an open bottom crossing to promote natural flow.



An undersized culvert is causing bank scours at the culvert outlet.

Site NWL-12: Olde Canterbury Road

Location: 43.2259, -71.2459 Impact: Moderate Land use: Stream Crossing, Town Road

Observations: Severe erosion was observed at the culvert outlet on Olde Canterbury Road, and minor erosion was observed at the culvert inlet. There are twin culverts at the site that carry Kelsey Brook under Olde Canterbury Road near its confluence with Narrows Brook.

Recommendations: Stabilize the culvert inlet and outlet with rip rap to prevent future erosion. Consider recrowning the road. Berms along the road shoulders may be used to direct stormwater into vegetated areas rather than directly into the stream at the culvert inlet and outlet.



(Left) Severe erosion at the culvert outlet. (Middle) View of twin culverts. (Right) There is minor erosion at the culvert inlet.

Site NWL-14: Long Pond Road

Location: 43.2399, -71.2408

Impact: Low Land use: Private Road

Observations: Long Pond Road directly abuts a stream crossing, which is part of a larger wetland complex upstream of Durgin Pond. Part of the stream bank at the culvert outlet is eroding. On the road surface, a berm was installed to prevent stormwater from entering the stream, instead directing it into vegetated areas along the stream bank. Stormwater bypasses the berm in some locations and is eroding the bank



(Left) The streambank at the culvert outlet is eroding, partly due to a crumbling berm. (Right) The stream is part of a larger

Recommendations: Reinstall the berm and stabilize bare soil at the culvert outlet, either using live stake plantings or rip rap.

Site NWL-25: Griffin Brook at Route 107

Location: 43.2122, -71.2849

Impact: High Land use: Agricultural

Observations: Griffin Brook lacks an adequately wide and dense riparian vegetated buffer on a private agricultural land near its crossing with Route 107 and Ritchie Road. Much of the riparian buffer is mowed grass. Where there are shrubs, the buffer is only as wide as one plant.

Recommendations: Consider improving the buffer to 20-50 feet on each side of the stream to allow agricultural runoff to be intercepted and nutrients retained by the plants rather than entering Griffin Brook. Use native plants and shrubs as recommended in the [Native Shoreland/Riparian Buffer Plantings for New Hampshire guide](#) to stabilize the soil and decrease nutrient laden runoff from entering Griffin Brook.



Griffin Brook lacks a riparian buffer on an agricultural property.

Site NWL-29: Lagoon Road – Stream Crossing

Location: 43.2031, -71.2431

Impact: Moderate Land use: Private Road

Observations: A small, intermittent stream crossing was observed on Lagoon Road. The stream channel leads to a culvert underneath Lagoon Road. The inlet area to the culvert has a large area of eroded soil and exposed tree roots indicating stormwater flows may be large and fast during heavy amounts of precipitation. A local resident noted that during heavy flows, stormwater often overtops the road.

Recommendations: Begin by stabilizing the inlet side of the culvert with the exposed tree roots. Add large rip rap stones to stabilize the edges and base. Stabilize the outlet side with rip rap as well. Consider installing check dams in the flow path that leads to this culvert to slow the speed of stormwater and stream flow and promote infiltration along the way.



(Left) The upgradient side of the culvert showing the large, eroded basin. (Right) View of the eroded soils and exposed tree roots on the upstream side of the culvert.

ROAD SURFACE AND ROAD SHOULDER SITES

The Northwood Lake Watershed has a mix of both paved and unpaved roads. Proper road management is a crucial component for both public safety and environmental protection. Unpaved roads, including private ones, require routine maintenance and care. There are several resources available to provide guidance on gravel road maintenance and problem solving, addressing issues like gullies, tire rutting, wash boarding, soft spots, and potholes. The University of New Hampshire maintains a [database of resources for gravel roads](#). Other helpful resources include the Maine Department of Environmental Protection's [Gravel Road Maintenance Manual](#), the US Environmental Protection Agency's [Gravel Road Maintenance and Design Manual](#), and [A Ditch in Time](#) gravel road manual. Additionally, the University of Kentucky and Kentucky Transportation Center have a guidance document on [When to Pave a Gravel Road](#), which provides a detailed step-by-step process to consider if paving may be a better long-term solution to gravel road maintenance.

Site NWL-1: Harmony Road

Location: 43.2086, -71.2211 Impact: Low Land use: Town Road

Observations: A steeply sloped portion of Harmony Road has road shoulder ditch erosion leading partially down the road; erosion does not lead directly to stormwater infrastructure or a stream. The bottom of the ditch is bare (beneath the fallen leaves) and has a moderately sized gully. The backslope of the ditch also shows signs of erosion with an accumulation of this material within the ditch. Some check dams have been installed as a stormwater control measure, but require maintenance.

Recommendations: Reshape the ditch into a U-shape. Armor the ditch and backslope with rip rap if revegetation with grass is not possible.



(Left & Middle) A well-defined gully is present in the road shoulder ditch, which is typically bare, but was filled with fallen leaves at the time of the survey. (Right) The road shoulder of Harmony Road is eroding into the ditch.

Site NWL-3: Route 4 – Road Shoulder

Location: 43.2117, -71.1936

Impact: Low Land use: State Road

Observations: There is moderate road shoulder erosion on the north side of Route 4 between Gary Road and Town Works Way. The erosion channel cuts through the sandy gravel in the road shoulder and a nearby lawn, leading to a blocked catch basin; the catch basin is filled with sediment and blocked at the surface by gravel. Erosion begins at the mailbox of house 702 and extends west to the following driveway.

Recommendations: Clean out the catch basin and remove debris/gravel from the grate. Enlarge the catch basin area and stabilize the catch basin with rip rap. Check dams may be used across the road shoulder ditch to slow stormwater and settle out sediment before reaching the catch basin.



(Left) Road shoulder erosion leading to a catch basin.

(Right) The catch basin is buried in gravel.

Site NWL-4: Ridge Road shoulder ditch

Location: 43.2119, -71.1781

Impact: Low Land use: Town Road

Observations: The road shoulder ditch on Ridge Road has exposed, bare soil and minor erosion. Downhill of this ditch, there is a vegetated swale with minor erosion. It appears that recent work was done on the utility pole, which may account for some of the bare soil in the ditch.

Recommendations: Seed the ditch to create a grass swale and stabilize loose soil.



Bare soil areas in the road shoulder ditch.

Site NWL-6: Range Road

Location: 43.2234, -71.1810 Impact: Low Land use: Town Road

Observations: Stormwater on Range Road has caused road surface and shoulder erosion. Stormwater from the top of the hill erodes the road surface instead of entering the roadside ditch. It eventually enters the ditch and turns out into the forested area. There is a large sediment pile at the turnout, which is likely a result of plowing and erosion over many years. There is no stream channel near the turnout, but the area is mapped as a wetland, and there are multiple sediment deposits in the forest. Stormwater also completely bypasses an under-driveway culvert, which also has become exposed, indicating that the driveway surface has eroded. This culvert is more vulnerable to damage due to being exposed.

Recommendations: Replace the under-driveway culvert and add surface material to cover it. Create a U-shaped (cross-section) road shoulder ditch and armor it with rip rap. Install a plunge pool at the bottom of the turnout to prevent sediment from accumulating in the wetland. Dig ditches to connect the culverts to the road shoulder ditch and prevent surface erosion; regrade the road if needed.



(1) The turnout on Range Road has accumulated sediment at its end. (2) The road shoulder ditch is eroding. (3) An under-driveway culvert is exposed. (4) The road surface of Range Road is eroding.

Site NWL-8: Pine Street & Harvey Lake Road

Location: 43.2129, -71.2222 Impact: Low Land use: Town Road & Private Road

Observations: Stormwater from Pine Street (unpaved) leads directly to a culvert. Sediment has accumulated at the bottom of the road, likely from stormwater runoff and winter snow maintenance, and some of the sediment is presumed to have entered the culvert's flow path. The culvert outlet likely forms a stream channel that leads to Kelsey Brook.

Recommendations: Remove the accumulated sediment from the site. If possible, revegetate the area; if establishing vegetation is not possible, armor it with rip rap. If the area is used for plow piles and snow storage, remove accumulated sediment each spring and mind how far plows push snow (and road surface material) towards the culvert area.



Stormwater and/or winter plowing on Pine Street carries sediment down to the intersection with Harvey Lake Road.

Site NWL-13: Jenness Pond Road

Location: 43.2378, -71.2451 Impact: Low Land use: Town Road

Observations: There is minor ditch erosion on Jenness Pond Road. In some stretches, the ditch is bare (beneath the leaves). This ditch leads directly to an intermittent stream. There is one check dam installed further uphill at the site. The intermittent stream likely flows into Durgin Pond.

Recommendations: Reshape the ditch into a U-shape and armor it with rip rap. Use multiple check dams to slow stormwater flow and settle out sediment before it reaches the stream.



(Left) The backslope of the road shoulder ditch. (Middle) The ditch on Jenness Pond Road. (Right) Stormwater from the ditch enters the intermittent stream at the culvert.

Site NWL-15: Clough Road #1

Location: 43.2667, -71.2535 Impact: Moderate Land use: Town Road

Observations: Large amounts of road shoulder erosion were observed along Clough Road with a gully nearly 500 feet long. Stormwater follows the road shoulder until reaching a culvert that leads to a stream that feeds Jenness Pond. The culvert inlet is perched, meaning stormwater settles and may infiltrate before moving downstream under low flow conditions. The area around the culvert inlet is completely bare and shows signs of erosion.

Recommendations: Reshape the road shoulder into a U-shaped ditch and armor it with rip rap and check dams. Install turnouts wherever the slope of the adjacent forest allows. Remove accumulated sediment from the site; consider installing a check dam and plunge pool at the end of the ditch and stabilizing the area with vegetation or rip rap.



(Left) The culvert inlet has bare soil. (Middle) The end of the gully is a wide, bare soil area. (Right) The gully extends 500 feet up the road.

Site NWL-16: Clough Road #2

Location: 43.2700, -71.2551

Impact: Moderate Land use: Town Road

Observations: The road shoulder on Clough Road (unpaved) is eroding, depositing sediment into a nearby stream channel. At the culvert outlet of the stream crossing, the banks are slightly incised, suggesting that there may be high or flashy stormwater flows here. There are also three pipes leading to the culvert from a nearby home; the sources of these pipes are unknown.

Recommendations: Remove accumulated sediment from the road shoulder ditch. Vegetate the road shoulder wherever possible. Armor the road shoulder ditch with rip rap where vegetation is not feasible. Install check dams across the ditch and at the end of the ditch to slow down stormwater and settle out sediment. Investigate the source of the three pipes and consider re directing pipe outflows into residential BMPs. For examples of residential BMPs, see the [New Hampshire Homeowner's Guide to Stormwater Management](#).



(Left) Three pipes appear to route water from a nearby home to the culvert inlet. (Right) Road shoulder ditch erosion at the site.

Site NWL-19: Catamount Road #1

Location: 43.2609, -71.2748

Impact: Low Land use: State Road

Observations: Very heavy road shoulder material is eroding into a catch basin on Catamount Road. Based on the weight of the material and design of the catch basin, it is likely that this stretch of the road experiences high stormwater flows. This catch basin is located in a headwater stream area.

Recommendations: Re-form the road shoulder ditch with more erosion resistant material, such as rip rap. If needed, convert the road shoulder ditch into a paved swale, and route stormwater from the catch basin to an engineered BMP downhill where it can be treated. An engineered BMP may be an infiltration basin, a vegetated swale basin. A standard rain garden may not be large enough to handle the amount or velocity of flow capable of causing this erosion.



Road shoulder erosion on Catamount Road. Eroded material enters a catch basin designed for high stormwater velocities.

Site NWL-20: Catamount Road #2

Location: 43.2574, -71.2620 Impact: Moderate Land use: State Road

Observations: The road shoulder at the site is very wide, completely bare, and composed of loose sand and is actively eroding, and stormwater travels from the site through a culvert. The soil around the culvert inlet also shows signs of erosion. A gully on the downflow side of the road leads towards Jenness Pond.

Recommendations: Revegetate road shoulder. Armor bare areas of the culvert inlet with rip rap. Stabilize the culvert outlet with a vegetated swale and armored swale outlet to prevent breakthrough gullies from forming.



(Left) The road shoulder is composed of loose, bare sand. (Middle) The culvert inlet also shows signs of erosion. (Right) The gully created by the outflow.

Site NWL-21: Main Street Paved Swale

Location: 43.2297, -71.2473 Impact: Moderate Land use: State Road

Observations: A paved swale on Main Street leads to a catch basin that outfalls to Narrows Brook. Sediment was observed on the road surface leading to the catch basin. While paved swales prevent erosion, they channelize untreated stormwater directly to the receiving location, and mobilize other pollutants that have accumulated on the road surface.

Recommendations: Multiple options exist to treat stormwater at the site. One option is to direct stormwater from the catch basin to a nearby vegetated area that could be used as an infiltration area for stormwater. The area could also be converted to an engineered stormwater control measure, such as a rain garden or bioretention basin.



(Left) Sediment from the road enters the catch basin through the paved swale. (Middle & Right) Vegetated areas that may be used to infiltrate stormwater.

Site NWL-22: Ye Olde Canterbury Road

Location: 43.2269, -71.2575

Impact: Moderate

Land Use: Town Road

Observations: Large amounts of erosion were observed along the road shoulder of Ye Olde Canterbury Road leading to a culvert that routes stormwater into a nearby stream. Road surface erosion was also observed at the site. Erosion begins at the unpaved section of the road. Runoff from a nearby residential property appears to be directed toward the road.

Recommendations: Ensure that residential stormwater runoff enters the road shoulder ditches rather than the road surface where it could cause erosion. Re-crown the road to divert stormwater into road shoulder ditches. Stabilize the road shoulder ditches with vegetation and/or rip rap, if possible.



(Photos 1-3) Road surface erosion in addition to road shoulder ditch erosion. (Bottom Left) Stormwater is eroding the road surface. (Photo 4) Stormwater enters water resources through a culvert.

Site NWL-26: Lynn Lane

Location: 43.2069, -71.2507

Impact: High Land use: Private Road

Observations: Moderately sized erosion gullies were observed on Lynn Lane, carrying sediment directly to Northwood Lake.

Recommendations: Stormwater control measures such as a broad-based dip or water bars may be used to divert stormwater to road shoulders and other designated areas for infiltration. Assess if there are open space areas downhill (possibly private property) to infiltrate stormwater and filter sediment and nutrients. Consider removing excess impervious cover downhill if needed to accommodate an area to infiltrate stormwater.



Road surface erosion on Lynn Lane leading to Northwood Lake.

Site NWL-27: Frary Road

Location: 43.2034, -71.2445 Impact: Low Land use: Private Road

Observations: Frary Road (unpaved) is known to wash out frequently with rain events, causing a loss of surface material. Frary Road was resurfaced earlier in 2025, and there is a small drainage ditch on the eastern side of the road behind the houses that leads to the lake.

Recommendations: To prevent future washouts, consider installing water bars across Frary Road to direct stormwater runoff into the adjacent forested area.



(Left) Looking down Frary Road, (center) looking up Frary Road, (right) looking up Frary Road near the top.

Site NWL-28: End of Lagoon Road

Location: 43.2040, -71.2432 Impact: Moderate Land use: Private

Observations: A long gully in the pathway at the end of Lagoon Road was observed leading down the hill to the dock at the bottom. The substrate was loose sandy gravel.

Recommendations: Collaborate with the homeowners in this area to promote residential stormwater BMPs to reduce the volume of water reaching this hillside. Consider installing water bars across the pathway to direct stormwater runoff to the adjacent vegetated area. Consider re-grading the road just before this driveway/walkway to drain away from the lake and into a stable road shoulder ditch and infiltration basin.



(Lef two) Lagoon Road slopes steeply to the side towards the lake. (Right two) Gullies lead to the dock along the water.

Site NWL-30: Pine Point Road

Location: 43.2048, -71.2439 Impact: High Land use: Private Road, Private Property

Observations: Stormwater likely flows down Pine Point Road (unpaved) towards both a foot path and a driveway along the most northern section of the road. The footpath (unpaved) and driveway (paved) are steeply sloped towards the lake. Gullies were observed along Pine Point Road within the tire track lines that continue to both downhill slopes.

Recommendations: Consider installing rubber razors or broad-based dips across Pine Point Road to direct stormwater flow into the wooded areas rather than continuing down the roadway. Alternatively, crowning the road and establishing road shoulder ditches with turnouts would be helpful. Consider adjusting the location of the pathway to create a meandering path with infiltration basins on the bends and rubber razors across the pathway as needed to redirect stormwater from its current straight pathway downhill.



(1) Gullies were present along Pine Point Road leading to the north east bend in the road to a steeply sloped driveway in the second photo. (3) Gullies were also present on the northern stretch of Pine Point Road that lead to an unpaved walkway straight down to the lake (4).

Site NWL-31: Sleepy Hollow Intersection

Location: 43.2184, -71.2850 Impact: Moderate Land use: Private Road

Observations: A wide (unpaved) intersection on Sleepy Hollow Road is present where the primary road splits in two directions to access the shoreline homes. A small stormwater erosion gully was observed through the patch of pine trees behind the small shed, likely coming from sheet flow across the roadway. Further up the hill on Sleepy Hollow Road, away from the lake, the road shoulder directed stormwater flow to a turnout which seemed to be working well as sediment was observed in the turnout and in the nearby wooded area.

Recommendations: Create additional turnouts along Sleepy Hollow Road further downhill from the first. Consider re-grading the road surface to direct stormwater off to the side rather than down the roadway. Consider re-grading the two arms of Sleepy Hollow to drain to the uphill side, away from Northwood Lake into an established road shoulder stabilized with vegetation.



(Left) Sleepy Hollow Road intersection looking up the roadway where it splits to access shoreline properties. (Middle) Sleepy Hollow Road intersection looking downhill, towards Northwood Lake. (Right) Stormwater flows through the patch of pine trees behind the little shed.

Site NWL-32: Sleepy Hollow – Settling Basin

Location: 43.2183, -71.2845

Impact: Low Land use: Private Road

Observations: A relatively new stormwater infiltration basin/ditch has been established along the eastern arm of Sleepy Hollow Road next to a driveway on the southwest side of the road. The soil surface of the dug area does not appear to be stabilized, though boulders were placed at the top for vehicle safety.

Recommendations: Add large, crushed stone to the basin's walls and bottom to stabilize the loose soil and prevent erosion. Additionally, the basin could be seeded and planted with water-tolerant plants and shrubs.



Eastern (left) and western (right) views of the small infiltration area.

Site NWL-35: Lake Road Behind Boat Yard

Location: 43.2210, -71.2818 Impact: Moderate Land use: Private Road

Observations: Lake Road, located behind the boat yard is a combination of both paved and unpaved surfaces. Where unpaved, the loose sandy gravel surface has ruts, gullies, and is at a slightly lower elevation than the paved portion. This could be due to compaction, weathering, and/or erosion.

Recommendations: Regrade the unpaved section of Lake Road with crushed. Consider paving this area and creating infiltration basins within the road shoulders that are regularly cleaned out. Work with homeowners in this area to create residential BMPs for stormwater management to decrease the volume of water flowing across and down Lake Road.



(Left) Lake Road facing east, (middle) west, (right) and behind the boat yard.

Site NWL-37: Driveway on Maple Avenue

Location: 43.2204, -71.2624 Impact: Moderate Land use: Private Road, Residential

Observations: A large gully was observed beginning along a residential driveway and continuing on Maple Avenue. The home appears to be a newer construction and may still be undergoing improvements.

Recommendations: Collaborate with the homeowner to provide education on unpaved driveway management. Begin uphill and address sources of stormwater runoff entering the driveway with residential BMPs. Create turnouts along the driveway to direct stormwater flow into the vegetated ditch rather than continuing down the driveway and through Maple Avenue.



Erosion gully at the base of the driveway turning onto Maple Avenue.

Site NWL-36: Park Avenue

Location: 43.2196, -71.2610 Impact: High Land use: Private Road

Observations: Park Avenue has experienced lots of stormwater erosion as evident in the long and deep gullies present which have left a prominent hump in the middle of the road. Park Avenue is not plowed in the winter or maintained during the other seasons. The road surface is comprised of hard compacted sediment and gravel. Smaller particulates have eroded away to more downhill areas towards the lake. A local resident shared that the road is used by many in the neighborhood and access is sometimes challenging, particularly for the year-round residents. Six years ago, the road was resurfaced but has not been maintained since, indicating all visible erosion occurred in the last six years.

Recommendations: Mitigating runoff and erosion at Park Avenue may be challenging due to road, neighborhood, and landscape characteristics which naturally appear to funnel high flows along the road. Collaboration with the neighborhood residents is crucial. We strongly recommend consulting with an engineer to develop a neighborhood site plan. Mitigation should not only focus on the road itself, but the sources of stormwater from residential roofs, driveways, and other areas. Beginning at the top of the hill, our preliminary recommendations are a broad-based dip or drivable berm across the road at the intersection of Sawyer Lane to divert runoff into vegetation to the east. Residential BMPs like gutters to French drains, water barrels (if emptied between storms), rain gardens, driveway rubber razors, and turnouts would decrease the volume of stormwater runoff entering Park Avenue. Once sources of stormwater runoff are mitigated, regrade the road surface and create a road shoulder ditch stabilized with rip rap and many check dams. Regularly clean any accumulated sediment, debris, and leaf litter from road shoulder ditches. Once the ditch and check dams are established, consider adding an infiltrating catch basin at the bottom of Park Avenue at Lakeshore Drive, as well as at the intersections of Hillcrest and Maple Ave and Maple Lane and Lakeshore Dr. Designate a responsible party to maintain all SCMs.



(Left and middle) Park Ave looking towards Lakeshore Dr. (Right) Park Ave looking uphill towards Sawyer Ln.



(Left) Intersection of Park Ave and Sawyer Ln where the broad-based dip leading to the potential area for infiltration (right).

Site NWL-38: Wildwood Ave to Lakeshore Drive

Location: 43.2206, -71.2625 Impact: Moderate Land use: Private Road

Observations: Wildwood Ave and Park Ave are the two most used roadways into this neighborhood off Lakeshore Dr. Wildwood Ave is unpaved and comprised of a more gravelly substrate than Park Ave. Uphill stormwater issues at sites NWL-36 and NWL-37 are contributing to the erosion occurring on Wildwood Ave, which has evidence of sheet flow erosion and channelization. The road was created less than 10 years ago and has not been maintained since.

Recommendations: Work with residents in this neighborhood to establish a road maintenance committee. In conjunction with addressing recommendations for sites NWL-36 and NWL-37, consider installing rubber razors across Maple Ln to direct stormwater flow into the vegetated area to the west.



Photos of Wildwood Ave from the intersection with Maple Ave to the intersection with Lakeshore Dr. (paved).

Site NWL-41: Camp Road to Cabins (Camp Conrad)

Location: 43.2105,-71.2412 Impact: Moderate Land use: Private, Recreational

Observations: A gully was observed along the camp roadway that leads to the cabins (labeled as “Camp Conrad” on the camp map) and to a water access point. An accumulation of sediment was observed at the bottom of the hill near the docks.

Recommendations: Install broad-based dips or water bars along the camp road with turnouts to carry stormwater into the wooded area to the north of the road rather than continuing down the unpaved camp roadway. Consider creating a designated and stabilized pathway from the dock storage area down the slope to the flat area by the water’s edge.



(Left) Camp road with gully, (center and right) camp road as it slopes down to the water from the dock storage area.

Site NWL-42: Williams Lodge

Location: 43.2094, -71.2403 Impact: Low Land use: Private, Recreational

Observations: Runoff coming from lodge down towards the parking area washes away wood chips, exposing bare soil across the full path. Path continues to lead onto to site NWL-41, presented above.

Recommendations: Consider adding residential stormwater BMPs to Williams Lodge such as an infiltration dripline trench and a broad base dip in the pathway to divert water into a vegetated area, which could be reconfigured into a rain garden. Consider adding educational signage about the rain garden if installed.



Williams Lodge (left) and the pathway that leads to it (right).

Site NWL-43: Road to Boat House at Camp

Location: 43.2058, -71.2398 Impact: Low Land use: Private, Recreational

Observations: Walking along the primary camp roadway that parallels the lake, evidence of stormwater runoff was observed entering the roadway from the cluster of cabins between Vervaert Lodge and the South Showers. The roadway is sloping to the south in this area, towards boathouse and waterfront.

Recommendations: Create a broad-based dip or water bar across the top of the pathway that leads to these cabins to direct stormwater flow to the south (right) side of the little stone wall and into a designated area for infiltration (recessed and vegetated, or stabilized with crushed stone). There were also three opportunities along this roadway to create more formalized infiltration areas – the three areas where snowplows pile the snow. Each of these three areas should be accompanied with a broad-based dip to divert sheet flow from the roadway into the retention basins. Consider lining these basins with rip rap rather than vegetation because of the winter snow maintenance, as snow would likely be pushed into and on top of these retention areas.



(1) Stormwater flow path coming from the cluster of cabins to the primary camp roadway (2). (3 and 4) Two of the three areas along the roadway where it widens and the infiltration basins could be created, minding snow maintenance needs.

Site NWL-46: Intersection of Blake's Hill Road & Route 4

Location: 43.2215, -71.2416 Impact: Low Land use: Town Road/State Road intersection

Observations: Two eroding gullies were observed along the road shoulders of Blake's Hill Road as it slopes to its intersection with Route 4. The road edge was also found to be crumbling into the road shoulder.

Recommendations: Establish a road shoulder ditch, stabilized with rip rap, and crossed with check dams to decrease stormwater erosion and sediment transport. Depending on the amount of stormwater volume this site receives, consider also installing an infiltrating catch basin at the western corner (near the small advertisement sign in the first photo).



Western road shoulder (left and right), and eastern road shoulder (right).

Site NWL-48: Baker Avenue

Location: 43.2130, -71.26280

Impact: Moderate Land use: Private Road

Observations: An intermittent ditch or stormwater flow path was observed through the woods perpendicular to Baker Ave. The channel originates from a culvert on the upward side of the road. It appears as if the upward side was hand dug or severely scoured, with lots of loose soil edges and a depth of approximately 2-3 feet.

Recommendations: Stabilize the uphill ditch area with rip rap to prevent loose sediment from being easily transported downhill to Northwood Lake. Additionally, try to stabilize the flowpath on the downhill side with rip rap or vegetation where possible. Sediment coir logs may be placed across the ditchway if they can be maintained and accumulated sediment cleaned out periodically. Consult a wetland scientist before beginning improvements as this the drought conditions make it difficult to discern if this is a ditch or an intermittent stream channel.



The downhill view of the ditch/flow path with caving edges and exposed roots.

Site NWL-47: Old Richie Road

Location: 43.2141, -71.2820 Impact: Low Land use: Town Road

Observations: Road shoulder gully erosion was observed along Old Richie Road leading to Griffin Brook (the stream at site NWL-25) that flows through the mowed/hayed field. The gully travels down the hill and then across the road surface towards Northwood Lake Road. The road shoulder ditch has lost its finer sediments, which have been transported downhill and are deposited at the intersection of Northwood Lake Road.

Recommendations: Install a turnout at the top of the hill, near the opening into the hayfield but on the opposite side, so that stormwater flows on the uphill side of the rock wall and into the wooded area. Stabilize road shoulder from further erosion with large crushed stone and check dams. An infiltration area could be created near the mailboxes. Alternatively, consider re-grading the road away from the hayfield and install turnouts on the uphill side of the road before the steep edge on the northern road shoulder.



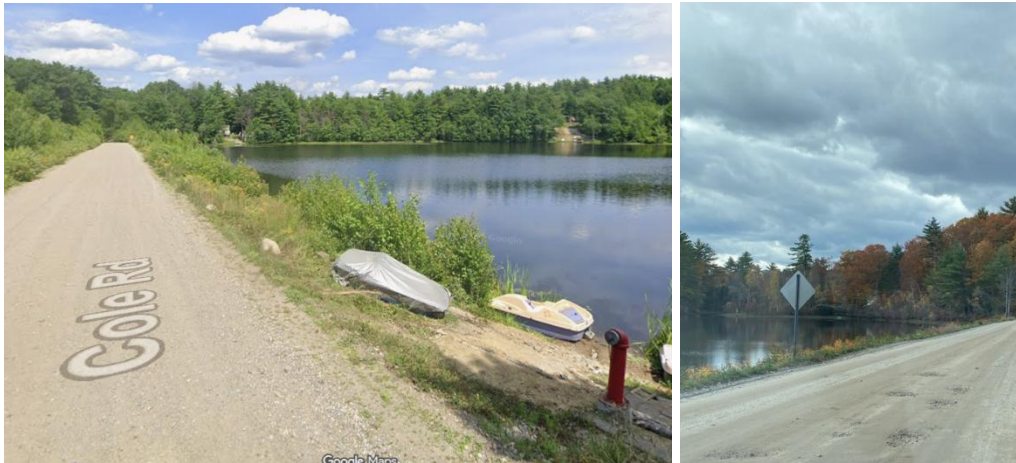
(Right) Southern road shoulder of Old Richie Road facing downhill towards its intersection with Northwood Lake Road (middle and right).

Site NWL-52: Voydatch Pond Roads

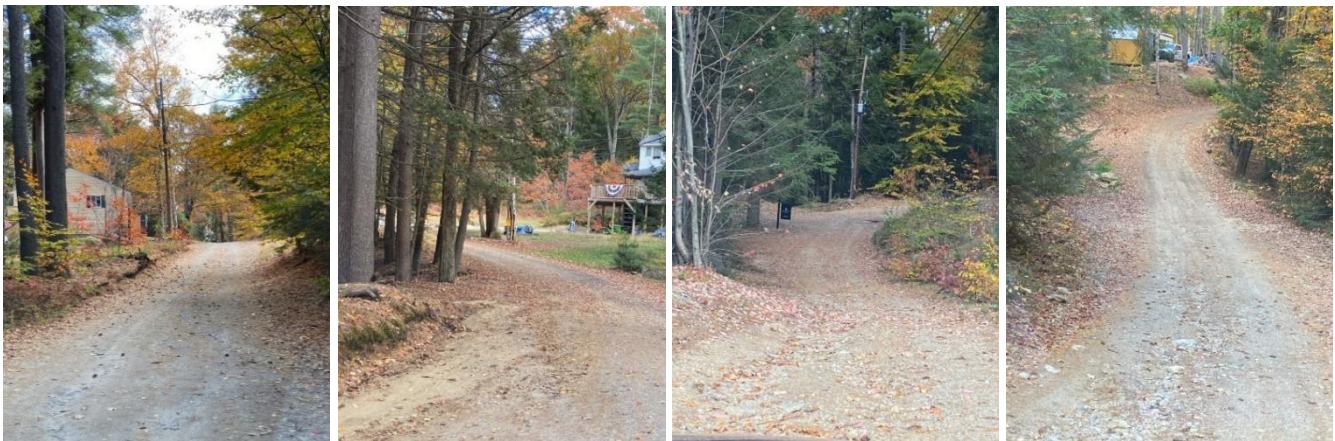
Location: 43.1958, -71.2473 Impact: Moderate Land use: Private Roads

Observations: The roadways encircling Voydatch Pond (Cole Road, Rita's Circle, and Jack Street) are unpaved and show signs of erosion with gullies, potholes, and uneven surfaces. Additionally, only a small, vegetated buffer was observed between Cole Rd and Voydatch Pond. The roads are hilly, and many small gullies were observed.

Recommendations: Collaborate with the homeowners in this area to regrade and resurface each road with a more stable surface material. Add turnouts to vegetated areas where possible to keep erosion from progressing down the road surface. Work with homeowners that have pond access to ensure accessways are stable and maintained, and revegetate shoreline areas where possible. Increase the vegetated buffer along Cole Road with hearty native shrubs and trees. Stabilize any access points here with crushed stone, vegetation, and/or perched (and infiltrating) sitting area or dock. Consult shoreline regulations and permitting needs before conducting work so close to the shoreline.



Views of Cole Road from Google street view (left) and from the watershed survey (right) showing the limited buffer.



Erosion gullies and stormwater flow paths on the road surfaces of Rita's Circle and Jack Street.

Site NWL-53: Birch Street Road Shoulder

Location: 43.2150, -71.2187 Impact: Moderate Land use: Private Road

Observations: A large road shoulder gully was observed along Birch Street and Shore Drive. The gully travels along Birch Street but also continues across the road and to Shore Drive, then into a ditch that appears to flow during non-drought conditions. The lower end of the gully has very loose piles of sediment (on the southern side of the intersection).

Recommendations: Clean out accumulated sediment and debris from flow path and from the piles of loose sediment. Install check dams and consider installing a plunge pool at the base of the road shoulder by the telephone pole. Regrade the road to the south to direct stormwater runoff into the southern road shoulder check dams and plunge pool.



(Left) Southern road shoulder gully looking uphill. (Middle) Southern road shoulder gully looking downhill. (Right) Flow path of the road shoulder flow crossing Birch Street to the intersection with Shore Drive.

GENERAL NONPOINT SOURCE SITES

Site NWL-7: Route 4 by School & Church

Location: 43.2176, -71.2091 Impact: Moderate Land use: State Road, Town/Commercial Property

Observations: Route 4 is a major road with curbing and a stormwater system. Pollutants can accumulate on impervious surfaces in the form of dust, leaf litter, automobile chemicals and animal waste. During rainstorms, stormwater can mobilize these pollutants and impact water quality. While there are no signs of erosion or flooding (note the survey was conducted during a drought), there is ample room for surface-grade stormwater management, rather than piped stormwater infrastructure which discharging to surface waters. There are four catch basins present here.

Recommendations: Identify the outlet point(s) of the catch basin system. If the system discharges to surface waters, consider creating an engineered stormwater control measure, such as a vegetated swale to infiltrate stormwater and filter stormwater runoff. There are large open spaces near the school parking lot that may be suitable for such infiltration. Alternatively, filtration bags may be installed at each catch basin inlet to collect sediment and debris before it enters piped stormwater infrastructure. These techniques can be replicated elsewhere along Route 4 to reduce pollutant concentrations in stormwater. Other benefits of surface-level green stormwater infrastructure include groundwater recharge, traffic calming, aesthetic improvements, and better access for inspection and maintenance.



(Left) Open area near parking lot may be used for a rain garden, vegetated swale or other engineered stormwater control measure. (Right) Untreated stormwater from Route 4 enters catch basins.

Site NWL-11: Route 4 Construction

Location: 43.2219, -71.2413 Impact: Moderate Land use: Private/Commercial

Observations: Active construction was observed along Route 4. Bare soil covers the lot and erosion/sediment control measures were not observed. There were also large, uncovered sediment piles.

Recommendations: Revegetate the road shoulders. Encourage property owners to use sediment/erosion controls while under construction. This may involve covering exposed piles, using silt fences and coir logs to either stabilize bare soil or capture mobilized sediment.



Bare soil and sediment piles at the construction site on Route 4.

Site NWL-18: Hill Road

Location: 43.2594, -71.2744 Impact: Moderate Land use: Agricultural

Observations: A small strip of rip rap was observed leading from an agricultural property on Catamount Road/Hill Road to a roadside ditch on Hill Road, suggesting that agricultural runoff likely follows this flow path to enter the road shoulder ditch. The ditch leads to a crossroad culvert that ultimately enters a headwater stream. There is minor road shoulder erosion on Hill Road, though eroded sediment is likely attenuated by the large amount of vegetation in the road shoulder ditch.

Recommendations: Engage with farmers about agricultural BMPs and stormwater control measures that can retain and treat all stormwater onsite. The plastic culvert at the site is also crushed and may merit replacement.



(Left) Trail of rip rap leading from an agricultural property to the road shoulder ditch, obscured by vegetation in the photo. (Right) Slightly crushed culvert outlet at the site.

Site NWL-23: School Street & Route 4 at Heritage Market

Location: 43.2235, -71.2545 Impact: High Land use: State Road and Commercial

Observations: Catch basins on School Street and in the parking lot of the Heritage Market collect stormwater from impervious surfaces. Untreated stormwater contains pollutants from various sources such as atmospheric dust, winter sand, soil, automotive chemicals, leaf litter, other organic matter, and pet/animal waste. Large pervious surfaces also restrict infiltration and increase the volume of stormwater runoff traveling to more downhill areas.

Recommendations: Multiple opportunities exist to utilize engineered urban stormwater control measures onsite. On School Street, planter bump outs may be used to capture and infiltrate stormwater in the road shoulder apron. A large open space area is present adjacent to the parking lot, which could be converted to a rain garden, vegetated swale, or other engineered green stormwater infrastructure. There is already a catch basin in this area, meaning it is already connected to stormwater infrastructure. Investigate the location of the catch basin outlet(s). Engage with the property owner about winter salt use and opportunities for reducing the extent of impervious cover on the parking lot.



(Left) The catch basins in the market parking lot by the orange cone. (Right) The catch basin along School Street.



(Left) The large impervious parking lot. (Right) An open space area with a catch basin in the center may be a suitable location for engineered green stormwater infrastructure.

Site NWL-24: McEvoy Lane

Location: 43.2331, -71.2799

Impact: Low Land use: Private Road

Observations: Stormwater from McEvoy Lane discharges through an under-driveway culvert and leads to a stream channel. No erosion was observed at the site. Improving vegetation at the site would enhance pollutant and nutrient uptake from stormwater and decrease pollutant loads downstream while also reducing the volume of stormwater reaching the stream.

Recommendations: Stormwater management could be improved at the site by increasing stormwater infiltration, through installations such as a rain garden or vegetated swale. Alternatively, letting the current vegetation grow freely between the culvert outlet and stream would provide additional pollutant filtering capacity and some nutrient uptake by plants. A minimal improvement would be to increase the mower height to at least four inches.



Stormwater exits the under-driveway culvert and enters the stream after traveling through a sloped, grassed area.

Site NWL-33: Boat House

Location: 43.2209, -71.2830 Impact: Low Land use: Private

Observations: No vegetated shoreline buffer was observed along the boat house property at the marina. Only a few small plants were present. An apron of soil and mulch is present and ready for planting.

Recommendations: Plant a vegetated buffer with native, deep rooting species for stability against winds and weather. Refer to the [Native Shoreland/Riparian Buffer Plantings for New Hampshire guide](#) for species suggestions. Ensure soil and mulch are not being pushed over the top of the retention wall and into the lake.



The shoreline of the Boat House.

Site NWL-34: Side of Boat Yard

Location: 43.2212, -71.2827 Impact: Low Land use: Commercial

Observations: At the time of the watershed survey, a smaller retention basin was present at the south western corner of the boat storage yard. Stormwater that falls on the yard (paved) travels to a series of catch basins, but some also enters the south western corner of the lot. The previous retention basin was dug and lined with rip rap, but has since filled in after years of infiltrating stormwater and settling out sediment. Additionally, a small breakthrough channel was observed leading to Lake Road and the homes along the shoreline.

Recommendations: Following the site visit, the MacCallum's Boathouse staff promptly enlarged the retention basin by making it both deeper and wider, and building up the side walls to decrease the chance of breakthrough flow paths. A sediment coir log is also present along both the inlet and outlet sides to provide further stability and sediment/pollution retention capabilities. No further recommendations are provided at this time, great work!



The boat yard catch basin (left) and the original retention basin and breakthrough path during the watershed survey (right).



Photos of the improved retention basin, deeper, lined with rip rap, and stabilized with coir logs. Photos provided by MacCallum's Boathouse.

Site NWL-49: Sand Pit Avenue

Location: 43.2161, -71.2778 Impact: High Land use: Private Road

Observations: A large clear-cut area was observed along the eastern side of Sand Pit Avenue not too far south from the intersection with Klopp Avenue. Large piles of slash and soil are present on this steeply sloped lot. A stream flows parallel to Sand Pit Ave at the bottom of the recently cleared hill. The stream has minimal buffer on the cleared side, debris within the stream, and no stormwater control measures were observed such as silt fences or coir logs to keep the disturbed land and slash from eroding into the stream and to Northwood Lake. There is approximately 400 feet of stream length between this site and Northwood Lake. The ground appears to be comprised of very loose soil.

Recommendations: Contact the landowner and work to remove slash from the stream channel and to install erosion control measures along the stream bank. Ensure the future land use intended for this area has erosion control measures because of the steep grade down to the stream.



(Left) View north down Sand Pit Ave towards Klopp Ave. (Middle and right) the recent clear-cut and stream at the bottom.

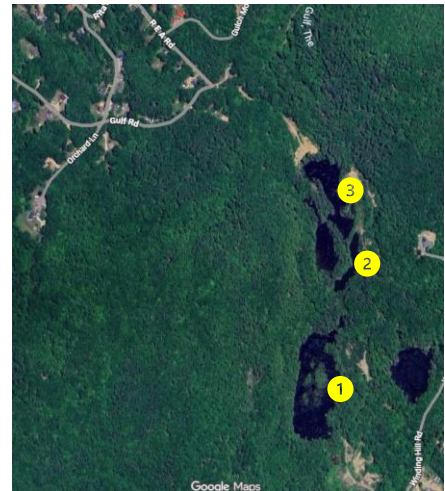
POINTS OF INTEREST

Sand/Gravel Quarry Ponds

Location: 43.1913, -71.2383 Impact: NA Land use: NA

Observations: The quarry ponds located between Winding Hill Rd and Gulf Road were visited to determine the influence, if any, they have on Northwood Lake's water quality. During the visit, which was conducted in a drought, water levels in the ponds were very low, and were not discharging to an outlet stream. However, had the field visit been conducted during a wetter time of year, we would expect water levels to be higher and discharge could be possible.

Recommendations: None. Continue to monitor the water quality of "the Gulf" tributary where it outlets into Northwood Lake.



(1) The first pond from an inlet stream. Water does not appear unusual, a lot of aquatic vegetation is present.



(2) The second pond has a greenish hue. Water level is low, no outlet was found.



(3) The third pond also had lots of aquatic vegetation growing in it, and the water did not appear unusual. Water level was too low to outlet.



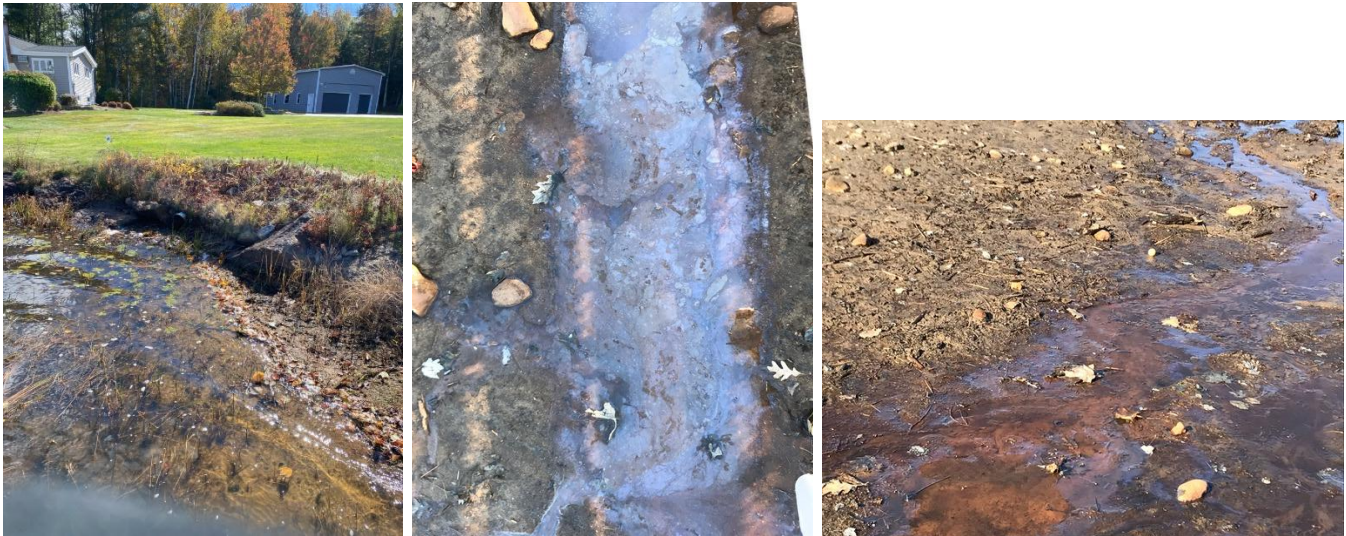
Loose sand piles were present to the east of pond #3, though a berm between the piles and the pond would keep any of this sediment from entering the pond.

Oil Sheen in Northwood Lake at Sleepy Hollow Ln

Location: 43.2188, -71.2838 Impact: NA Land use: NA

Observations: Residents have observed an “oil sheen” in the water of Northwood Lake between 55 and 57 Sleepy Hollow Lane. An outlet pipe is present at this location and may connect to a wetland on the opposite side of Sleepy Hollow Lane. An oil sheen was not present at the time of the survey. No obvious sources were present near the inlet pipe or on the surrounding landscape. It is possible the oil sheen is being caused from naturally occurring oils from the wetland ecosystem. A bus company and bus parking lot is present higher up in the drainage area to this wetland, but this lot was not visited during the time of the survey so possible drainage connections to the wetland could not be determined.

Recommendations: If the oil sheen reappears, conduct the “stick test” and poke the oil sheen with a stick. If the sheen swirls around in arcs and ripples it is likely from a synthetic source. If the sheen breaks apart into smaller bits and pixelates, then it is likely of natural source. If the sheen is from a natural source, no further action is needed. If the sheen is from a synthetic source, contact the bus company to see if a volunteer may access the property to search for a stream connecting the lot to the wetland. Explain the situation and see where collaborations can be made and support provided.



(Left) the shoreline where the pipe outlets on the day of the watershed survey. (Middle and right) The oil sheen as observed by a local resident.