KINGSTONLAKE(GREATPOND)

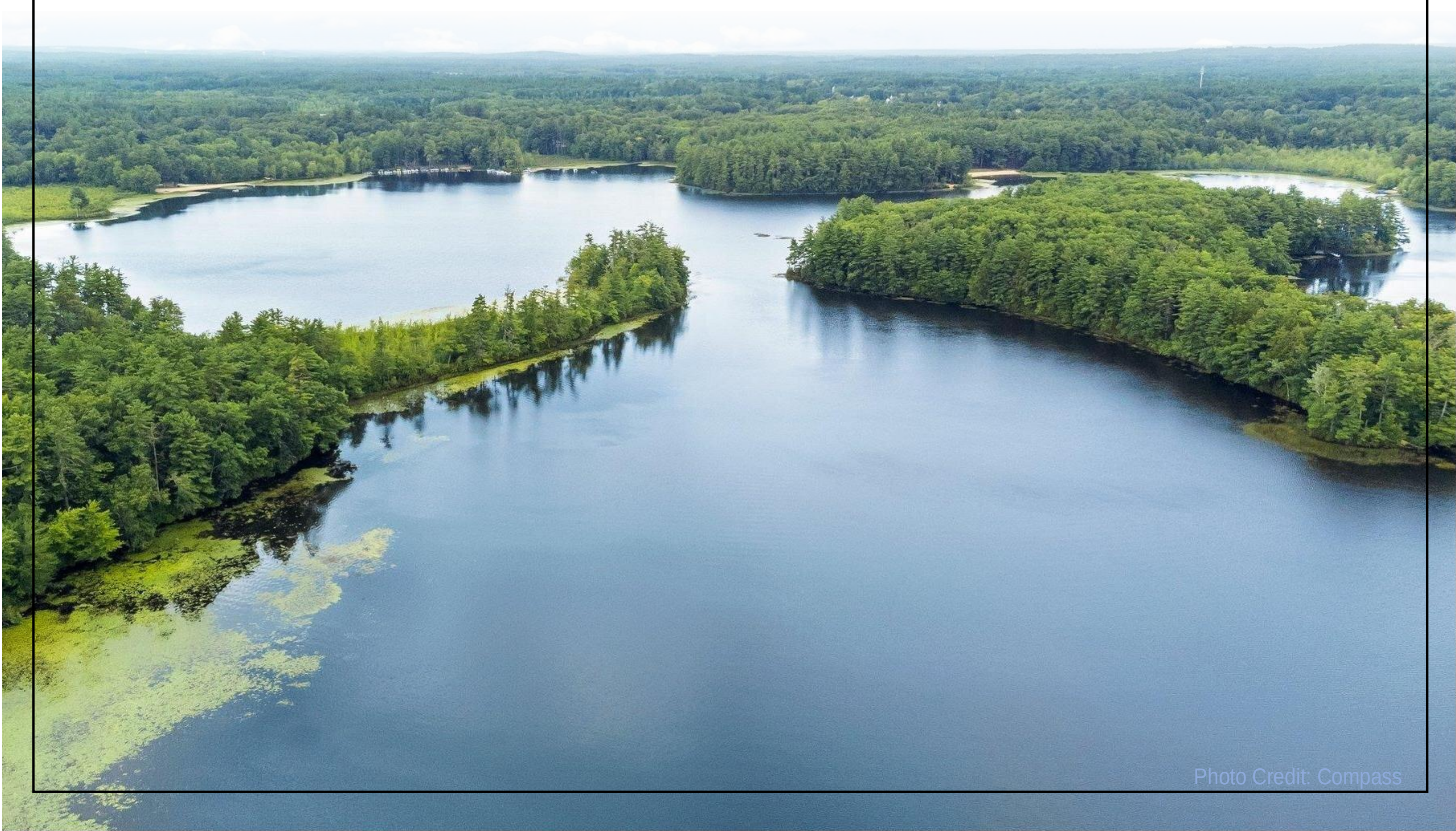
WATERSHED-BASED MANAGEMENT PLAN

PREPAREDBY FB ENVIRONMENTALASSOCIATES

incooperation with the Town ofKingston, KingstonLake Association, and

YMCA Camp Lincoln

SEPTEMBER2024 | **FINAL**



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For questions, comments, oradditional information related to the Kingston Lake Watershed-Based Management Plan, please contact the Kingston Lake Association at dmingalls@comcast.net.

TABLE OFCONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

ACRONYM	DEFINITION
AC	Assimilative Capacity
AIPC	Aquatic Invasive Plant Control, Prevention and Research Grants
ACEP	Agricultural Conservation Easement Program
ALI	Aquatic Life Integrity
ARM	Aquatic ResourceMitigation Fund
BMP	Best Management Practice
CAGR	Compound Annual Growth Rate
CDC	Centers for Disease Controland Prevention
CHL-A	Chlorophyll-a
CNMP	Comprehensive Nutrient Management Plan
CSP	Conservation Stewardship Program
CUM	Cubic Meters
CWA	Clean Water Act
CWP	Center for Watershed Protection
CWSRF	Clean Water StateRevolving Fund
DO	Dissolved Oxygen
DPW	Department of Public Works
EMD	Environmental Monitoring Database
EPA	United States EnvironmentalProtection Agency
EQIP	Environmental Quality Incentives Program
ESRI	Environmental Systems Research Institute
FBE	FB Environmental Associates
FT	Feet
HA	Hectare
HAB	Harmful AlgalBloom
ILF	In-Lieu Fee
KG	Kilogram
LCHIP	Land and Community Heritage Investment Program
LID	Low Impact Development
LLMP	Lay Lakes Monitoring Program
LLRM	Lake Loading Response Model
LRCT	Lakes Region Conservation Trust
RPC	Lakes Region Planning Commission
LWCF	Land and Water Conservation Fund
M	Meter
NAWCA	North American Wetlands Conservation Act
NERFG	New England Forest and River Grant
NCEI	National Centers for Environmental Information
NFWF	National Fish and WildlifeFoundation
NH GRANIT	New Hampshire Geographically Referenced Analysis and Information Transfer System
NHACC	New Hampshire Association of Conservation Commissions
NHD	National Hydrography Dataset
NHDES	New Hampshire Department of Environmental Services
NHFG	New Hampshire Fish and Game Department
NHLCD	New Hampshire Land Cover Database
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant DischargeElimination System
NPS	Nonpoint Source Pollution

ACRONYM	DEFINITION
NRCS	Natural Resources Conservation Service
NRI	Natural Resources Inventory
NWI	National Wetlands Inventory
PAS	Potentially Attaining Standards
PCR	Primary Contact Recreation
PCS	Potential Contamination Source
PFAS	Per- and polyfluoroalkyl substances
PNS	Potentially Not Supporting
ppb, ppm	parts per billion, parts per million
RCCD	Rockingham County Conservation District
RCCP	Regional Conservation Partnership Program
RCRA	Resource Conservation and Recovery Act
ROW	Right-of-Way
SCC	State Conservation Committee
SDT	Secchi Disk Transparency
TKN	Total Kjeldahl Nitrogen
TP	Total Phosphorus
UNH	University of New Hampshire
USLE	Universal Soil Loss Equation
WBMP	Watershed-Based Management Plan
YR	Year

DEFINITIONS

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

Anoxia is a condition of low dissolved oxygen.

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

Best Management Practices (BMPs) are conservation practices designed to minimize discharge of NPS pollution from developedlandtolakesandstreams.Managementplansshouldincludebothnon-structural(non-engineered)andstructural (engineered) BMPs for existing and new development to ensure long-term restorationsuccess.

Build-out analysis combines projected population estimates, current zoning restrictions, and a host of additional development constraints (conservation lands, steep slope and wetland regulations, existing buildings, soils with low development suitability, andunbuildable parcels)todetermine the extent of buildableareas in the watershed.

Chlorophyll-a(Chl-a)isameasurementofthegreenpigmentfoundinallplants,includingmicroscopicplantssuchasalgae. Measured in parts per billion or ppb, it is used as an estimate of algal biomass; the higher the Chl-a value, the higher the number of algae in thelake.

Clean Water Act (CWA) requires states to establish water quality standards andconduct assessments to ensure that surface waters are clean enoughto support human and ecologicalneeds.

Cyanobacteria are photosynthetic bacteria that can grow prolifically as blooms when enough nutrients are available. Some cyanobacteria canfix nitrogen and/or produce microcystin, which is highly toxicto humans and other lifeforms.

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

Epilimnionisthetoplayeroflakewaterdirectlyaffectedbyseasonalairtemperatureandwind.Thislayeriswell-oxygenated by wind and wave action.

Eutrophication is theprocess bywhich lakes becomemoreproductiveovertime(oligotrophictomesotrophictoeutrophic). Lakes naturally become more productive or "age" over thousands of years. In recent geologic times, however, humans have enhanced the rateof enrichment and lake productivity, speeding up this natural process to tens or hundreds of years.

Fallturnoveris the process of completelakemixingwhencoolingsurfacewaters becomedenserandsink,especiallyduring 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 inthe lake.

Flushing rate (also called retention time) is the amount of time water spends in a waterbody. It is calculated by dividing the flow in or out bythe volumeof the waterbody.

Full build-out refers to the time and circumstances in which, based on a set of restrictions (e.g., environmental constraints andcurrentzoning),nomorebuildinggrowthcanoccur,orthepointatwhichlotshavebeensubdividedtotheminimumsize allowed.

Hypolimnion is the bottom-most layer of the lake that experiences periods of low oxygen during stratification and is devoid of sunlight for photosynthesis.

Impervious surfaces refer toany surfacethat will not allow water tosoak into theground. Examples include paved roads, driveways, parking lots, androofs.

InternalPhosphorusLoadingistheprocesswherebyphosphorusboundtolakebottomsedimentsisreleasedbackintothe water column during periods of anoxia. The phosphorus can be used as fuel for plant and algae growth, creating a positive feedback to eutrophication.

Low Impact Development (LID) 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 closeto thesource, and preserving natural drainage systems and open space, among other techniques.

Metalimnion is the markedly cooler, dynamic middle layer of rapidly changing water temperature. The top of this layer is distinguished by at least a degree Celsius drop per meter of depth.

Nonpoint Source (NPS) Pollution comes from diffusesources throughout a watershed, suchas stormwater runoff, seepage from septic systems, and gravel road erosion. One of the major constituents of NPS pollution is sediment, which contains a mixture of nutrients (like phosphorus) and inorganic and organic materialthat stimulate plant and algae growth.

Non-structuralBMPs,whichdonotrequireextensiveengineeringorconstructionefforts,canhelpreducestormwaterrunoff and associated pollutants through operational actions, such as land use planning strategies, municipal maintenance practices, andtargetededucation and training.

Oligotrophic lakes arelessproductiveorhave fewernutrients (i.e.,lowlevels of phosphorus andchlorophyll-a),deepSecchi Disk Transparency readings (8.0 m or greater), and high dissolved oxygen levels throughout the water column. In contrast, **eutrophic** lakes have more nutrients and are therefore more productive and exhibit algal blooms more frequently than oligotrophic lakes. **Mesotrophic** lakes fall in-between withan intermediate level of productivity.

pH is thestandard measure of theacidity or alkalinity of a solution on a scale of 0(acidic)to 14 (basic).

Riparian refers to wildlife habitat found along the banks of a lake, river, or stream. Not only are these areas ecologically diverse, but they arealsocritical toprotectingwater quality by preventing erosion and filtering pollutedstormwater runoff.

Secchi Disk Transparency (SDT) is a vertical measure of the transparency of water (ability of light to penetrate water) obtainedbyloweringa blackandwhitediskintothewateruntilit is nolongervisible.Transparencyis anindirect measure of algal productivity and is measured in meters (m).

StructuralBMPs,orengineeredBestManagementPractices,areoftenattheforefrontofmostwatershedrestorationprojects and help reduce stormwater runoff and associated pollutants.

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

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

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

EXECUTIVESUMMARY

KingstonLake,alsoknownasGreatPond,isa276-acrelakewitha5,145-acrewatershedsituatedwithinthetownsofKingston andDanvillein southeasternNewHampshire.KingstonLakeis fedbyupstream waterbodies includingGreenwoodPondand Long Pond, as well as several tributaries such as the headwaters of the Powwow River and many other unnamed streams. FromtheoutletofKingstonLake,waterflowssoutheastasthePowwowRiveracrosstheborderofMassachusettstoitsunion with the Merrimack River in Amesbury, Massachusetts, roughly 6.5 miles before reaching the AtlanticOcean.

The Problem

Kingston Lake has experienced generally good water quality in the past but is under increasing threat by low dissolved oxygen, elevated chloride, and cyanobacteria blooms. The New Hampshire Department of Environmental Services (NHDES) assessed Kingston Lake as not supporting for Aquatic Life Integrity (ALI) due to low dissolved oxygen saturation and low pH. Kingston Lake is also listed as impaired for Primary Contact Recreation for elevated concentrations of Escherichia coli at certainbeaches.Additionally,fourcyanobacteriablooms havebeenobserved inKingstonLakeresultinginadvisorieslasting a cumulative 46 days, of which the most recent was in 2024. Two major waterbodies feeding into Kingston Lake have issues that threaten the water quality of Kingston Lake: Long Pond is infested by the invasives, variable milfoil and fanwort, and Greenwood Pond suffers from recurrent cyanobacteria blooms.

Cyanobacteria blooms are typically spurred by a combination of warming waters and excessive nutrients, in particular phosphorus, to surface waters. Sources of phosphorus in the watershed impacting the lake's water quality include stormwater runoff from developed areas, shoreline erosion, erosion from construction activities or other disturbed ground particularly along roads, excessive fertilizer application, failed or improperly functioning septic systems, leaky sewer lines, unmitigated agricultural activities, and pet, livestock, and wildlife waste. Fifty-five (55) problem sites were identified in the watershed during a field survey, and the main issues found were unpaved road and ditch erosion, buffer clearing, and untreated stormwater runoff. Additionally, 59 shorefront properties were identified as having some impact to water quality due to evidence of erosion and lack of vegetated buffer. The model results revealed changes in phosphorus loading and in-lake phosphorus concentrations over time from pre-development through future conditions, showing that the water quality of Kingston Lake is threatened by current development activities in the watershed and will degrade further with continued development in thefuture, especially when compounded by the effects of ongoing climate change.

The Goal

The goal of the Kingston Lake (Great Pond) Watershed-Based Management Plan (WBMP) is to improve the water quality of Kingston Lake such that it meets state water quality standards for the protection of ALI and substantially reduces the likelihoodof harmful cyanobacteriablooms inthelake. Thisgoalwill beachievedbyaccomplishing thefollowing objectives:

OBJECTIVE 1: Reduce phosphorus loading from existing development in the watershed.

OBJECTIVE 2: Mitigate(prevent or offset) anticipatedadditional phosphorus loading from future development.

The Solution

In collaboration with the Town of Kingston, Kingston Lake Association (KLA), and YMCA Camp Lincoln, FB Environmental Associates (FBE) was contracted to develop a WBMP to better understand and protect the water quality of Kingston Lake. As part of the development of the WBMP and according to the Site-Specific Project Plan (SSPP), a build-out analysis, land-use model,waterqualityandassimilativecapacityanalysis,septicsystemdatabase,shorelinesurvey,andwatershedsurveywere completed to identify and quantify the sources of phosphorus and other pollutants to the lake. Results from these analyses were used to determine recommended management strategies for the identified pollutant sources in the watershed. An Action Plan (Section 5) was developed in collaboration with the Steering Committee comprised of key watershed stakeholders(seeAcknowledgements).Thefollowingactions wererecommendedtomeettheestablishedwaterqualitygoal and objectives for Kingston Lake:

WATERSHED STRUCTURAL BMPS: Sources of phosphorus from watershed development should be addressed through installationofstormwatercontrols,stabilizationtechniques,bufferplantings,etc. asrecommendedforthehighprioritysites (and the medium and low priority sites as opportunities arise) identified during the watershed survey, the high and medium impact shoreline properties identified during the shoreline survey, and any new or redevelopment projects in thewatershed with high potential forsoil erosion.

MONITORING: Along-term waterqualitymonitoring plan is criticaltoevaluatetheeffectiveness of implementationefforts over time. KLA, in concert with New Hampshire Department of Environmental Services (NHDES) Volunteer Lake Assessment Program (VLAP), should continue the annual monitoring program and consider incorporating additional monitoring recommendations laid out in this plan. **Establishing a consistent and robust monitoring program for Greenwood Pond is a high priority to inform a higher-level survey of stormwater runoff and septic systems and possibly development of a WBMP for Greenwood Pond, whose recurrent cyanobacteria blooms represent a**

EDUCATION AND OUTREACH: KLA and other key watershed stakeholders should continue all aspects of their education and outreach strategies and consider developing new ones or improving existing ones to reach more watershed residents. Examples include providing educational materials to existing and new property owners, as well as renters, by distributing them at various locations andthrougha varietyof means,suchas websites,newsletters,socialmedia,communityevents,or community gathering locations. Educational campaigns should include raising awareness of water quality concerns, 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.

OTHERACTIONS: Additionalstrategiesforreducingphosphorus loadingtothelakeinclude:revising localordinancessuchas setting low impact development (LID) requirements on new construction; identifying and replacing malfunctioning septic systems; inspecting and remediating leaky sewer lines; using best practices for road maintenance and other activities including municipal operations such as infrastructure cleaning; conserving large or connective habitat corridor parcels; and improving agricultural practices. Future development should also be considered as a pollutant source and potential threat towaterquality. KingstonLake is at riskforgreaterwaterqualitydegradationbecauseofnewdevelopment inthewatershed unless climate change resiliency and LID strategies are incorporated into existing zoning standards.

The recommendations of this plan will be carried out largely by the Town of Kingston, KLA, and YMCA Camp Lincoln with assistance from a diverse stakeholder group, including representatives from municipalities (e.g., select boards, planning boards),conservationcommissions,stateandfederalagencies (e.g.,NHStateParks)ororganizations,nonprofits,landtrusts, schools and community groups, local business leaders, and landowners. The cost of successfully implementing the plan is estimatedat$0.8-$1.4millionoverthenext10ormoreyearsinadditiontothededicationandcommitmentofvolunteertime and supportto manage plan implementation. However, many costs are still unknown or were roughly estimatedandshould be updated as information becomes available. This financial investment can be accomplished through a variety of funding mechanisms via both state and federal grants, as well as commitments from municipalities or donations from private residents. Of significant note, this plan meets the nine planning elements required by the EPA, and Kingston Lake is now eligible for federalwatershedassistance grants.

Important Notes

The success of this plan is dependent on the continued effort of volunteers and a strong and diverse stakeholder group that meets regularly to coordinate resources for implementation, review progress, and make any necessary adjustments to the plan to maintain relevant action items and interim milestones. A reduction in nutrient loading is no easy task, and because there are many diffuse sources of phosphorus reaching surface waters in the watershed, it will require an integrated and adaptive approach across many different parts of the watershed community to be successful. The recommendations in this plan are idealized and, in some cases, may be difficult to achieve given the physical and political realities of the community dealing with oldinfrastructure, lack of access to key lakefront areas, and limitedfunding and volunteer or staff capacity.

Finally,weallhaveacommonresponsibilitytoprotectourlakes forfuturegenerationstoenjoy.Privatelandownersarguably holdthemost powerinmakingsignificant impacttorestoring andmaintaining excellent waterqualityinourlakes;however, engaging private landowners as a single stakeholder group can be difficult and outreach efforts often have limited reach, especially to those individuals who may require the most education and awareness of important water quality protection actions.Thejointcommitteewillcontinuetoengagethepublicasmuchaspossiblesothatprivateindividualscanhelpreview and implement the recommendations of this plan and protect thewater quality of Kingston Lake long intothe future.

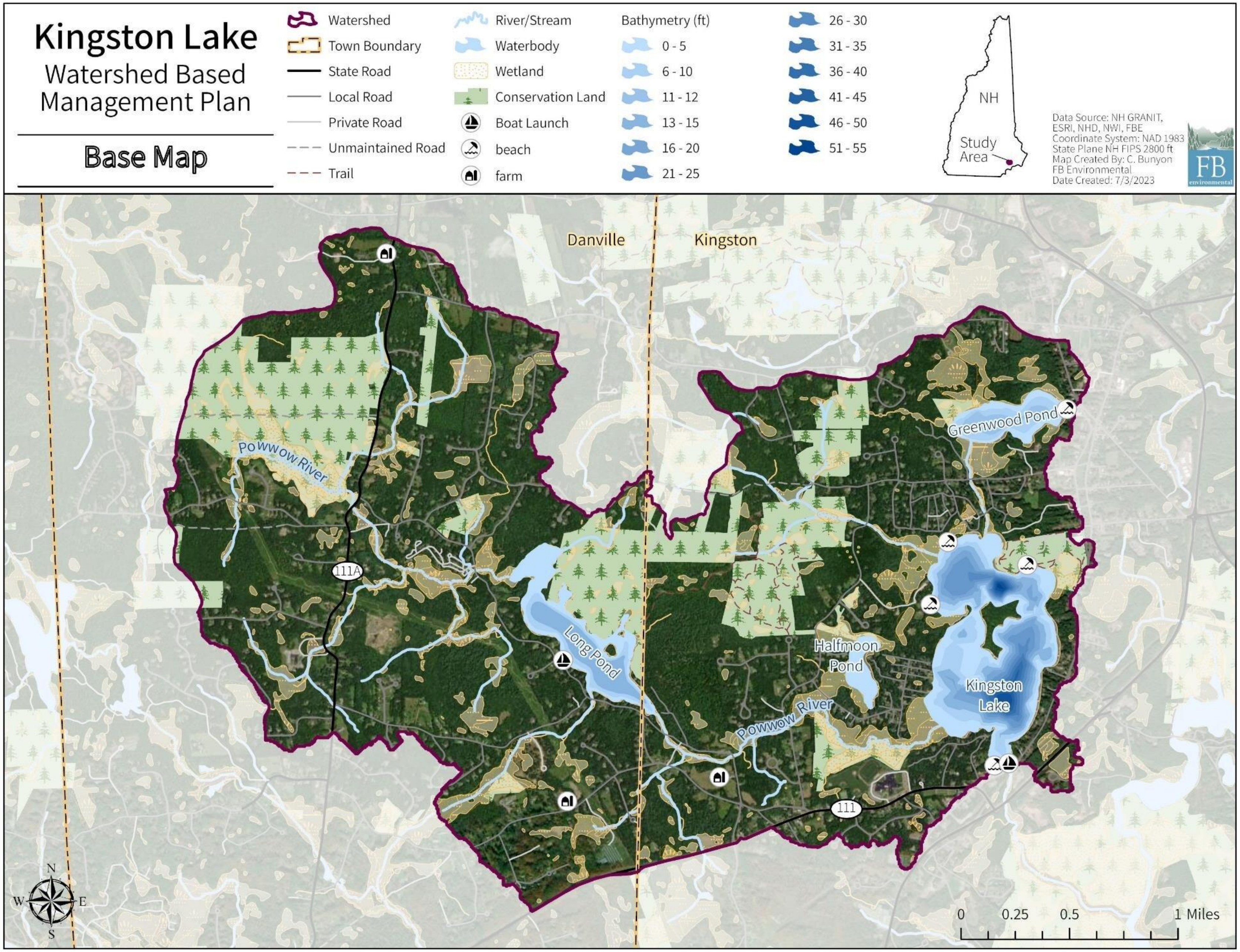

Figure 1. Kingston Lake watershed.

1 INTRODUCTION

1.1 WATERBODYDESCRIPTIONAND LOCATION

KingstonLakeisa276-acre(112-hectare)lakewitha5,145-acre(2,082-hectare)watershedinthetownsofKingston(48%)and Danville (52%). Kingston Lake is fed by upstream waterbodies including Greenwood Pond, Long Pond, and Halfmoon Pond as well as the Powwow River and several unnamed tributaries (Figure 1). Greenwood Pond is a 50-acre pond to the north of Kingston Lake. The outlet of Greenwood Pond flows south for 0.46 miles before reaching the northernmost part of Kingston Lake near Thayer Road. The other major tributary, the Powwow River, begins slightly west of Main Street in Danville before flowingsoutheastthroughLongPondbeforereachingKingstonLakebetween9thStreetandDrewLaneinKingston.Excluding the stretch of the river flowing through Long Pond, thePowwow tributary to Kingston Lake flows about fourmiles.

The Kingston Lake watershed is situated within a temperate zone of converging weather patterns from the hot, wet southern regions and the cold, dry northern regions, which causes various natural phenomena such as heavy snowfalls, nor'easters, severe thunder and lightning storms, and hurricanes. The area experiences moderate to high rainfall and snowfall, averaging 45 inches of precipitation annually. Data were collected for 1994-2023 from Daymet whichinterpolatesweatherdataataspecificlocationfrom nearby weather stations. Annual precipitation has varied over the 30-year period, showing no significant increasing or decreasing trend (using the rtk package in R Studio) (Figure 2). Average and minimum annual temperature values have increased during the same time frame ($p < 0.05$), while maximum temperature has not displayed a significant trend (Figure 2).

The highest elevation in the watershed (about 344 ft above sea level)islocatednorthofSudburyRoadandinthewesternmostpart of the Rock Rimmon State Forest. Kingston Lake and the direct shoreline drainage area are approximately 118 ft above sea level. These elevation measurements were derived from digitalelevation models provided by NH GRANIT.

The watershed is characterized primarily by mixed forest that includes both conifers (e.g., white pine and eastern hemlock) and deciduous(e.g.,beech,redoak,andmaple)treespecies.Faunathat enjoy these forested resources include land mammals (deer, black bear, coyote, bobcats, fisher, fox, raccoon, weasel, porcupine, muskrat, mink, chipmunks, squirrels, and bats), water mammals (muskrat,otter,andbeaver),landandwaterreptilesandamphibians (turtles, snakes, frogs, and salamanders), various insects, birds (herons, loons, gulls, geese, multiple species of ducks[1], wild turkeys, ruffedgrouse,cormorants,baldeagles,andsongbirds),andfish.The Towns of Kingston and Danville are home to a variety of threatened (T) and endangered (E) species, including the common loon (T), Blanding's turtle (E), spotted turtle (T), and the northern black racer (T) (NHFG, 2022).

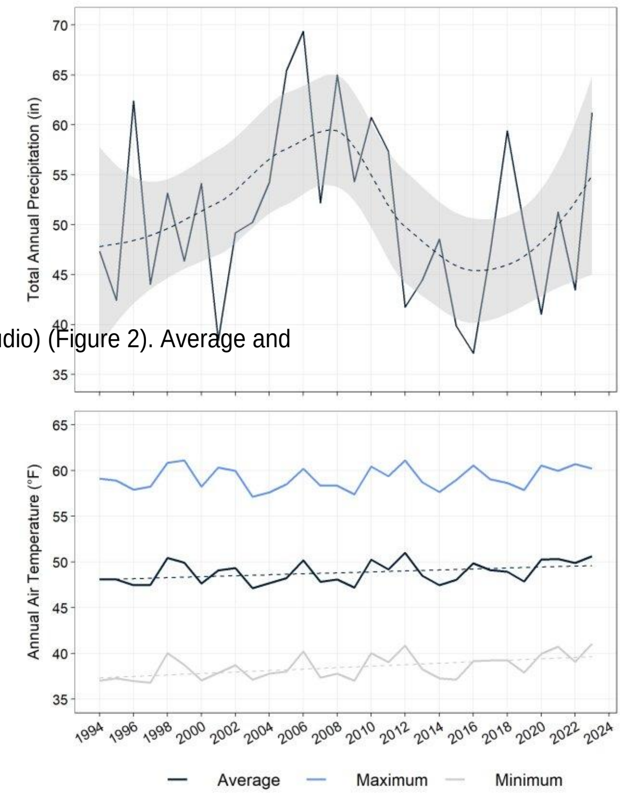

Figure 2. Precipitation andaverage, maximum, and minimum air temperature for theKingston Lake watershed from 1994-2023. Data retrieved from Daymet (2024). The dashedline and grey shaded area for precipitation represents the Locally Estimated Scatterplot Smoothing (LOESS) regression and 95% confidence intervals, respectively. The dashed lines for air temperature indicate a statistically significant trend ($p < 0.05$).

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[1] American black duck, black scoter, canvasback, common goldeneye, common loon, common merganser, hooded merganser, long tailed duck, mallard, red-breastedmerganser,andwoodduck.

1.2 WATERSHED PROTECTIONGROUPS

The Kingston Lake Association (KLA) serves asthe non-profit lake association for Kingston Lake and its surrounding watershed with a mission to " quality and sound land preserve and imp use practices in and around Kingston Lake (Great Pond) including watershed areas." KLA conducts volunteer lake host monitoring and helps involve residents through community outreach events such ascleanupsatthestateparkandalongtheshoreline.KLApartnerswiththeVolunteerLakeAssessment

YMCA Camp Lincoln is located on the shores of Kingston Lake and offers summer camp programs for children.Theirgoalsinclude providinganinclusive communitywherecampers enjoya"safe,supportive environment" to "develop leadership skills, build life-long friendships and gain self-confidence" as well as to "be a steward of Kingston Lake." "YMCA Camp Lincoln is an active member of the KLA, with whom they work "to preserve and improve healthy water quality and sound land use practices for future

The Danville Long Pond Protective Association (LPPA)is a volunteer-based nonprofit organization with a mission to strive towards maintaining the ecological health, beauty, and recreational uses of the pond while supporting conservation within the watershed

The Rockingham County Conservation District (RCCD) is one of 10 county conservation districts in New Hampshire that operate as resource management agencies and a subdivision of local governments. RCCD's mission is "to conserve and sustain the natural environment for present and future generations."TheRCCD works withlandowners, farmers, forest owners,schools, and municipalities to help protect and conserve the area's natural resources through projects such as wetland and reptile educationdemonstrations,streambedrestoration,invasivespeciesmanagement,habitatrestoration,

TheSoutheastLandTrustofNewHampshire (SELT)"conservesandstewardslandforthebenefitofpeople and nature in New Hampshire. SELT serves all of Rockingham and Strafford counties and has conserved tensofthousandsofacressince1980,includingnaturepreserves,hikingtrails,farmland,andscenic vistas."

The New Hampshire Association of Conservation Commissions (NHACC) works to provide educational assistance to conservation commissions throughout New Hampshire (216 in total). As a non-profit organization, the NHACC's mission is to instill responsible use of the available natural resources by promoting conservation and serving as the communication link between conservation commissions, whileproviding technicalsupport onthelogistics of conservationcommissionmeetings anddocument language. Conservation commissions in the Kingston Lake watershed include those of Kingston and

Covering 27 communities, the Rockingham Planning Commission (RPC) is a valuable resource to the region. The RPC aids communities with their local planning services in a targeted approach to protect the environment, while supporting local economies and cultural values

The New Hampshire Department of Environmental Services (NHDES) works with local organizations to improve water quality in New Hampshire at the watershed level. NHDES works with communities to identify water resource goals and to develop and implement watershed-based management plans. This work is achieved by providing financial and technical assistance to local watershed management organizations and by investigating actual and potential water

1.3 PURPOSEAND SCOPE

The purpose and overarching goal of the Kingston Lake Watershed-Based Management Plan (WBMP) is to guide implementation efforts over the next 10 years (2024-2033) to improve the water quality of Kingston Lake such that it meets state water quality standards for the protection of Aquatic Life Integrity (ALI) and substantially reduces the likelihood of harmful cyanobacteria blooms in the lake.

Aspartofthedevelopmentofthisplanandinaccordancewiththe Site-SpecificProjectPlan(FBE,2023),a **build-outanalysis**, land-use model, water quality and **assimilative capacity** analysis, and shoreline and watershed surveys were conducted to betterunderstandthesources ofphosphorusandotherpollutantstothelake(Sections 2and3).Resultsfrom theseanalyses were used to establishthe water quality goaland objectives (Section 2.4), determine recommended management strategies for the identified pollutant sources (Section 4), and estimate pollutant load reductions and costs needed for remediation (Sections 5 and 6). Recommended management strategies involve using a combination of **structural and non-structural Best Management Practices** (BMPs), 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 developed in collaboration with the Steering Committee (Section 1.4). This plan meets the nine elements required by the United States EnvironmentalProtection Agency(EPA)sothat communities becomeeligible forfederal watershedassistance grants (Section 1.5).

1.4 COMMUNITY INVOLVEMENTAND PLANNING

The plan was developed through the collaborative efforts of numerous meetings, public presentations, and conference calls between FB Environmental Associates (FBE), KLA, YMCA Camp Lincoln, NHDES, representatives from the towns of Kingston and Danville, and private landowners (see Acknowledgments).

1.4.1 Plan Development Meetings

Several meetings were held over the duration of the plan development. The following list does not include routine annual meetings conducted separately by stakeholders, except as they relate tothe watershedplan development.

- **April 20, 2023:** Initial meeting with KLA, FBE, and YMCA Camp Lincoln to review the scope of work and brainstorm representativestoserveontheSteeringCommittee.Discussedprojectroles,communications,andtimelinefortasksand deliverables.
- **September 26,2023:**Kickoff meetingwiththeNHDESWatershedGrant Coordinatorto reviewthetimelinefortasksand deliverables and grant administrative duties.
- **October12,2023:**KickoffmeetingwiththeSteeringCommitteetoexplainthewatershedmanagementplanningprocess and review the sites identified in the watershedsurvey.
- **February15,2024:**FBEmetwithKLA,YMCACampLincoln,andNHDEStoreviewproject progress aspartoftherequired mid-project meeting for thegrant.
- **May 1, 2024:** FBE met with the Steering Committee to review the water quality analysis, model, and build-out analysis and set the water qualitygoals for Kingston Lake and LongPond.
- **May 13, 2024:** FBE met with the Steering Committee to discuss the action plan recommendations.
- **September 19, 2024:** FBE met with KLA, YMCA Camp Lincoln, and NHDES to close out the project as required by the grant.

1.4.2 Final Public Presentation

A final public presentation was held on June 26, 2024 at the Kingston Community Library to summarize the analyses and recommendationsdetailedintheplan. Thepresentationwasattendedbyover20people.Anopportunityforpublicfeedback on the plan was offered.

1.5 INCORPORATING EPA'SNINEELEMENTS

EPA guidance lists nine components that are required within a WBMP to restore waters impaired or likely to be impaired by **nonpoint source (NPS) pollution**. These guidelines highlight important steps in restoring and protecting water quality for any waterbody affected by human activities.The nine required elements found within this plan areas follows:

A. **IDENTIFY CAUSES AND SOURCES: Section 3** highlights known sources of NPS pollution to Kingston Lake and describes the results of the watershed survey and other assessments conducted in thewatershed. These sources of pollutants must becontrolled to achieveload reductionsestimatedin this plan, as discussed in item (B)below.

B. **ESTIMATE PHOSPHORUS LOAD REDUCTIONS EXPECTED FROM MANAGEMENT MEASURES: Sections 2, 3, and 5** quantify the sources of phosphorus load to Kingston Lake, calculate the pollutant load reductions that could be achieved by identified management measures, and determine the amount of reduction needed to meet the water quality goal,respectively.

C. **DESCRIPTION OF MANAGEMENT MEASURES: Sections 4 and 5** identify waystoachieve theestimatedphosphorus load reduction and reach water quality targets. The Action Plan focuses on several major topic areas that address NPSpollution.Managementoptions intheActionPlanfocus onnon-structuralBMPsintegral totheimplementation of structural BMPs.

D. **ESTIMATE OF TECHNICAL AND FINANCIAL ASSISTANCE: Sections 5 and 6** include descriptions of the associated costs, sources of funding, and primary authorities responsible for implementation. Sources of funding need to be diverse and should include local, state, and federal granting agencies, local groups, private donations, and landowner contributions for implementation of theActionPlan.

E. **EDUCATION & OUTREACH: Sections 4 and 5** describe how the educational component of the plan is already being or will be implementedto enhance public understanding of the project.

F. **SCHEDULE FOR ADDRESSING PHOSPHORUS REDUCTIONS: Section 5** provides a list of action items and recommendations to reducethe phosphorus loadto Kingston Lake. Eachitem has a set schedulethat defines when the action should begin and/or end or run through (if an ongoing activity). The schedule should be adjusted by the committee on an annualbasis (seeSection 4 on AdaptiveManagement).

G. **DESCRIPTION OF INTERIM MEASURABLE MILESTONES: Section 6** outlines indicators along with milestones of implementationsuccess that should betracked annually.

H. **SET OF CRITERIA: Sections 2 and 6** can be used to determine whether loading reductions are being achieved over time, substantial progress is being made towards water quality objectives, and if not, criteria for determining whether this plan needs toberevised.

I. **MONITORINGCOMPONENT:Section6**describesthelong-termwaterqualitymonitoringstrategyforKingstonLake, the results of which can be used to evaluate the effectiveness of implementation efforts over time as measured against the criteria in (H) above. The success of this plan cannot be evaluated without ongoing monitoring and assessment and careful tracking of loadreductions following successful BMP implementation projects.

2 ASSESSMENT OFWATER QUALITY

Thissectionprovidesanoverviewofthepast,current,andfuturestateofwaterqualitybasedonthewaterqualityassessment and watershed modeling, which identified pollutants of concern and informed the established water quality goal and objectives for Kingston Lake.

2.1 WATERQUALITY SUMMARY

2.1.1 Water Quality Standards & Impairment Status

2.1.1.1 Designated Uses & Water Quality Criteria

The **CleanWaterAct**(CWA) requires states todeterminedesignateduses forallsurfacewaters withinthestate's jurisdiction. Designated uses are the desirable activities and services that surface waters should be able to support and include uses for ALI, fish consumption, shellfish consumption, drinking water supply, primary contact recreation (swimming), secondary contact recreation (boating and fishing), and wildlife. Surface waters can have multiple designated uses. **Primary Contact Recreation(PCR)andALIarethetwomajorusesforlakes–ALIbeingthefocusofthisplan.**InNewHampshire,allsurface waters are also legislatively classified as Class A or Class B, most of which are Class B (Env-Wq 1700). **Kingston Lake is classified as Class B in the State of New Hampshire**. Additionally, from 1976 to 2009, NHDES conducted surveys of lakes to determine**trophicstate**(**oligotrophic**,**mesotrophic**,or**eutrophic**).Thetrophicsurveysevaluatedphysicallakefeatures,as wellaschemicalandbiologicalindicators.ForKingstonLake,theNHDESLakeTrophicSurveyReports(1976,1985,2004,2009) classify the lake as mesotrophic or eutrophic with an abundance of rooted plants across all surveys. **The most recent assessmentin2009classifiesthelakeaseutrophic** anddescribesitasa"borderlinemeso-eutrophicpond"(NHDES,2009). This means that in-lake waterquality did not attain standards for oligotrophic or mesotrophic lakes in 2009.

Water quality criteria are then developed to protect designated uses, serving as a "yardstick" for identifying water quality exceedancesandfordeterminingtheeffectivenessofstateregulatorypollutioncontroland preventionprograms.Depending on the designated use and type of waterbody, water quality criteria can become more or less strict if the waterbody is classified as either Class A or B or as oligotrophic, mesotrophic, or eutrophic. To determine if a waterbody is meeting its designateduses,waterqualitycriteriaforvariousparameters(e.g.,**chlorophyll-a**,**totalphosphorus**,**dissolvedoxygen**,**pH**, and toxics) are applied to the water quality data. If a waterbody meets or is better than the water quality criteria, the designated use is supported. The waterbody is considered impaired for the designated use if it does not meet water quality criteria. Water quality criteria for each classification and designated use in New Hampshire can be found in RSA 485 A:8, IV and in the state's surface water quality regulations.

2.1.1.2 Antidegradation Provisions

The Antidegradation Provision (Env-Wq 1708) in New Hampshire's water quality regulations serves to protect or improve the quality of the state's waters. The provision outlines limitations or reductions for future pollutant loading. Certain development projects (e.g., projects that require Alteration of Terrain Permit or 401 Water Quality Certification) may be subject to an Antidegradation Review to ensure compliance with the state's water quality regulations. The Antidegradation Provisionisofteninvokedduringthepermitreviewprocessforprojectsadjacenttowatersthataredesignatedimpaired,high quality, or outstanding resource waters. While NHDES has not formally designated high-quality waters, unimpaired waters are treated as high quality with respect to issuance of water quality certificates. Antidegradation requires that a permitted activity cannot use more than 20% of the remaining assimilative capacity of a high-quality water. This is on a parameter-by-parameter basis. For impaired waters, antidegradation requires that permitted activities discharge no additional loading of the impaired parameter.

2.1.1.3 Waterbody Impairment Status

The Kingston Lake watershed contains four lake/pond assessment units: Kingston Lake, Greenwood Pond, Halfmoon Pond, and Long Pond (Table 1). The four assessment units are formally listed as impaired for either ALI or PCR on the 303(d) New Hampshire List of Impaired Waters for the 2020/2022 cycle(NHDES, 2022a). Additionally, the NH Statewide Mercury Advisory to limit consumption of fish applies to all assessment units (NHDES, 2021). Despite not being listed as impaired for PCR due to the presence of cyanobacteria hepatotoxic microcystins, cyanobacteria blooms have recently emerged as a serious concern for the Kingston Lake, as described in Section 2.1.6 on cyanobacteria.

Table 1. NHDES assessment units covering lakes/ponds within the Kingston Lake watershed and their associated water quality rating as reported onthe NHDES 2020/2022 303(d) list.

Assessment Unit Name	AUID	Impaired Designated Use	Parameter
GREAT POND	NHLAK700061403-06-01	ALI	Dissolved oxygen saturation, pH*
GREAT POND - KINGSTON STATE PARK BEACH	NHLAK700061403-06-02	PCR	E. coli
GREAT POND - CAMP LINCOLN BEACH	NHLAK700061403-06-04	PCR	E. coli
GREAT POND- GREAT POND PARK ASSOCIATION BEACH	NHLAK700061403-06-05	PCR	E. coli
GREENWOOD POND	NHLAK700061403-07	PCR	Cyanobacteria hepatotoxic microcystins*
HALFMOON POND	NHLAK700061403-08	ALI and PCR	Chlorophyll-a, Cyanobacteria hepatotoxic microcystins

*Great Pond potentially not supporting for turbidity and nonnative fish, shellfish, or zooplankton. Greenwood Pond potentially not supporting for chlorophyll-a,dissolvedoxygensaturation,dissolvedoxygen,andtotal phosphorus. Long Pondpotentially notsupporting fordissolvedoxygensaturation, total phosphorus,andpH.

2.1.2 Water Quality Data Collection

New Hampshire VLAP has been monitoring Kingston Lake every year since 1991, with monitoring of the north deep spot beginning in 1995 (NHDES, 1999). VLAP has produced31 lake reports through 2022.

Water quality data were obtained for this plan from the NHDES Environmental Monitoring Database (EMD). Thirty-nine (39) waterqualitystationswereidentifiedinthewatershed.Adescriptiveoverviewofavailablewaterqualitydatainthewatershed is as follows (ordered from upstream to downstream) fora subset of sites shown in Figure 3 and Table 2:

- **GREKIND (Greenwood Pond Deep Spot):** variable depth grab or composite samples (from the epilimnion or hypolimnion) were collected from 2017-2020 for numerous parameters but largely for temperature, dissolved oxygen, total phosphorus, chlorophyll-a, Secchi disk transparency, specific conductance, pH, color, turbidity, and alkalinity.
- **LONDVLI/LONDVLPI/LONDVLO(PowwowRiverandPineStInletstoLongPond,LongPondoutlet):**surfacegrab samples were collected 1-2 times yearly from 2016-2022 for total phosphorus, chloride, specific conductivity, and turbidity.
- **LONDVLD(LongPondDeepSpot):**epilimniongrabsamplesorcompositesampleswerecollectedoccasionallyfrom 1982-1996andconsistentlyfrom 2016-2022fornumerousparametersbutlargelyfortemperature, dissolvedoxygen, totalphosphorus, chlorophyll-a, Secchi disktransparency, specific conductance, pH, color, turbidity, and alkalinity.
- **GRTKINB/GRTKINK/GRTKINT (Ball Rd, Kelley Brook, and Thayer Road inlets to Kingston Lake):** surface grab samples were collected 1-5 times yearly (typically 3 times yearly) from 1991-2022 for total phosphorus, chloride, specific conductivity, andturbidity.
- **GRTKINND/GRTKINSD (Kingston Lake North and South deep spots):** variable depth grab or composite samples (from the epilimnion, metalimnion, and/or hypolimnion) were collected from 1995-2022 for numerous parameters but largely for temperature, dissolved oxygen, total phosphorus, chlorophyll-a, Secchi disk transparency, specific conductance, pH, color,turbidity, and alkalinity.

Two lake sites (GRTKINND and GRTKINSD) and three stream sites (GRTKINB, GRTKINK, and GRTKINT) are the most recently active sites with the most consistent dataset in the watershed. These sites were historically monitored comprehensively by VLAP volunteers typically three times per year between June-August beginning in 1991. Volunteers began consistently monitoring Long Pond and its streams beginning in 2016.

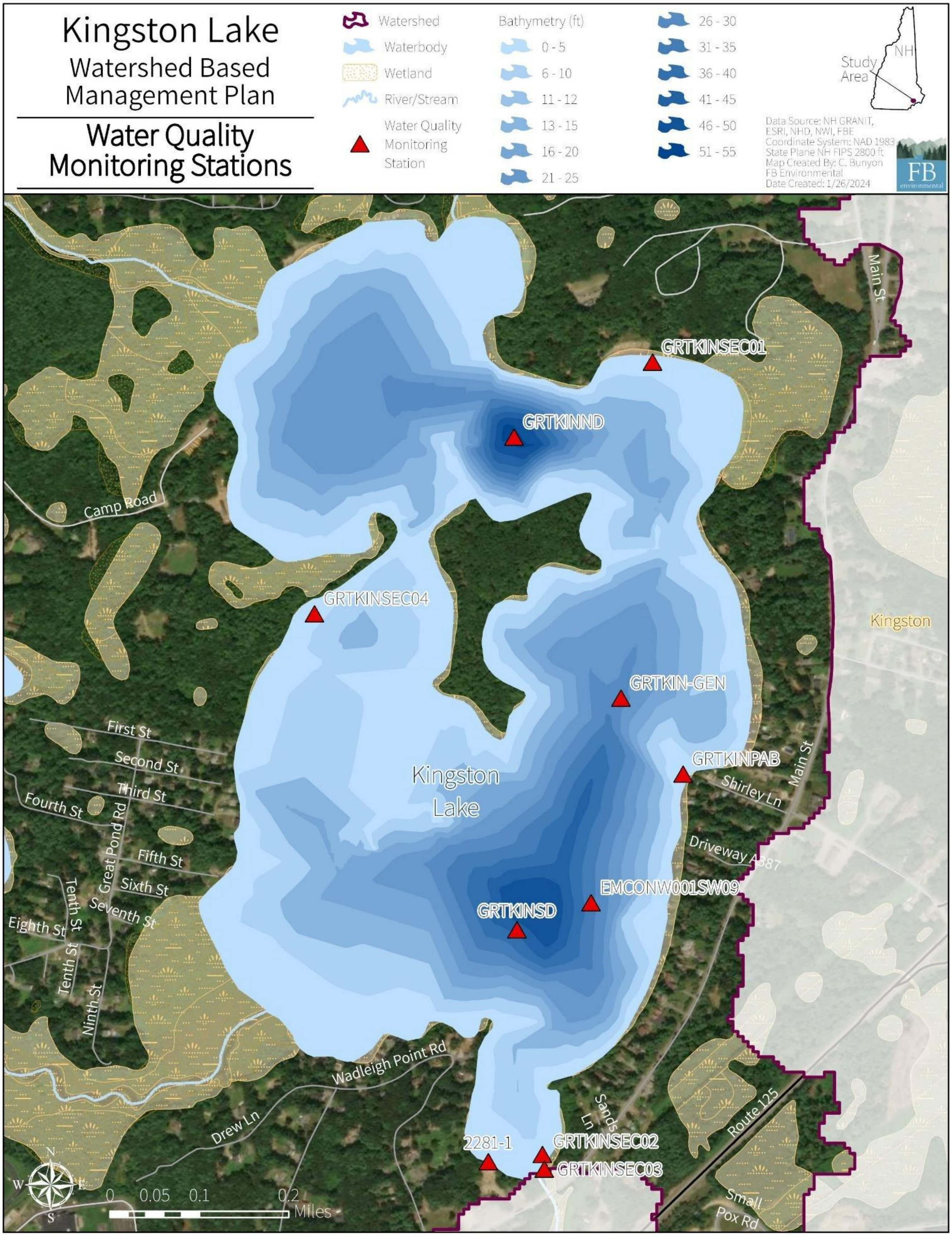


Figure 3. Water quality monitoring sites in Kingston Lake.Not all sites included in the watershed areshown on this map. Refer to Table 2 forsite descriptions.

Table 2. Matching site IDand site names by waterbody and sitetype. Refer toFigure 3for location of KingstonLake sites.

Waterbody Name	Site ID	Site Name	Site Type
Kingston Lake (Great Pond)	GRTKINSD	Great Pond-South DeepSpot	Lake/Pond
	GRTKIN-GEN	Great Pond-Generic	
	GRTKINND	Great Pond-North Deep Spot	
	GRTKINSEC01	Great Pond-Bacteria Sample#01	
	GRTKINSEC02	Great Pond-Bacteria Sample#02	
	GRTKINPAB	Great Pond-Pine Acres Beach	
	GRTKINSEC03	Great Pond-Bacteria Sample#03	
	GRTKINSEC04	Great Pond-Bacteria Sample#04	
	2281-1	Dock At 1 Sixth St Kingston Nh	
	EMCONW001SW09	Great Pond	
Great Pond-Thayer Rd Inlet	GRTKINT	Great Pond-Thayer Rd Inlet	River/Stream
Greenwood Pond	GREKIND	Greenwood Pond-Deep Spot	Lake/Pond
	GREKIN-GEN	Greenwood Pond-Generic	
	GREKIN-A	Greenwood Pond - Habitat Station A	
	GREKIN-B	Greenwood Pond - Habitat Station B	
	GREKIN-C	Greenwood Pond - Habitat Station C	
	GREKIN-D	Greenwood Pond - Habitat Station D	
	GREKIN-E	Greenwood Pond - Habitat Station E	
	GREKIN-F	Greenwood Pond - Habitat Station F	
	GREKIN-G	Greenwood Pond - Habitat Station G	
	GREKIN-H	Greenwood Pond - Habitat Station H	
	GREKIN-I	Greenwood Pond - Habitat Station I	
	GREKIN-J	Greenwood Pond - Habitat Station J	
Halfmoon Pond	HALKIND	Halfmoon Pond-DeepSpot	Lake/Pond
	HALKIN-GEN	Halfmoon Pond-Generic	
	LONDVLD	Long Pond-Deep Spot	

2.1.3 Trophic State Indicator Parameters

Total phosphorus, chlorophyll-a, and Secchi disk transparency are trophic state indicators, or indicators of biological productivity in lake ecosystems. The combination of these parameters helps determine the extent and effect of **eutrophication** in lakes and helps signal changes in lake water quality over time. For example, changes in Secchi disk transparency may be due to a change in the amount and composition of algae communities (typically because of greater totalphosphorus availability)or theamount of dissolved or particulatematerials ina lake. Such changes are likely the result of human disturbance or other impacts tothe lake's watershed.

For the north and south deep spots of Kingston Lake, no statistically significant trends were found for epilimnetic total phosphorus or Secchi disk transparency over the time period of 1995-2022 (Figure 4). Statistically significant decreasing (improving) trends were found forchlorophyll-a at boththe northand southdeepspotsof Kingston Lake. The 2021 and 2022 Data Summary of the NH VLAP Individual Lake Reports for the north and south deep spots on Kingston Lake also indicate similar trends fortheseparameters.

ForthedeepspotsofKingstonLakeandGreenwoodPond,generallyhighertotalphosphorusconcentrationsweremeasured inthehypolimnioncomparedtotheepilimnionandmetalimnion,indicatingsomeamount of internalphosphorusloading is occurring in these waterbodies (Figure 5). Long Pond is shallow (~3 m deep) and does not stratify, so no true discrete depth total phosphorus data exist and the limited data show no significant difference among the depth zones. Winter samples collectedinLongPondshowtotalphosphorus concentrations lowerthansummersamples,which suggestssomeamount of internal phosphorus loading is occurring during the summer months. Halfmoon Pond was not included due to limited data. Both deepspots of KingstonLake show similar mediantotal phosphorus concentrations for respective depth zones.

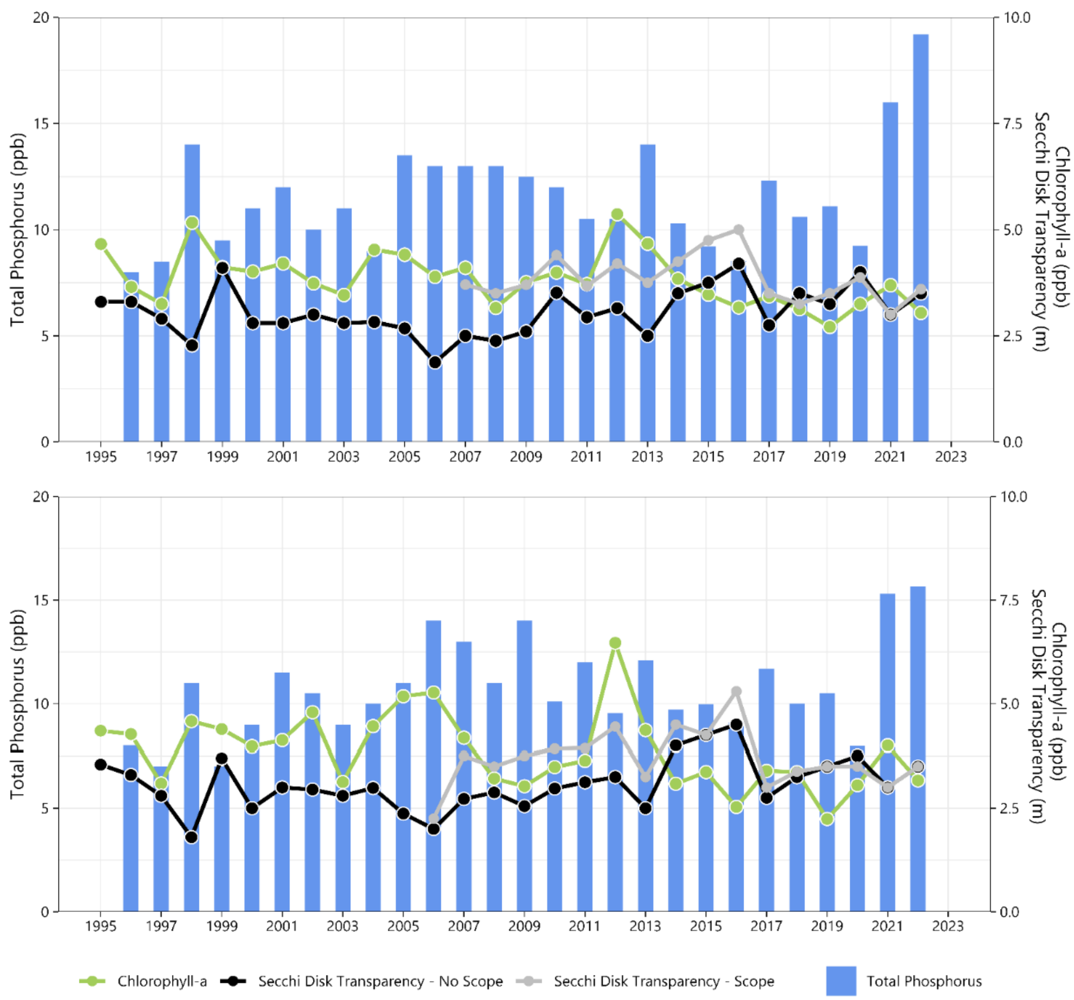


Figure 4. Median epilimnion total phosphorus,epilimnion chlorophyll-a, and water clarity (Secchi disk depthfor scope and no scope methods)measured at the north deepspot of Kingston Lake [GRTKINND] (top) and thesouthdeep spot of Kingston Lake [GRTKINSD] (bottom)largely in June-September from 1995-2022. Statistically significant decreasingtrends in chlorophyll-a for both stations were detectedby theMann-Kendall nonparametrictrend test using rkt packagein R Studio.

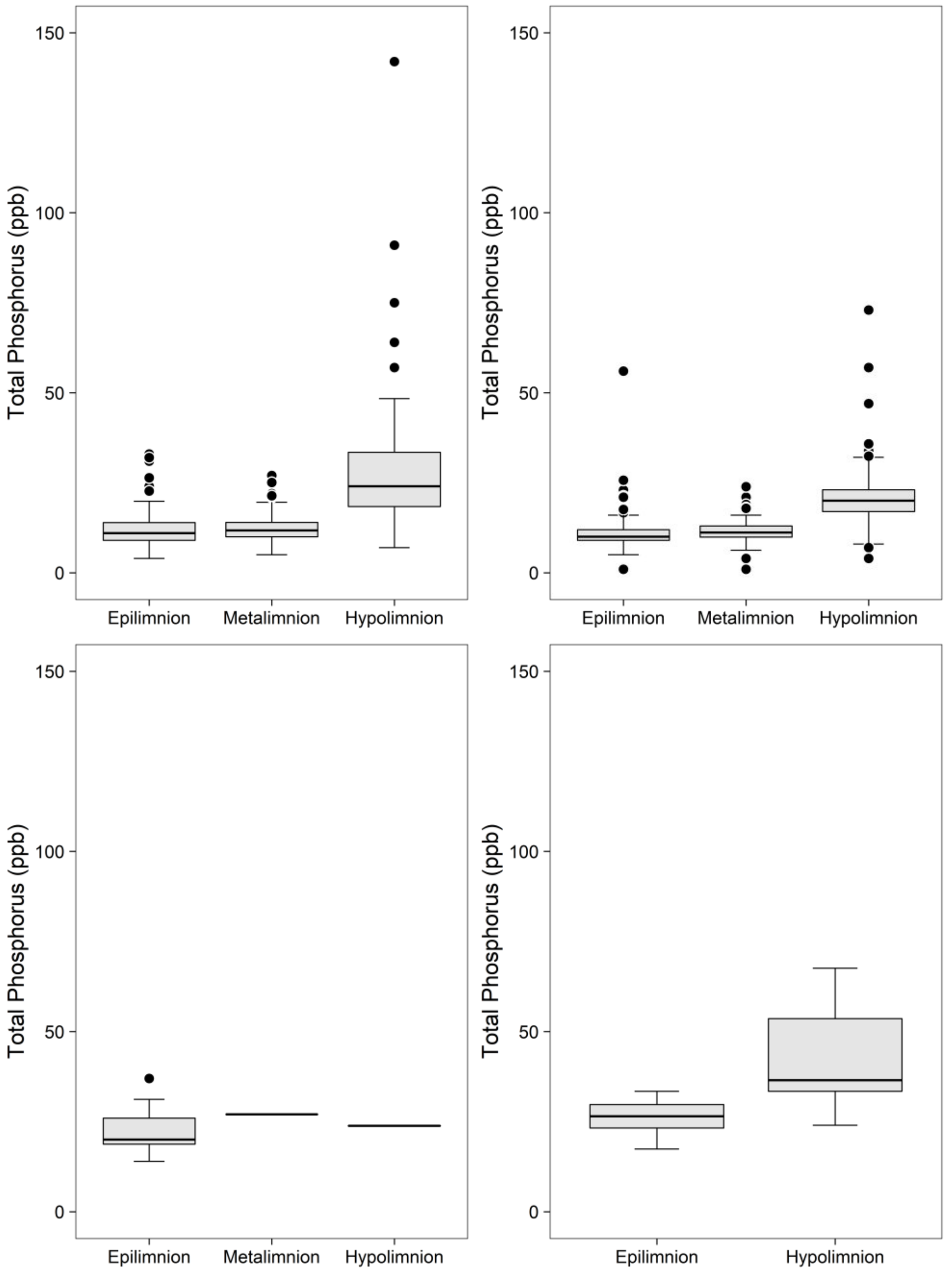


Figure 5. Boxplots showing median total phosphorus concentration in the epilimnion,metalimnion, and hypolimnion of the north deepspot of Kingston Lake [GRTKINND] (top left), the south deepspot of Kingston Lake [GRTKINSD] (top right), the deep spot of Long Pond[LONDVLD] (bottom left), andthe deep spot of Greenwood Pond [GREKIND] (bottom right). Long Pond has limited data for metalimnetic(n=1) and hypolimnetic (n=3)total phosphorus.

2.1.4 Dissolved Oxygen & Water Temperature

Acommonoccurrenceis thedepletionof dissolvedoxygeninthedeepestpartoflakes throughout thesummermonths.This occurs when thermal stratification prevents warmer (less dense), oxygenated surface waters from mixing with cooler (denser), oxygen-depletedbottom waters in thelake. Chemical andbiologicalprocesses occurring in bottom watersdeplete the available oxygen throughout the summer, and because these waters are colder and denser, the oxygen cannot be replenished through mixing with surface waters. Dissolved oxygen levels below 5 ppm (and water temperature above 24 °C) can stress and reduce habitat for coldwater fish and other sensitive aquatic organisms. In addition, **anoxia** (low dissolved oxygen) at lake bottom can result in the release of sediment-bound phosphorus (otherwise known as **internal phosphorus loading**),which canbecome a readilyavailablenutrient sourceforalgaeandcyanobacteria.Whilethermalstratificationand depletion of oxygen in bottom waters is a natural phenomenon in **dimictic** lakes such as Kingston Lake, it is important to track these parameters to make sure the extent and duration of low oxygen does not change drastically because of human disturbance in the watershedresulting in excess phosphorus loading.

Figure 6 shows temperature and dissolved oxygen profiles averaged across sampling dates (1991-2021) during **thermal stratification**largelyinsummer(betweenspringandfall**turnover**)forthenorthandsouthdeepspotsofKingstonLake.The changeintemperature,seenmost dramaticallybetween4and7m,indicates thermalstratificationinthewatercolumn.The average dissolved oxygen of <2 ppm at 10-14 m depth indicates the possibility of internal loading under anoxic conditions. Historicrecordingoftemperatureanddissolvedoxygenprofilesincludesonlyonewatercolumnprofilepersamplingseason. While these data are useful in tracking major trends over time, monitoring consisting of several profiles per samplingseason canprovidebetterinsighttoseasonalchangesinthelake. The1999NHDESGreatPondDiagnostic/FeasibilityStudydescribes the seasonal variations of anoxia in the two deep spots (NHDES, 1999). At the north deep spot of Kingston Lake [GRTKINND], the bottom three meters canbecome anoxic in early June.By lateAugust,the extent of anoxia can extend from 6m depth to thebottomofthelake.AtthesouthdeepspotofKingstonLake[GRTKINSD],anoxiainthebottomthreemetersoccursinlate July, later than at the north deep spot. The extent of anoxia extends from 5 m depth to the bottom by late August. The Diagnostic/Feasibility Study attributes the differences between the twostations todifferences in lake morphometry.

Figure 7 shows temperature and dissolved oxygen profiles averaged across sampling dates largely in the summer between spring and fall turnover in Long Pond and Greenwood Pond. Despite the shallow maximum depths of these ponds, there is evidenceofweakthermalstratificationinthewatercolumn,thoughthereisnodefinedmetalimnionorhypolimnionineither waterbody. There is an observed decline in dissolved oxygen with depth, but the average dissolved oxygen does not decline below2ppmineitherlakeexceptat3.5mdepthinGreenwoodPondandoccasionallyat2-3mdepthinLongPond.Dissolved oxygen of <2 ppm indicates the possibility of internal loading under anoxic conditions. Data on these two lakes are limited, withconsistentcollectionofoneprofileperseasonstartingaround2016,soexpandingmonitoringtoincludemultipleprofiles each year could provide better insight toseasonal variations in temperatureand dissolved oxygen.

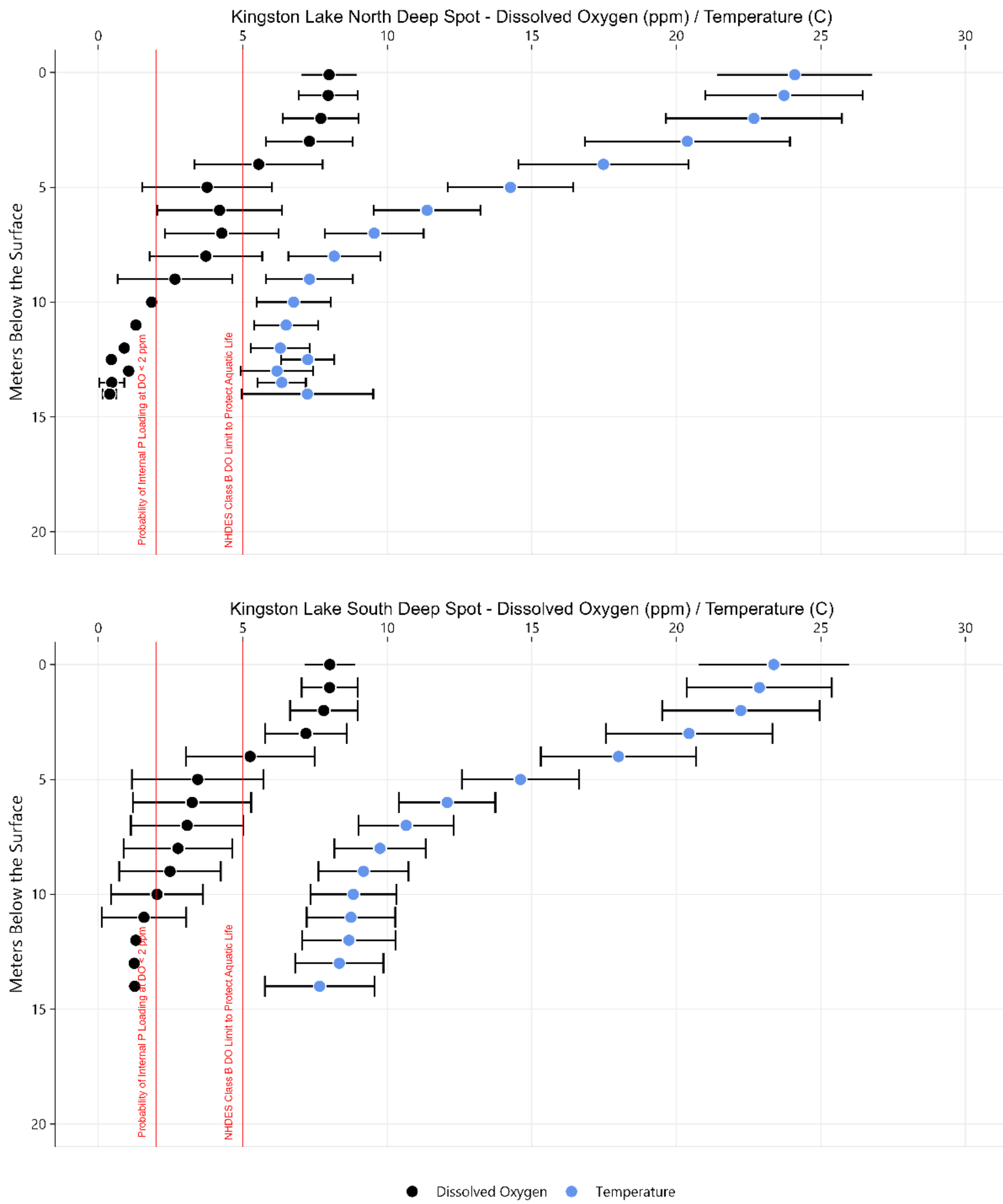


Figure 6. Dissolved oxygen (black) and watertemperature(blue) depthprofiles for thenorth deep spot [GRTKINND] (top) and south deepspot [GRTKINSD] of Kingston Lake. Dots represent average values across sampling dates for each respective depth. Error bars represent one standard deviation. Profiles were collected in 1995-2021 with a fewadditional observations from 1976 and 1995 for the north deep spot (n=27). Forthesouth deepspot, profiles were collectedfrom 1991-2021 (n=31). Maximum depthfor KingstonLake is 16 m.

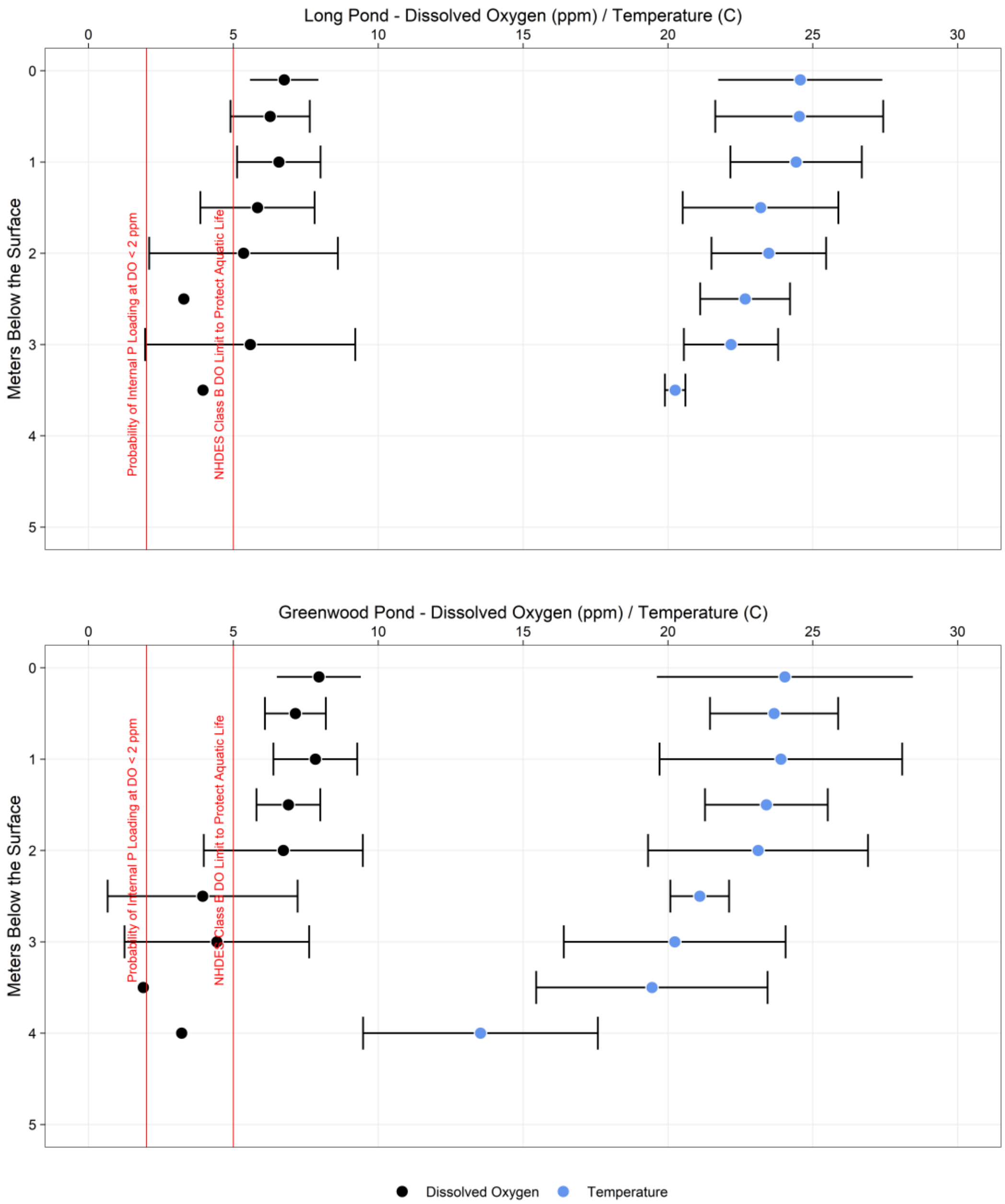


Figure 7. Dissolved oxygen (black) and watertemperature(blue) depthprofiles for thedeep spots of Long Pond [LONDVLD] (top) andGreenwood Pond [GREKIND] (bottom). Dots represent average values across sampling dates for each respective depth. Error bars represent one standard deviation. Profiles were collected in 1995 and 2016-2021 for Long Pond (n=6). For Greenwood Pond, profiles were collected in 1995 and 2017-2020, with one additional observation in 1982 (n=5). One winter observation was removed from eachstation.

2.1.5 Chloride & Specific Conductivity

Chloridepollutioncancauseharmtoaquaticorganismsanddisrupt internalmixingprocesseswhenchlorideconcentrations reach toxic levels. The State of New Hampshire sets a chronic threshold of 230 ppm for chloride (which roughly equates to 835 µS/cm forspecificconductivity). Chloride concentrations at bothdeepspots of KingstonLake arewellbelowthechronic threshold,thoughthe2022DataSummaryoftheNHVLAPIndividualLakeReportsforbothstationsonKingstonLakeindicate that chloride and specific conductivity are higher than state medians. Both parameters show statistically significant increasing trends over time for each respective station (1977/1995-2022) (Figure 8). The increasing trends indicate that chloride from winter salting practices for deicing roads and other surfaces in the watershed may be contaminating the lake. While not an immediate concern for the health of the lake, chronic chloride toxicity will likely become an issue in the future without a proactive reductionin salt use inthe watershed.

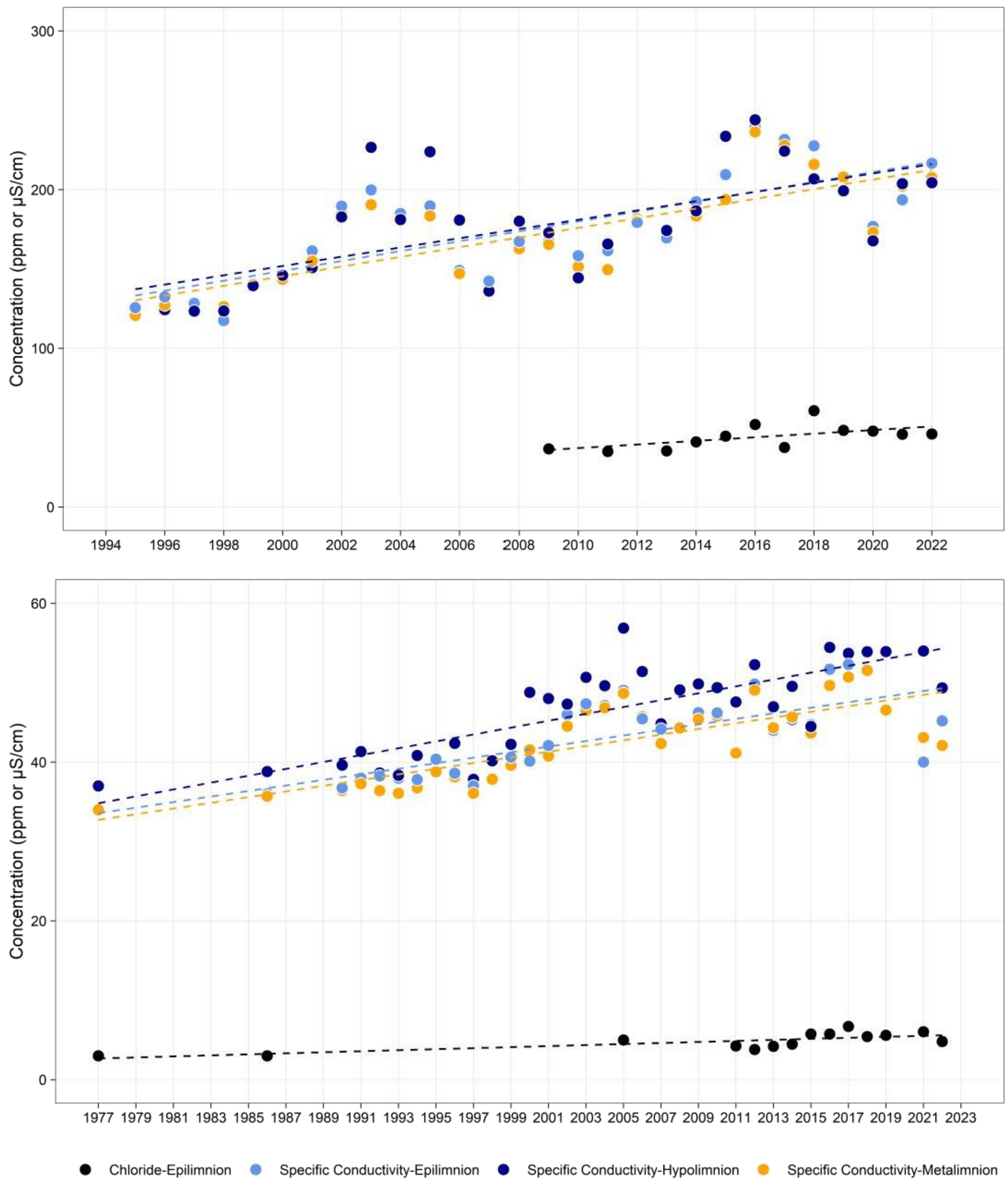


Figure 8. Yearly median of monthly medians forchloride and specific conductivity in the north deep spot [GRTKINND] (top) and south deepspot [GRTKINSD] (bottom) of Kingston Lake. Dashed lines indicate a statisticallysignificant increasing (degrading) trend.

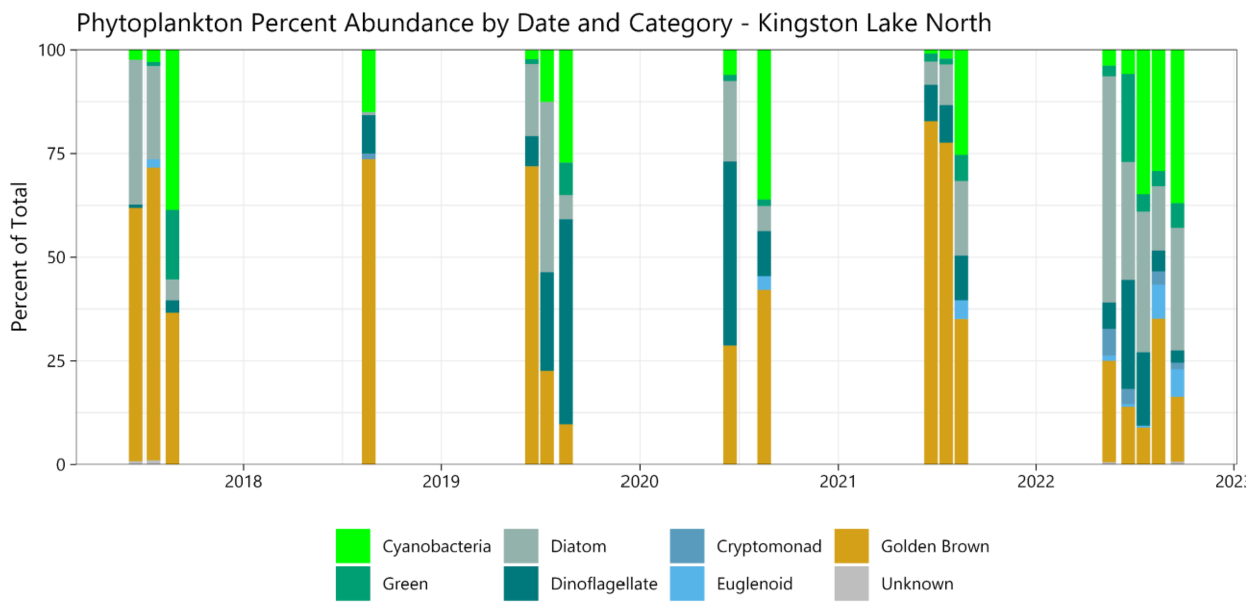
2.1.6 Phytoplankton (Cyanobacteria) and Zooplankton

2.1.6.1 Phytoplankton/Zooplankton Surveys

Phytoplankton and zooplankton samples were collectedand analyzed during the1976,1985, 2004, and 2009NHDESTrophic Surveys of Kingston Lake, as well as during the 1999 Great Pond Diagnostic/Feasibility Study. The dominant phytoplankton species were Asterionella (diatom), Chrysosphaerella (golden-brown), Tabellaria (diatom), Dinobyron (golden-brown), Ceratium (dinoflagellate), Anabaena/Dolichospermum (cyanobacteria), and Oscillatoria/Planktothrix (cyanobacteria). The dominant zooplankton species were Nauplius larvae (copepod), Keratella (rotifer), Calanoid (copepod), and Vorticella (rotifer). The Great Pond Diagnostic/Feasibility Study found that Daphnia and Bosmina are also common crustaceans. Bosminaaresmallandinefficientgrazers.Copepodsaresmallcrustaceansthateatphytoplanktonandprovideanimportant food source to fish. Daphnia are among the most efficient grazers of phytoplankton. The relative abundance of each type of phytoplankton changes seasonally, with diatoms dominating in the springand fall andcyanobacteria most abundant in late summer.

Additional phytoplankton samples were collected through VLAP at both the north and south deep spots of Kingston Lake. Between 2017-2022, the most abundant type of phytoplankton were diatoms, followed by cyanobacteria and golden-brown algae. Specifically, the most dominant phytoplankton species were Dinobyron (golden-brown), Ceratium (dinoflagellate), Fragilaria (diatom), Synura (golden-brown), and Stephanodiscus (diatom). Of the diatoms, the most abundant species were Fragilaria, Stephanodiscus, and Asterionella. The most common dinoflagellate was Ceratium. Abundances of the different phytoplanktontaxadifferduringseasonsandacrossyears.In2017,diatomsandgolden-brownalgaedominatedinthespring and the cyanobacteria population grew larger in the summer, whereas in 2022 there were more cyanobacteria throughout the whole season with a lower abundance of golden-brown algae (Figure 9). Diatom abundances tend to wane throughout theseasonastheyareimmobileandcansinkintothehypolimnionwheretheyareunabletoaccesslightandcannotbemixed upwardinthewatercolumn.Cyanobacteriacanbecomemoreabundantlaterinthesummerbecausetheycanregulatetheir buoyancy in the water column to avoid harsh sunlight and access phosphorus deep in the water column released from the sediment.

In 2022, there were more cyanobacteria reported at the southern site than at the northern, particularly in the earlier months (Figure 9). For both sites, the dominant cyanobacteria species in 2022 was Dolichospermum, followed closely by Woronichiniaand Chroococcus.Inpreviousyears,thedominantcyanobacteriaspecieshasbeen Anabaena/Dolichospermum (2017, 2018, 2019, 2020, 2021), followed by Merismopedia (2017), Microcystis (2020), and Woronichinia (2020). Over all years, the dominant species of cyanobacteria were and Microcystis. are nitrogenfixers that areknowntoform nuisancebloomsinNewHampshire. Microcystis and Woronichinia cannot fix nitrogen but can still outcompete other phytoplankton by regulating their buoyancy in the water column. At both sites in 2017 and 2021,golden-brownalgaecomprisedthelargest percentageof phytoplanktonandwasdominatedby Dinobryon and Synura (themostcommongolden-brownalgaeacrossallyears)(Figure9).In2022,particularlyatthenorthernsite,therewasalarger populationof Mallomonas(golden-brownflagellate)whichwasnotseeninpreviousyears.Golden-brownalgaetendtothrive in low-nutrient lakes.



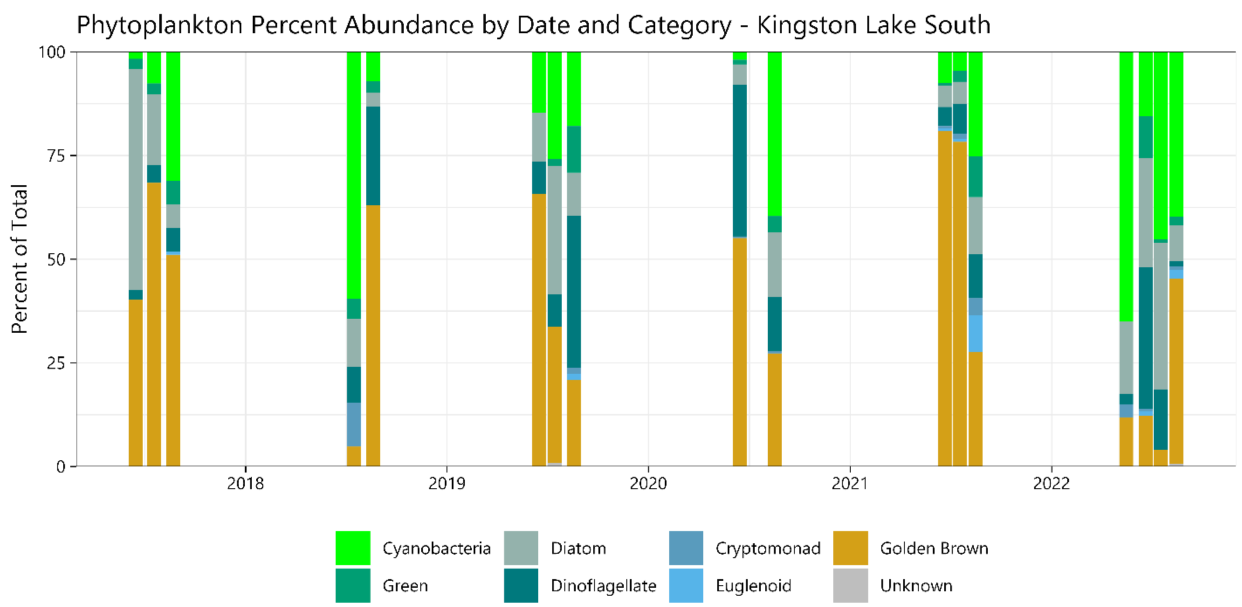


Figure 9. (Top) The percent abundance of different phytoplankton taxa in thenorth deep spot of Kingston Lake from2017-2022 (n=17). (Bottom) The percent abundance of different phytoplankton taxa in thesouth deep spot of Kingston Lake from 2017-2022 (n=17).

2.1.6.2 Cyanobacteria Bloom History

Nutrientssuchasphosphorusandnitrogen,aswellasalgaeandcyanobacteria,naturallyoccurintheenvironment,including lakes andtributariesandtheircontributingwatersheds,andareessentialtolakehealth.Undernaturalconditions,algaeand cyanobacteria concentrations are regulated by limited nutrient inputs and lake mixing processes that keep them from growing too rapidly. However, human related disturbances, such as erosion, overapplied fertilizers, polluted stormwater runoff, excessive domesticated animal waste, and inadequately treated wastewater, can dramatically increase the amount of nutrients entering lakes and their tributaries. Excess nutrient loading to human-disturbed lake systems, in combination with a warming climate, has fueled the increasing prevalence of Harmful Algal Blooms (HABs) or the rapid growth of algae and cyanobacteria in lakes across the United States.

Cyanobacteria are small photosynthesizing, sometimes nitrogen-fixing, single-celled bacteria that can live in a variety of environments, including freshwater systems. Cyanobacteria blooms can (but not always) produce microcystins and other toxins that pose a serious health risk to humans, pets, livestock, and wildlife, such as neurological, liver, kidney, and reproductive organ damage, gastrointestinal pain or illness, vomiting, eye, ear, and skin irritation, mouth blistering, tumor growth, seizure, or death. Blooms can form dense mats orsurface scum that can occurwithin the water column or along the shoreline. Dried scum along the shoreline can harbor high concentrations of microcystins that can re-enter a waterbody months later. There are several different species of cyanobacteria, suchas:

- **Anabaena/Dolichospermum:** typically observed as filaments, associated with microcystins, anatoxins, saxitoxins, and cylindrospermopsin, documented in Kingston Lake in 2009 and 2021, and in Greenwood Pond in 2011.
- **Microcystis:** typically observed as variations of small-celled colonies, associated with microcystins and anatoxins, documented in Kingston Lake in 2017.
- **Aphanizomenon:** Typically forms rafts of filaments, associated with anatoxin-a, anatoxin-a (S), saxitoxins, and possibly microcystins.
- **Woronichinia:** Typically forms dense colonies,associatedwith microcystins, documented in Greenwood Pond in 2023.
- **Planktothrix/Oscillatoria:** typically observed as filaments, associated with microcystins and cylindrospermopsin, can maintain high growth rate at relatively low light intensities when it forms metalimnetic blooms (NHDES, 2020), documentedinGreenwoodPondin2004,2008,2016,2018,2019,2021,2022and2023,andinHalfmoonPondin2008and 2022.

Cyanobacteria are becomingmore prevalent in low-nutrient lake systems likely due to climate change warming effects (e.g., warmer water temperatures, prolonged thermal stratification, increased stability, reduced mixing, and lower flushing rates at critical low-flow periods that allow for longer residence times) 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 travel vertically in the water column to maximize their capture of both sunlight and sediment phosphorus (evenduring stratificationand/orunderanoxicconditions)forgrowth.Inaddition,somecyanobacteriacanalso fix atmospheric nitrogen, if enough light, phosphorus, iron, and molybdenum are available for the energy-taxing process. Some taxa are also able to store excess nitrogen and phosphorus intra-cellularly for later use under more favorable conditions. Because of these traits and as climate warming increases the prevalence and dominance of cyanobacteria, cyanobacteria are one of the major factors driving positive feedbacks with lake eutrophication. Cyanobacteria may be both accelerating eutrophication in low-nutrient lakes and preventing complete recovery of lakes from eutrophic states (Dolman, et al., 2012; Cottingham, Ewing, Greer, Carey, & Weathers, 2015). A better understanding of cyanobacteria's role in nutrient feedbacks will beneeded forbetter and more effective lake restoration strategies.

There have been four NHDES-issued cyanobacteria bloom warnings for Kingston Lake, the first of which lasted for two days in 2009 (Table 3). The bloom had a cell count of 144,000 cyanobacterial cells/mL and was primarily composed of Anabaena (now Dolichospermum). Another bloom in September 2017 that lasted eight days was composed of [illegible] and had a higher cell count of 1,300,000 cells/mL. The longest warning lasted for 34 days beginning in September 2021 following a high amount of rainfall that summer. The dominant types of cyanobacteria were Microcystis and Dolichospermum, which are potentially toxin-producing taxa, with a cell count of 7,500,000 cells/mL. The most recent cyanobacteria bloom warning (previously called advisory) was issuedon May 22, 2024 and was removed on May 24,2024.

The waterbodies upstream of Kingston Lake also have a history of cyanobacteria blooms. Greenwood Pond had 11 NHDES-issued bloom warnings, starting with its first warning in 2004. Warnings have lasted between one and 56 days, usually beginninginJuly.BloomsonGreenwoodPondhavebeentypicallydominatedby *Oscillatoria/Planktothrix*.GreenwoodPond hashadabloomwarningeveryyearsince2016.Awatersamplefromthe *Oscillatoria/ Planktothrix*bloomin2016wasanalyzed for microcystin, a hepatotoxin that cyanobacteria can produce. The sample had a microcystin concentration of 3.2 µg/L, which falls under recreationalguidelines but exceeds the drinking water standard recommended by EPA.

Halfmoon Pond has had two recorded NHDES-issued bloom warnings. The first occurred in late July of 2008 and was dominated by *Oscillatoria/Planktothrix*. The most recent bloom warning was issued in August 2022, with *Oscillatoria/Planktothrix* as the most abundant taxon. Both blooms lasted about 30 days.

Table 3. Cyanobacteria warnings issuedby NHDES for Kingston Lake (NHDES, 2024).

Advisory Date	Duration (days)	Dominant Taxa	Total Cell Concentration (cells/mL)
August 18, 2009	2	Anabaena/Dolichospermum	144,000
September 19, 2017	8	Microcystis	1,300,000
September 10, 2021	34	Microcystis, Anabaena/ Dolichospermum	7,500,000
May 22, 2024	2	Dolichospermum, Microcystis	[illegible]

It is unlikely that cyanobacteria blooms will be fully eradicated in the Kingston Lake watershed; some species of cyanobacteria can become dormant in sediment and then can jump-start cell reproduction once conditions are favorable (warm water temperatures and plenty of sunlight and nutrients). Given the long-term trend of increasing hypolimnion total phosphorus concentration in the lake, the likelihood of blooms will continue and possibly accelerate, though year-to-year variabilityinweather maydeterminetheavailabilityof phosphorus and/orthepresenceof otheroxygencompoundssuchas nitrates and thus determine the timing, extent, and severity of blooms in any given year. Despite this, conditions favorable for blooms can be substantially minimized by reducing nutrient-rich runoff from the landscape during warm, sunny spells. Water level andflow also helps to either flushout bloomsor limit upstream nutrient sources tostymie growth.

2.1.7 Fish

Fishareanimportantnaturalresourceforsustainableecosystemfoodwebsandproviderecreationalopportunities.Kingston Lake supports populations of warmwater species including but not limited to largemouth bass, chain pickerel (Eastern), brown bullhead, black crappie, white and yellow perch, and pumpkinseed (commonsunfish).

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 animalcommunities, reduced property values, impaired fishing and degraded recreational experiences, and high removal costs. Once established invasive species are difficult and costlyto remove. Kingston Lake is part of the Lake Host Program, which provides courtesy boat inspections aimed at preventing the transport of invasive aquatic species into or out of the lake. This program is sponsored by KLA

Asian clams pulled out of Kingston Lake. Photo courtesy ofDonKretchmer,CLM.

NHDES indicates in its Lake Information Mapper that the Asian or basket clam (*Corbicula fluminea*) and Chinese mystery snail (*Cipangopaludina chinensis*)wererecordedinKingstonLakeattheMainStreetboatlaunch in 2017. There are currently no effective treatments for either species. The Chinese mystery snail can become a nuisance but are considered non-disruptive to aquatic habitats in New Hampshire to date. NH Lakes recommends that boaters on Kingston Lake are especially vigilant with cleaning, draining, and drying their boats to prevent the spread of these invasives to other waterbodies. Variable milfoil (*Myriophyllum heterophyllum*) and fanwort have been actively managed by herbicide treatments and suction harvesting in Long Pondsince their discovery in 2008 and 2020, respectively.

2.2 ASSIMILATIVECAPACITY

Theassimilativecapacityofawaterbodydescribestheamountofpollutantthatcanbeaddedtoawaterbodywithoutcausing a violation of the water quality criteria and is based on lake trophic designation. Kingston Lake is a borderline mesotrophic/eutrophic waterbody, though it is currently classified as eutrophic. For enhanced protection of water quality, both mesotrophic and eutrophic designations were used to run the assimilative capacity analysis for Kingston Lake. For mesotrophic waterbodies, the water quality criteria are set at 12 ppb for total phosphorus and 5.0 ppb for chlorophyll-a, above which the waterbody is considered impaired (28 ppb and 11 ppb, respectively, for eutrophic waterbodies; Table 4). NHDESrequires a portionofthedifferencebetweenthebest possiblewaterqualityandthewaterqualitystandardbekept in reserve as described in the 2020/2022 Section 305(b) and 303(d) Consolidated Assessment and Listing Methodology (CALM); therefore,accordingtoTable3-17oftheCALM,totalphosphorusandchlorophyll-amustbeatorbelow11.6ppband4.8ppb, respectively,toachieveTier2HighQualityWaterstatusunderamesotrophicdesignation.Under aeutrophicdesignation,the parameters must be at or below 26.4 ppb and 10.4 ppb, respectively, to achieve Tier 2 High Water Quality status. Support determinations are based on the nutrient stressor (phosphorus) and response indicator (chlorophyll-a), with chlorophyll-a dictatingthe assessment if both chlorophyll-a and totalphosphorus data are availableand the assessments differ (Table 5).

ResultsoftheassimilativecapacityanalysisshowthatKingstonLakeandLongPondmeetTier2(HighWaterQuality)forboth trophic class designations (Table 6).Greenwood Pond would beconsidered impaired based on totalphosphorus under both trophic class designations and chlorophyll-a under a mesotrophic designation.

Table 4. Aquatic life integrity(ALI) nutrient criteria ranges by trophic class in New Hampshire. TP = total phosphorus.Chl-a = chlorophyll-a, a surrogatemeasure for algae.

Trophic State	TP (ppb)	Chl-a (ppb)
Oligotrophic	< 8.0	< 3.3
Mesotrophic	> 8.0 - 12.0	> 3.3 - 5.0
Eutrophic	> 12.0 - 28.0	> 5.0 - 11.0

Table 5. Decision matrix for aquatic lifeintegrity (ALI)assessment in New Hampshire. TP= total phosphorus. Chl-a = chlorophyll-a, a surrogatemeasure for algae concentration.

Nutrient Assessments	TP Threshold Exceeded	TP Threshold NOT Exceeded	Insufficient Info for TP
Chl-a Threshold Exceeded	Impaired	Impaired	Impaired
Chl-a Threshold NOT Exceeded	Potential Non-support	Fully Supporting	Fully Supporting
Insufficient Info for Chl-a	Insufficient Info	Insufficient Info	Insufficient Info

Table 6. Assimilative capacity (AC) analysis results for Kingston Lake and other waterbodies within its watershed using mesotrophic and eutrophic thresholds. Chlorophyll-a dictates the assessment results.

Parameter	Mesotrophic AC Threshold (ppb)	Existing Median WQ (ppb)*	Remaining AC (ppb)	Results
KINGSTON LAKE – NORTH DEEP SPOT [GRTKINND]				
Total Phosphorus	11.6	11.1	0.5	Tier 2 (High
Chlorophyll-a	4.8	3.3	1.5	Water Quality)
KINGSTON LAKE– SOUTH DEEP SPOT [GRTKINSD]				
Total Phosphorus	11.6	10.5	1.1	Tier 2 (High
Chlorophyll-a	4.8	3.4	1.4	Water Quality)
LONG POND – DEEP SPOT [LONDVLD]				
Total Phosphorus	11.6	19.6	-8.8	Tier 2 (High
Chlorophyll-a	4.8	4.0	0.8	Water Quality)
GREENWOOD POND – DEEP SPOT [GREKIND]				

Parameter	Mesotrophic AC Threshold (ppb)	Existing Median WQ (ppb)*	Remaining AC (ppb)	Results
Chlorophyll-a	4.8	9.0	-4.2	
Parameter	**Eutrophic AC Threshold (ppb)**	**Existing Median WQ (ppb)***	**Remaining AC (ppb)**	**Results**
KINGSTON LAKE – NORTH DEEP SPOT [GRTKINND]				
Total Phosphorus	26.4	11.1	15.3	Tier 2 (High
Chlorophyll-a	10.4	3.3	7.1	Water Quality)
KINGSTON LAKE– SOUTH DEEP SPOT [GRTKINSD]				
Total Phosphorus	26.4	10.5	15.9	Tier 2 (High
Chlorophyll-a	10.4	3.4	7.0	Water Quality)
LONG POND – DEEP SPOT [LONDVLD]				
Total Phosphorus	26.4	19.6	6.8	Tier 2 (High
Chlorophyll-a	10.4	4.0	6.4	Water Quality)
GREENWOOD POND – DEEP SPOT [GREKIND]				

* Existing water quality data truncated to May 24-Sept 15 in the previous 10 years (2013-2022) 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 (LLRM)

Environmental modeling is the process of using mathematics to represent the natural world. Models are created to explain how a natural system works, to study cause and effect, or to make predictions under various scenarios. Environmental models range from very simple equations that can be solved with pen and paper, to highly complex computer software requiring teams of people to operate. Lake models, such as the Lake Loading Response Model (LLRM), 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. EPA guidelines for watershed plans require that pollutant loads to a waterbody be estimated.

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 data about watershed and sub-watershed boundaries, land cover, point sources (if applicable), septic systems, waterfowl, rainfall, volume and surface area, and internal phosphorus loading. These data are combined with coefficients, attenuation factors, and equations from scientific literature on lakes, rivers, and nutrient cycles to generate annual average predictions[2] 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 water quality goals, and guide watershed improvement projects. A complete detailing of the methodology employed for the Kingston Lake LLRM is provided in the Kingston Lake Lake Loading Response Model Report (FBE, 2024a).

2.3.1.1 Lake Morphology & 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 National Hydrography Dataset (NHD) shows the Kingston Lake surface area at 268 acres. Manual delineation of the Kingston Lake shoreline by FBE using recent aerial imagery suggests a slightly larger surface area of 276 acres (4.8 miles of shoreline) with a maximum depth of 50 ft (15.24 m) (Appendix A, Map A-1). The **areal water load** is 30.7 ft/yr (9.4 m/yr), and

[2] The model cannot simulate short-term weather or loading events.

the flushing rate is 2.5 times per year. The flushing rate of 2.5 means that the entire volume of Kingston Lake is replaced 2.5 times per year.

There are several dams in the watershed historically or currently controlling water flow. Active dams include the Great Pond Dam, Long Pond Dam, and Cheney Mill Dam, while Long Pond Brook Dam is indicated as “ruins” and is in disrepair (NHDES, 2022b).

2.3.1.2 Land Cover

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

Current land cover in the Kingston Lake watershed was determined by FBE using a combination of data sources. First, available data such as the National Wetland Inventory, National Hydrography Dataset (NHD), roads from the NHDOT roads layer (NHGRANIT), impervious surfaces in the coastal watershed of New Hampshire (NHGRANIT), coastal priority agricultural resources (NH GRANIT), and Microsoft building footprints were used as a base. Layers were buffered, if applicable, and assigned the proper LLRM land cover category. ESRI World imagery, 2015 1-ft Color Aerial Photos from NHGRANIT, and Google Earth satellite images were then reviewed to create the updated land cover for the Kingston Lake watershed, by editing the base layers. For more details on methodology, see the *Kingston Lake Lake Loading Response Model Report* (FBE, 2024a). Refer also to Appendix A, Map A-2.

As of the most recent aerialimagery, development accounts for 16% (326acres) of thewatershed, whileforestedand natural areas account for 67% (1,374 acres). Wetlands and open water represent 16% (323 acres) of the watershed, not including the surface area of Kingston Lake and Long Pond. Agriculture represents 1% (16 acres). Figure 10 shows a breakdown of land cover by major category for the entire watershed (not including lake area), as well as total phosphorus load by major land cover category (refer to Section 2.3.1.4 or FBE, 2024a). Developed areas cover 16% of the watershed and contribute 80% of the total phosphorus watershed load to Kingston Lake.

Developed areas within the Kingston Lake watershed are characterized by **impervious surfaces**, including areas with asphalt, concrete, compact gravel, and rooftops that force rain and snow that would otherwise soak into the ground to run off as stormwater. Stormwater runoff carries pollutants to waterbodies that may be harmful to aquatic life, including sediments, nutrients, pathogens,pesticides, hydrocarbons, and metals.

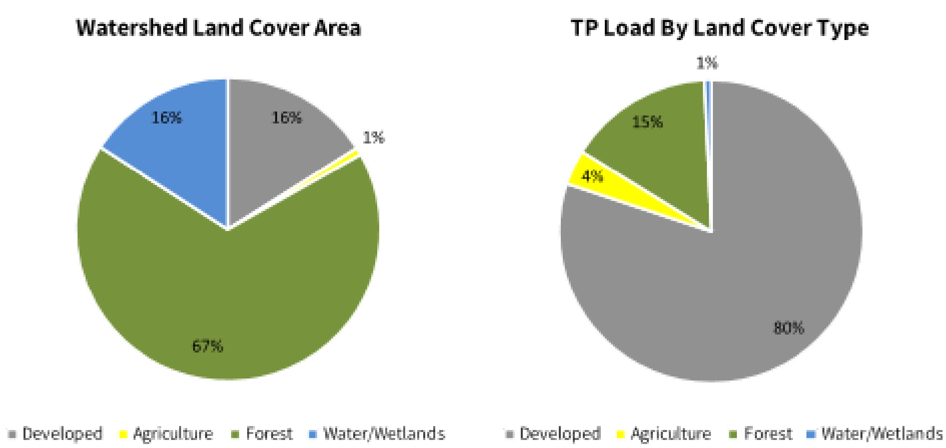


Figure 10. Kingston Lake watershed (including Long Pondwatershed) landcover area by general category (developed, agriculture, forest,and water/wetlands) andtotal phosphorus (TP) watershedloadby general land cover type. This shows that developedareas cover 16% of thewatershedand contribute 80% of the TP watershed load toKingston Lake. Water/wetlands category does not includethe Kingston Lake and Long Pond surfaceareas, but does include other ponds.

2.3.1.3 Internal Phosphorus Loading

Phosphorus that enters the lake and settles to the bottom can be re-released from sediment under anoxic conditions, 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 props, aquatic macrophyte management activities). Internal loading estimates were derived from dissolved oxygen and temperature profiles taken at the deep spots of Kingston Lake (to determine average annual duration and depth of anoxia defined as <2 ppm dissolved oxygen) and epilimnion/hypolimnion totalphosphorus data taken atthe deepspots of Kingston Lake(todetermineaveragedifferencebetweensurfaceand bottom phosphorus concentrations). These estimates, along with anoxic volume and surface area, helped determine rate of release and mass of annual internal phosphorus load. Data were limited during the late season (when internal loading is at its peak), meaning there was limitedinformationaboutphosphorusdynamicsandinternalloadingin KingstonLake.LongPondhasbeenobservedtostratifyweaklyornotat all, depending on the year. With few dissolved oxygen profiles and limited hypolimnion total phosphorus data, there is substantial uncertaintyintheinternalloading estimateuntiladditionaldatacanbe collected. However, the few winter samples collected from Long Pond showed in-lake total phosphorus concentrations significantly lower than summer samples, suggesting internal phosphorus loading is possible. Long Pond is otherwise too shallow and well-mixed year-round for quantification of internal phosphorus loading in a similar manner as deepstratifiedlakes suchas Kingston Lake.

> WHAT IS INTERNAL LOADING?
>
> Over time, as phosphorus enters the lake from the landscape,this phosphorus either stays inthe lake (i.e., settles to the bottom or is taken up by plants/algae for growth) or leaves thelake (i.e., get flushed out). The phosphorus that settles onthe lake bottom will generally bind with one of two naturally occurring elements that also get flushed into the lake eachyear from the watershed: aluminum or iron. If phosphorus binds with aluminum, thenthe bond is permanent, and the phosphorus is sedimented in the lake bottom. If the phosphorus binds with iron, then the bond is non-permanent and in summer when thelake bottom is deprived of oxygen (anoxic), it triggers a chemical reaction that releases phosphorus from the iron. This phosphorus is now freeto be mixed up into the water column and serve as a nutrient source for plants andalgae. Looking at the ratios between aluminum, iron, and phosphorus indicates whether the lake is vulnerable to internal loading or cycling of

2.3.1.4 LLRM Results

Overall, model predictions were in good agreement with observed data for total phosphorus (1-3%), chlorophyll-a (5-9%), and Secchi disk transparency (6-31%) (Table 7). 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 predictingchlorophyll-aandSecchidisktransparency.Forexample,chlorophyll-a isestimatedstrictlyfromnutrientloading, 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 onobserved chlorophyll-a concentrations and Secchi disk transparency readings.

Watershed runoff combined with baseflow (73%) was the largest phosphorus loading contribution across all sources to KingstonLake,followedbyshorefrontsepticsystemsat9%,atmosphericdepositionat8%,andinternalloadingat8%(Table 8;Figure11).Waterfowl(2%)werearelativelyminorsource.ThewatershedloadincludesthewatershedloadfromLongPond (32%) and the direct land area to Kingston Lake (41%). Greenwood Pond and Halfmoon Pond were not modeled separately, and their watershed land areas were therefore included in the Kingston Lake model. Development in the watershed is most concentrated in pockets near waterbodies, particularly between Greenwood Pond and Kingston Lake, the Great Pond Park area, and around lake shorelines where septic systems are located within a short distance to the water, leaving little horizontal (and sometimes vertical) space for proper filtration of wastewater effluent. Improper maintenance or siting of these systems can cause failures, which leach untreated, nutrient-rich wastewater effluent to the lake. Note that 1) the estimate for the septic system load is only for those systems directly along the shoreline and potentially short-circuiting minimally treated effluent to the lake; and 2) the load from septic systems throughout the rest of the watershed is inherent to the coefficients used to generate the watershed load. Internal loading, whereby lowdissolved oxygen in bottom waters is causing a release of phosphorus from sediments, was estimated as a relatively minor source of phosphorus to the lake; however, the limited amount of dissolved oxygen and total phosphorus data in the hypolimnion add uncertainty to internal loading estimates. Although internal loading is not estimated to be a major sourceof phosphorus,theseverityandextent of anoxiain KingstonLakeshould be monitored both to gauge the potential for internal loading and for the protection of aquatic life. In the meantime, watershed protection efforts should focus on reducingthe watershed and septicsystem loads.

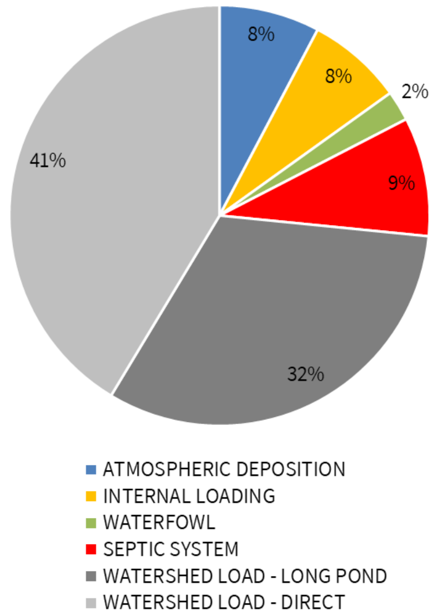


Figure 11. Summary of total phosphorus loading bymajor source for Kingston Lake. Referto **Error! Reference source not found.** for a breakdown.

Normalizing for the size of a sub-watershed (i.e., accounting for its annual discharge and direct drainage area) better highlights sub-watersheds with elevated pollutant exports relative to their drainage area. Sub-watersheds with moderate-to-highphosphorusmassexportedbyarea(>0.20kg/ha/yr)generally had more development (i.e., the direct shoreline area to Kingston Lake, the northern tributary to Kingston Lake, and the northern and southern reaches of the Powwow River; Figure 12). Drainage areas directly adjacent to waterbodies have direct connection to lakes and are usually targeted for development, thus increasing the possibility forphosphorus export.

Once the model is calibrated for current in-lake phosphorus concentration, we can then manipulate land cover and other loading factors to estimate pre-development loading scenarios (e.g., what in-lake phosphorus concentration was priortohumandevelopment orthebestpossiblewaterqualityforthelake). Refer to FBE (2024a) for details on methodology. Pre-development loading estimationshowed that totalphosphorus loadingtoKingstonLakeincreasedby 444%, from 53.1 kg/yr prior to European settlement to 289.0 kg/yr under current conditions (Table 8). These additional phosphorus sources come from development in the watershed (especially from the direct shoreline of Kingston Lake and Long Pond), internal loading, septic systems, and atmospheric dust (Table 8). Water quality prior to settlement was predicted to be excellent with extremely low phosphorus and chlorophyll-a concentrations and high-water clarity(Table 7).

We can also manipulate 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 constraints or the worst possible water quality for the lake). Refer to FBE (2024a) and the Kingston Lake Watershed Build-out Analysis (FBE, 2024b) for details on methodology. Note: the future scenario did not assume a 10% increase in precipitation over the next century (NOAA Technical Report NESDIS 142-1, 2013), which would have resulted in a lower predicted in-lake phosphorus concentration; this is because themodel does not considertherateanddistributionoftheprojectedincreaseinprecipitation.Climatechangemodelspredictmoreintenseand less frequent rain events that may exacerbate erosion of phosphorus-laden sediment to surface waters and therefore could increase in-lake phosphorus concentration (despite dilution and flushing impacts that the model assumes). Note also that future predictions are likely conservative given that detached accessory dwelling structures are not considered in the full build-out projection (only primary dwellings) but have been an observed development pattern around Kingston Lake in the Town of Kingston.

Future loading estimation showed that total phosphorus loading to Kingston Lake may increase by 23%, from 289.0 kg/yr under current conditions to 356.1 kg/yr at full build-out (2110) under current zoning (Table 8). Additional phosphorus will be generated from more development in the watershed (especially from suburban and undeveloped areas near tributaries to Long Pond and Kingston Lake), enhanced internal loading, and greater atmospheric dust (Table 8). The buildout analysis predicted very few new residences within the direct shoreline zone of Long Pond (3) and Kingston Lake (0). There is unlikely to be major increases in phosphorus loading from shoreline septic systems aside from the conversion of the final remaining seasonal properties to year-round use; however, converting to year-round usage would require designing and installing a newsepticsystemontheproperty,which wouldlikelybeanupgradecomparedtotheoldersystems ontheseparcels.At full buildout,themodelpredictedhigher(worse)phosphorus(19.9ppb),higher(worse)chlorophyll-a(5.6ppb),andlower(worse) water clarity (2.3 m) compared to current conditions for Kingston Lake (Table 7). The number of bloom days may increase from an average of 21 dayscurrently to an average of 60 days at full build-out (Table 7).

Table 7. In-lake water quality predictions for Long Pondand Kingston Lake. TP =total phosphorus. Chl-a =chlorophyll-a. SDT = Secchi disk transparency. Bloom Daysrepresent average annual probability of chlorophyll-a exceeding 8 ppb.

Model Scenario	Median TP (ppb)	Predicted Median TP (ppb)	Mean Chl-a (ppb)	Predicted Mean Chl-a (ppb)	Mean SDT (m)	Predicted Mean SDT (m)	BloomDays
Long Pond							
Pre-Development	--	3.4	--	0.5	--	9.0*	0
Current -2022	15.3	15.5	4.1	4.3	2.7	2.8	25
Future (2110)	--	19.3	--	5.9	--	2.4	73
KingstonLake							
Pre-Development	--	2.9	--	0.3	--	10.0	0
Current -2022	15.7	16.1	3.7	4.1	3.7	2.7	21

*The maximum depth of Long Pond is around 3 meters. The model predicts the mean Secchi disk transparency (SDT) based on the predicted total phosphorus concentration and other lake variables, which do not include the maximum depth of the pond. For the pre-development model scenario for Long Pond, the mean SDT is predicted at a deeper depth than the lake bottom. For lake management purposes, the predicted mean SDT in the pre-developmentscenarioshouldbeconsideredasthelakebottom.

Table 8. Total phosphorus (TP) and water loading summary by source for Long Pond and Kingston Lake.

	PRE-DEVELOPMENT			**CURRENT (2022)**			**FUTURE (2110)**		
	TP (KG/YR)	%	WATER (CU.M/YR)	TP (KG/YR)	%	WATER (CU.M/YR)	TP (KG/YR)	%	WATER (CU.M/YR)
LONG POND									
ATMOSPHERIC	3.0	8%	252,563	8.6	5%	252,563	10.8	5%	252,563
INTERNAL	0.0	0%	0	4.3	3%	0	5.4	3%	0
WATERFOWL	2.6	7%	0	2.6	1%	0	2.6	1%	0
SEPTIC SYSTEM	0.0	0%	0	10.1	6%	8,325	11.1	5%	9,630
WATERSHED LOAD	31.0	85%	5,761,873	140.4	85%	5,717,707	176.1	86%	5,701,534
TOTAL LOADTO LAKE	**36.6**	**100%**	**6,014,435**	**166.0**	**100%**	**5,978,595**	**205.9**	**100%**	**5,963,726**
KINGSTONLAKE									
ATMOSPHERIC	7.8	15%	655,572	22.4	8%	655,572	27.9	8%	655,572
INTERNAL	0.0	0%	0	21.3	8%	0	26.2	7%	0
WATERFOWL Long Pond	6.7	13%	0	92.7 6.7	2%	0	115.1 6.7	2%	0
SEPTIC SYSTEM	17.9 0.0	0%	0	26.5	9%	21,804	28.8	8%	23,681
WATERSHED LOAD	38.5	72%	9,884,603	212.2	73%	9,795,802	266.5	75%	9,763,161

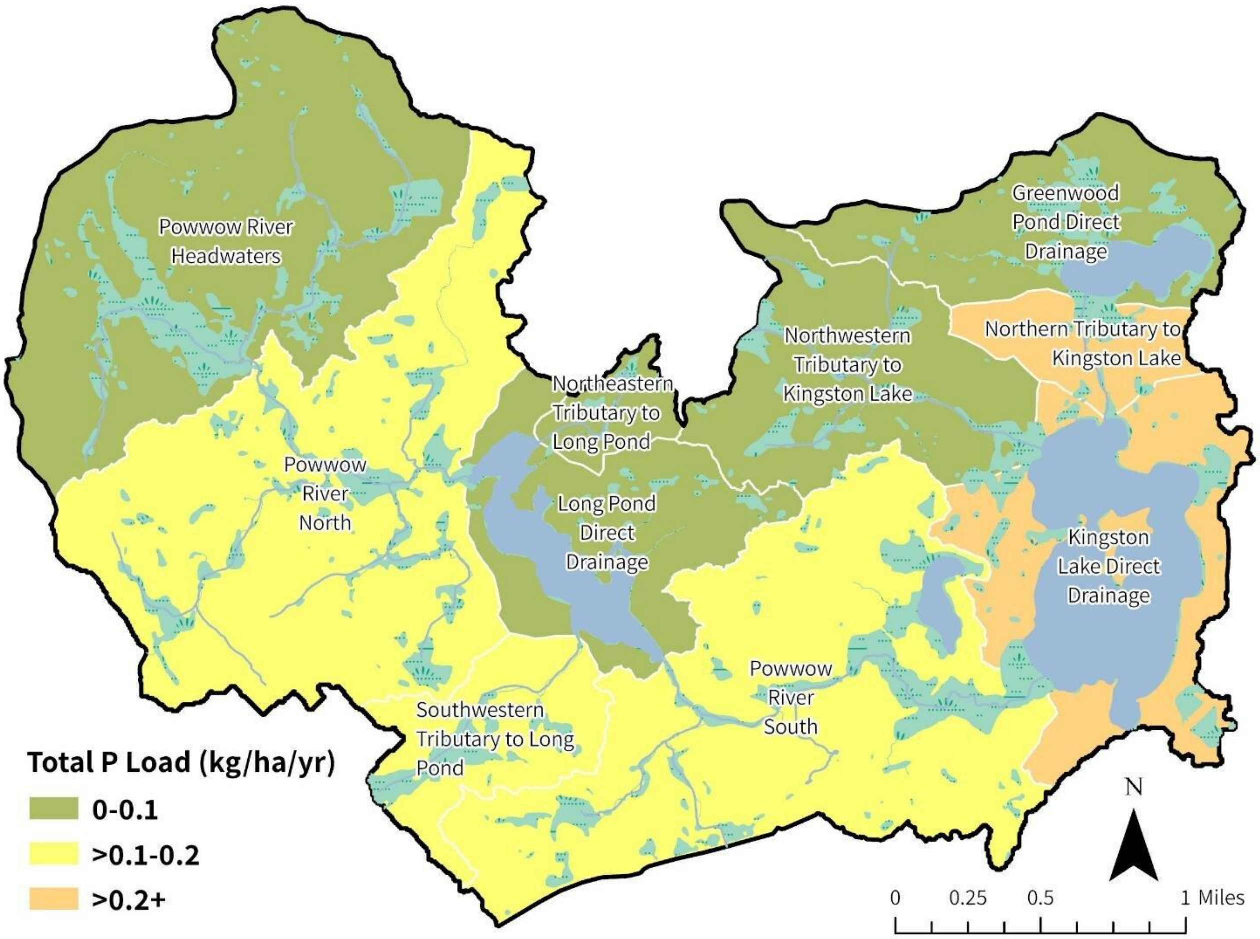


Figure 12. Map of current total phosphorus load per unitarea (kg/ha/yr) for each sub-watershed in the Kingston Lake watershed. Phosphorus loadper unit area only includes the direct areafor eachsub-watershed (excludes upstream sub-watersheds). Higher phosphorus loads per unitarea areconcentrated in themore developed areas, including direct shoreline areas.

2.3.2 Build-out Analysis

A full build-out analysis was completed for the Kingston Lake watershed for the municipalities of Kingston and Danville (FBE, 2024b). 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.

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 (ROWs), and building setbacks), and practical design considerations (e.g., lot layout inefficiencies) (Appendix A, Map A-3). Existing buildings also reduce the capacity for new development.

The build-out analysis showed that 47% (2,220 acres) of the watershed is buildable under current zoning regulations (Appendix A, Map A-4). The Residential/Agricultural zone in Danville has the most acreage of buildable area at 1,167 acres (Table 9). FBE identified 1,282 existing buildings within the watershed, and the build-out analysis projected that an additional 414 buildings could be constructed in the future, resulting in a total of 1,696 buildings in the watershed at full build-out (Appendix A, Map A-5). **Note that these estimates are likely conservative given that detached accessory dwelling structures are not considered in the model (only primary dwellings) but have been an observed development pattern around Kingston Lake in the Town of Kingston.**

Table 9. Amount of buildable land and projected buildings in the Kingston Lake watershed.

Zone	Total Area (Acres)	Buildable Area (Acres)	Percent Buildable Area	No. Existing Buildings	No. Projected Buildings	Total No. Buildings	Percent Increase
Kingston							
Single Family Residential District (SFR)	1,482	659	44%	558	142	700	25%
Rural Residential District (RR)	557	281	51%	88	93	181	106%
Historic District (H1)	78	24	31%	18	10	28	56%
Commercial (C3)	3	2	53%	0	1	1	-
Danville							
Residential/Agricultural (RA)	2,156	1,167	54%	577	153	730	27%
Historic District (HD)	307	6	2%	0	4	5	-
Mobile Homes (MH)	59	32	54%	25	4	29	16%
Highway Commercial and Light Industrial (HCLI)	50	26	51%	6	3	9	50%
Danville Village District (DVD)	34	25	74%	10	4	14	40%

Three iterations of the TimeScope Analysis were run using compound annual growth rates (CAGR) for 20-, 30- and 50-year periodsfrom2000-2020(0.32%),1990-2020(0.93%),and1970-2020(2.07%),respectively(Table10).Fullbuild-outisprojected to occur in 2110 for the 20-year CAGR, 2053 for the 30-year CAGR, and 2037 for the 50-year CAGR. This analysis showed that if thetownswithinthewatershedcontinuetogrowatrecentratesidentifiedinthe20-yearperiod,andcurrentzoningandother development constraints remain the same, full build-out could occur within 86 years (Figure 13).

Note that the growth rates used in the TimeScope Analysis are based on town-wide census statistics but have been applied here toa portion of themunicipalities. Alsonotethat thepopulationgrowth rate inthese municipalities is decreasing, sothe 20-year estimate is 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 such as when considering commercial versus residential development. 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 thevarious factors may be complex and therefore difficult tomodel.

Table 10. Compound annual growth rates for thetwo municipalities in the Kingston Lake watershed usedforthe TimeScope Analysis. Population estimates obtained from the NH Office of StrategicInitiatives.

	Compound Annual Growth Rate		
Town	**50 yr. Avg. 1970-2020**	**30 yr. Avg. 1990-2020**	**20 yr. Avg. 2000-2020**
Kingston	1.54%	0.36%	0.25%
Danville	3.17%	1.94%	0.43%
Combined	**2.07%**	**0.93%**	**0.32%**

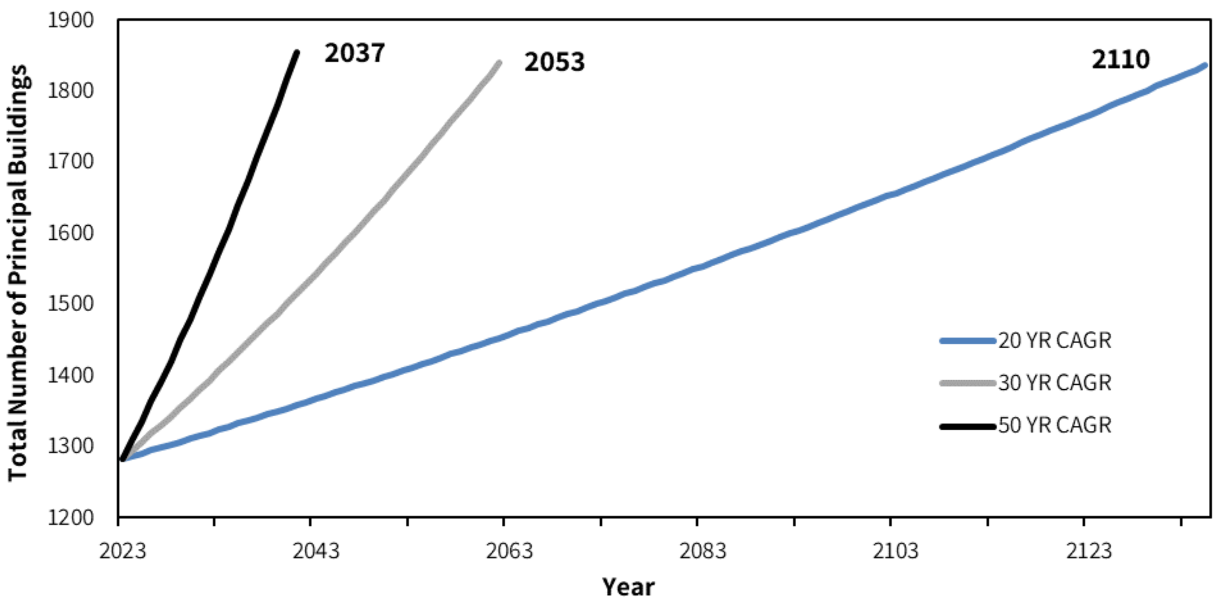


Figure 13. Full build-out projections of the Kingston Lakewatershed (based on compound annual growth rates).

2.4 WATERQUALITY GOAL&OBJECTIVES

The model results revealed changes in total phosphorus loading and in-lake total phosphorus concentrations over time from pre-development through future conditions, showing that the water quality of Kingston Lake is threatened by current development activities in the watershed and will degrade further with continued development in the future. We can use these results to make informed management decisions and set an appropriate water quality goal for Kingston Lake. In-lake chlorophyll-a and total phosphorus concentrations indicate that there may not be reserve capacity for the lake to assimilate additional nutrients under a "business as usual" scenario. Thus, it is highly recommended that strong objectives be established to protect the water quality of Kingston Lake over the long term, especially given that the lake is experiencing cyanobacteria blooms and is threatened by new development.

The goal of the Kingston Lake WBMP is to improve the water quality of Kingston Lake and Long Pond such that they meet state water quality standards for the protection of Aquatic Life Integrity (ALI) and substantially reduce the likelihood of harmful cyanobacteria blooms in the lake. This goal will be achieved by accomplishing the following objectives. Specific action items to achievethese objectives are provided in the Action Plan (Section 5).

> **Objective 1:** Reduce phosphorus loading from existing development by 16% (46.4 kg/yr) to Kingston Lake and 25% (41.5 kg/yr) to Long Pond to improve the average in-lake summer or annual total phosphorus concentration to 10.7 ppb for Kingston Lake and 11.6 ppb for Long Pond.
>
> **Objective 2:** Mitigate (prevent or offset) phosphorus loading from future development by 8 kg/yr to Kingston Lake and 5 kg/yr to Long Pond to maintain average summer in-lake total phosphorus concentration in the next 10 years (2034).

The interim goals for each objective allow flexibility in reassessing water quality objectives following more data collection and expected increases in phosphorus loading from new development in the watershed over the next 10 or more years (Table 11). Understanding where water quality will be following watershed improvements compared to where water quality should have been following no action will help guide adaptive changes to interim goals (e.g., goals are on track or goals are falling short). If the goals are not being met due to lack of funding or other resources for implementation projects versus due to increases in phosphorus loading fromnewdevelopment outpacingreductions inphosphorus loadingfromimprovementstoexistingdevelopment,thenthis creates much different conditions from which to adjust interim goals. For each interim goal year, stakeholders should update the water quality data andmodel andassess whygoals areorare not being met (referto Section 6.5: Indicators toMeasure Progress for environmental indicators). Stakeholders will then decide on how to adjust the next interim goals to better reflect water quality conditions and practical limitations toimplementation.

Table 11. Summary of waterquality objectives for Kingston Lake and Long Pond. Interim goals/benchmarks are cumulative.

Water Quality Objective	Interim Goals/Benchmarks		
	2026	2029	2034
1. Reduce phosphorus loading from existing development by 16% (46.4 kg/yr) to Kingston Lake and 25% (41.5 kg/yr) to Long Pond to improve average in-lake summer or annual total phosphorus concentration to 10.7 ppb for Kingston Lake and 11.6ppb for Long Pond.			
	Achieve 4% (11.6 kg/yr) reduction in TP loading to Kingston Lake and 5%(8.3 kg/yr) to Long Pond	Achieve 8% (23.2 kg/yr) reduction in TP loading toKingston Lake and 15% (24.9 kg/yr) to Long Pond; re-evaluate water qualityand track progress	Achieve 16% (46.4 kg/yr) reduction in TP loading to Kingston Lake and 25%(41.5 kg/yr) to Long Pond; re-evaluate water qualityand track progress
2. Mitigate (prevent or offset) phosphorus loading from future development by 8 kg/yr to Kingston Lake and 5 kg/yr to Long Pond to maintain average summer in-lake total phosphorus concentration in the next 10 years (2034).			
	Prevent or offset 2 kg/yr in TP loading from new development toKingston Lake and 1 kg/yr to Long Pond	Prevent or offset 4 kg/yr in TP loading from new development to Kingston Lake and 3kg/yr to Long Pond; re-evaluate water quality and track progress	Prevent or offset 8 kg/yr in TP loading from new development toKingston Lake and 5 kg/yr to Long Pond; re-evaluate water qualityand

3 POLLUTANT SOURCE IDENTIFICATION

This section describes sources of excess phosphorus to Kingston Lake. Sources of phosphorus to lakes include stormwater runoff, shorelineerosion,constructionactivities,illicitconnections,failedorimproperlyfunctioningsepticsystems,leakysewer lines,fabric softeners and detergents in greywater, fertilizers, and pet, livestock, and wildlife waste. These external sources of phosphorus to lakes can then circulate within lakes 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 managementoptions.Wildlifeismentionedasapotentialsourcebutlargelyfornuisancewaterfowlsuchasgeeseorducksthatmay be congregating in large groups because of human-related actions such as feeding or having easy shoreline access (i.e., lawns). Climate change is also not a direct source but can exacerbate the impact of the other phosphorus sources identified in this section and should beconsidered when striving to achievethe water quality objectives.

3.1 WATERSHED DEVELOPMENT

NPS pollution comes from many diffuse sources on the landscape and is more difficult to identify and control than point source pollution. NPS pollution can result from contaminants transported by overland runoff (e.g., agricultural runoff or runoff from suburban and rural areas), groundwater flow, or direct deposition of pollutants to receiving waters. Examples of NPS 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, pet waste, and wildlifewaste.

3.1.1 Historical Development

Many Native American tribes—particularly the Abenaki people—lived within the area surrounding Kingston Lake, also known as Great Pond. They utilized Kingston Lake, the Powwow River, and the surrounding ponds for fishing and farming (Lesley Hume, personalcommunication). OntheeastsideofKingstonLake,thereexistsastonewallconnectingtheshorelinetoClark's Islandthat the Native Americans constructed and used. However, it is unknown why it existed or what it was used for. The wall has been submergedwithinthelakesincethelakewasdammed(NHDES,1999;LesleyHume,personalcommunication).Itisbelievedthatthe Native Americans originally cleared the Plains area of Kingston, which offered a village site for the colonial settlers. In 1694, the first colonial residents of Kingston centered their settlement around Kingston Lake. The colonial seizure of the land around Kingston Lake led totensionbetweenthe colonists andtheIndigenous peopleof thearea, including numerous documented violent conflicts and killings (NHDES, 1999).

Early colonial residents of Kingston likely grew corn and hunted game. By the 1800s, raising cattle and sheep were the primary agricultural products, and waterpower from the local rivers became instrumental for the use of sawmills and grist mills (Town of Kingston, 1994). In particular, the Page/Cheney grist mill and sawmill were situated on the Powwow River in-between Long Pond and Kingston Lake. Dams on Long Pond and near the mills allowed the residents to control water levels for mill operation. Modern residents of Kingston can still recall a time when sawdust and other residue from the mills filled the Powwow River so much that it inhibited canoe travel. One other sawmill existed on this stretch of the Powwow River (Lesley Hume, personal communication). Other early industries included tanning andmining for ironore. In fact, the northern deep hole in Kingston Lake is anartifact of iron mining in the lake near Clark's Island (NHDES, 1999).

Horses were a main feature of the town in the late 1800s, not only for their utility on the farm or for transportation, but because of the popularity of horse racing in Kingston. A racetrack within the town brought in opponents and travelers. Horse racing was so popular that many families within the town began owning horses (Town of Kingston, 1994). In the late 1920s, Kingston became a local hub for the broiler industry due to the emergence of a unique breed of chicken being raised in Kingston called the New Hampshire Bird (Town of Kingston, 1994). Large-scale poultry farms were common in Kingston, with the most famous being the Nichols Poultry Farm. By the1950s, Kingston produced millions of eggs and chicks and had the largest stock of the New Hampshire Bird in the country (Town of Kingston, 1994). Despite this, not all chicken farms operated on a large-scale. Many local farmers had small chicken farms—it is estimated that about 50% of Kingston residents received some income from chicken during this time. Allegedly,achickencarcassdisposaltrenchwasusedduringthistimeandwaslocatednorthwestofKingstonLakebetweenthe lake and Greenwood Pond (Lesley Hume, personal communication). By the 1970s, the booming broiler industry had subsided, though many smallchicken coops can be found in modern-day Kingston.

As industry developed elsewhere in Kingston, the shoreline of Kingston Lake was used primarily for seasonal summer cottages or camps. Thesecottages wereoriginally served by outhouses andhad noelectricity (Lesley Hume, personalcommunication). Several day camps and overnight camps were also established along the shoreline, the most prominent of which was Camp Lincoln, which was founded in 1926. Many long-time Kingston residents have memories of visiting or staying at Camp Lincoln (Lesley Hume, personal communication).Itwas originallybuiltforovernight camping programsforyoung boys untilitbecameadaycampin 1981. In the 1970s, it was expanded to include 10 cabins and a new beach area. Today, some 300 children enroll in day programs at Camp Lincoln, and it is operatedbythe YMCA, who own a largeportion of the northwestern shoreline of Kingston Lake (Town of Kingston, 1994). Other day camps existed along the Kingston Lake shoreline, namely a YWCA Blue Tyrangle Camp (now the rec center), Camp Treasure Lea, and Camp Zouka. These camps made Kingston a popular destination in the summer. Established in 1934, Kingston State Park also offers shoreline recreation and a destination for travelers. The park features a beach, playground, bath houses, a large, forested area, anda maintained parking area. Camping was allowed in theparkinto the 1940s (Town of Kingston, 1994).

Nearly all residences around the Kingston Lake shoreline were for seasonal use until the 1950s. The following decade saw the conversion of many of these summer cottages into year-round homes. These changes, alongside poor septic system design, led to manywastewatermanagement problems inKingston.Of theseasonal-usehomes,a largeresidentialdevelopment onthewestside ofKingstonLakecalledGreatPondParkbeganforminginthe1930s.Theoriginalplanfortheareaincludedextremelysmalllotsthat would have allowed for much higher density than what exists today (Lesley Hume, personal communication). In contemporary Kingston, there are about 150 homes in Great Pond Park(NHDES, 1999). In the 1970s, a large storm event caused serious flooding in the Great Pond Park area. According to local knowledge, the combination of the flooding, weakly constructed septic tanks, and the increased amounts of wastewater from year-round conversions led toa series of septicsystem failures that floodedbasements and contaminated neighboring wells. Numerous other flooding events are recorded in the town’s history (Lesley Hume, personal communication). Today, there are far fewer summer cottages located along the lake shoreline, as most of them have converted to year-round use. Whilemany cottages originallylacked electricity and wereserved by outhouses, newer homes are larger in sizeand have modern utilities. Recreational activities suchas motor boating, fishing,and swimming all remain popular on Kingston Lake.

3.1.2 Watershed Survey

A watershed survey of the Kingston Lake watershed was completed by technical staff from FBE. The objective of the watershed survey was to identify and characterize sites contributing NPS pollution and/or providing opportunities to mitigateNPSpollutioninthewatershed.Priortothefieldwork,FBEsolicitedinput from KLA about locations with known NPS pollution through the interactive KingstonLakeWatershedReportingTool.FBEalsoanalyzedaerialimagesandGIS data for land use/land cover, roads, public properties, waterbodies, and other features.Thisinformationenabled FBEto betterplanforthesurvey(e.g.,totarget known or likely high-polluting sites, such as unpaved roads, beaches, highly impervious areas, etc.)and toinform recommended solutions.

Road shoulder/ditch erosionon Long Pond Road near Pine Street, July 2023. Photo credit: FBE.

FBE conducted the watershed survey in June and July of 2023. For each location, field staff recorded site data and photographs on mobile devices. Information collected included location description and GPS coordinates; NPS problem description and measurements (e.g., gully dimensions); receiving waterbody; discharge type (direct or indirect/limited); and preliminary recommendations to mitigatethe NPSproblem.Fieldstaffaccessedsitesfrom public andprivate roads and waterfront access points.

FBEidentified55problemsitesinthewatershed(Figure14).Themainissuesfound werewateraccess pointerosionand roadandditcherosion, andcampandbeach runoff. FBE estimated the potential pollutant removal that could be achieved by implementingrecommendations. AppendixBsummarizestherecommendations, load reduction estimates, and estimated costs for each site. The top four high priority sites (based on lowest impact-weighted cost per mass of phosphorus removed) areshownbelow,along with theGreenwoodPondTownBeachsitewhich theCommitteeidentifiedasanNPSlocationof high impact. In addition to these specific sites, managers of both private and public roads should use best practices for road installation and maintenanceto for water quality protection.

Site 0-01: Greenwood Pond Town Beach

Location (latitude, longitude): 42.93769495, -71.0558234

Impact: **High**

Observations: Greenwood Pond Town Beach is located on the eastern shores of Greenwood Pond, behind the Kingston Children’s CenterandFirst CongregationalChurch of Kingston.As a popularwateraccess siteforswimmingandpaddling,thesandyshoreline area receives significant traffic. There are two pathways to access the beach area. The first is from the parking lot adjacent to the Kingston Children’s Center (Photo A). This wide, sparsely grassed area is subject to stormwater flow as evidenced by gullies shown inPhotosBandE. Thesegulliestravelfromthepathwaytotheshorelineandintoto GreenwoodPond.Thebeachcanalsobeaccessed from a path behind the First Congregational Church (Photo C). Infiltration steps exist just to the right of Photo C and are in great condition; however, the pathway shown in Photo C remains. This pathway has been compacted and eroded into a gully-shaped shoot directly to the shoreline. Observations were also made in relation to the vegetation along the pond’s edge. A minimal buffer exists on the edges of the swimming/water access sandy area (Photo F). Additionally, at the time of observation, a cyanobacteria bloom advisory was in effect (Phots D and G). The cyanobacteria appeared as thin ribbons on the water’s surface andconcentrated along theshoreline likely due to an excess of nutrients and/or prevailing winds.

Recommendations: It is recommended that a full reconstruction of the Greenwood Pond Beach be completed. The amount of bare sand and soil should be reduced outside the direct play/access waterline. A designated path can be created and stabilized using subsurface stabilizers and filled with pea stone for strollers and wagons from the parking lot to near the shore. The rest of the unvegetated walkway can be planted with grass and/or shrubs and stabilized with pavers into a tiered system. If possible, the pathway shown inPhoto Ccan be roped off andmarked asa revegetation zone. Foot traffic canbe rediverted totheprimary access path described previously. Shrubs and riparian plants can be planted on the grassy sides of the swimmingarea to help stabilize the shoreline.Theobjectiveof theserecommendations is toprohibit theabilityof sediment tobetransportedfrom theaccess areainto the lake, since phosphorus,a limiting nutrient in many freshwater bodies, easilybinds to sediment.

A: The access walkway from the parking lot adjacent to the Kingston Children’s Center to the pond. **B and E:** Gullies of erosion present along thesandyshoreline.**C:**TheaccesspathwayfrombehindtheFirstCongregationalChurchofKingston. **F:**Minimalshorelinebufferispresenton the sides ofthe swimmingarea. **Dand G:** Theobserved cyanobacteria bloomand signage.

Site 0-07: Kingston Lake State Park Lawn
Location (latitude, longitude): 42.92744881,-71.0592895
Impact: High

Observations: Kingston Lake State Park is a well-maintained area providing members of the community and visitors access to Kingston Lake. The picnic area adjacent to the beach is a large,grassedareamaintainedforpicnickingandplay.Alsoenjoyingthegrassyareawitheasy access to the water were 13 geese at the time of observation. Geese and other waterfowl are sourcesofnutrients,suchasnitrogen,andbacteriaintowaterbodiesastheyoftencongregate and excrete wastealong theshoreline.

Recommendations:Werecommendinstallingsomegeesedeterrentsalongthe Kingston Lake State Park beach and picnic area. This may include expanding buffers, installing dog statues, or partnering with a geese deterrent company that uses dogs to scare away the geese when the parkis closed tothe public. It is also important to ensure lawn fertilizers are not in use.

Geese can be spottedin the backgroundofthe photo. FBEfield staffdidnot get a closer phototo keep the privacyofbeachgoers.

Site 2-20: Coburn Hill Road to Main Street
Location (latitude, longitude): 42.94167938, -71.11773314
Impact: **Medium**

Observations: Road shouldererosion was observed along the southernsideofCoburnHillRoadleadingtothedownhillside of the Coburn Hill Road – Main Street culvert. Larger erosion channels were observed at the corner of the road where stormwater was diverting into the road shoulder flow of Main Street. Heavy erosion is also present at the downhill culvert, creating an unstableculvert outlet.

Recommendations: Regrade and armor the road shoulder with rip rap. Install check dams or turnouts to help slow, infiltrate, and disperse stormwater flow. Stabilize culvert outlet and armor outlet with riprap. Line riprap with a sediment filtration fabric for stability. Revegetate road shoulder nearest to the roadway with grass. Install with topsoil, seed, and straw. Establish a watering regimen until the grass is established.

StormwatererosionalongCoburnHillRoadtothedownhillsideofthe culvert parallel to Main Street.

Site 2-10: Long Pond Road from Pine Street
Location (latitude, longitude): 42.91837535, -71.0994668
Impact: **Medium**

Observations:SevereerosionwasobservedalongLongPond Road from the intersection of Pine Street. The erosion gully spanned an area of 110 ft long by 3 ft wide and 1 foot deep. Theerosionhasexposedlargerrockshavingwashedawayall the finer silt and sand from the gully. Stormwater flow from this erosion channel goes directly into a forested wetland adjacent to a stream crossing of the southwestern tributary to Long Pond.

Recommendations: Armor the road shoulder ditch with rip rap. Install check dams and install turnouts where appropriate to redirect stormwater runoff from depositing into the tributary.

View of the road shoulder erosion along Long Pond Road near Pine Street.

Site 2-03: Kingston Lake Town Beach - Adjacent
Location (latitude, longitude): 42.9135442, -71.06271585
Impact: **High**

Observations: The Kingston Lake Town Beach can be found along the southern shores of Kingston Lake behind the Kingston Recreation Department. A large gullyhasformedfromtheparkingareaallthewaytothe waterontheouterrightsideofthefenced-inbeacharea. The eroded sediment has exposed larger rocks indicatingwaterhastransportedsmallersedimentsand sands intoKingston Lake.

Viewsofthe stormwater erosiongulliesadjacent to the fencedin beach area.

Recommendations: We recommend armoring the inlet of the ditch with riprap stone to help withstand the brunt of stormwaterflow.Revegetationofthis areawith understory shrubs will help stabilize the soil. Additionally, water bars or turnouts from the primary flow path can aid with water dispersal and decrease channelization. Finally, enhance the shoreline buffer where the flow path cuts through with additional plantings. Additional stormwater controls upslope such as installing gutters and rain barrels to capture roof runoff may reduce the amount of runoff reaching the path, as was recommended by Verdantas,a consultingfirm working with the Town of Kingston, in a site plan forthis parcel.

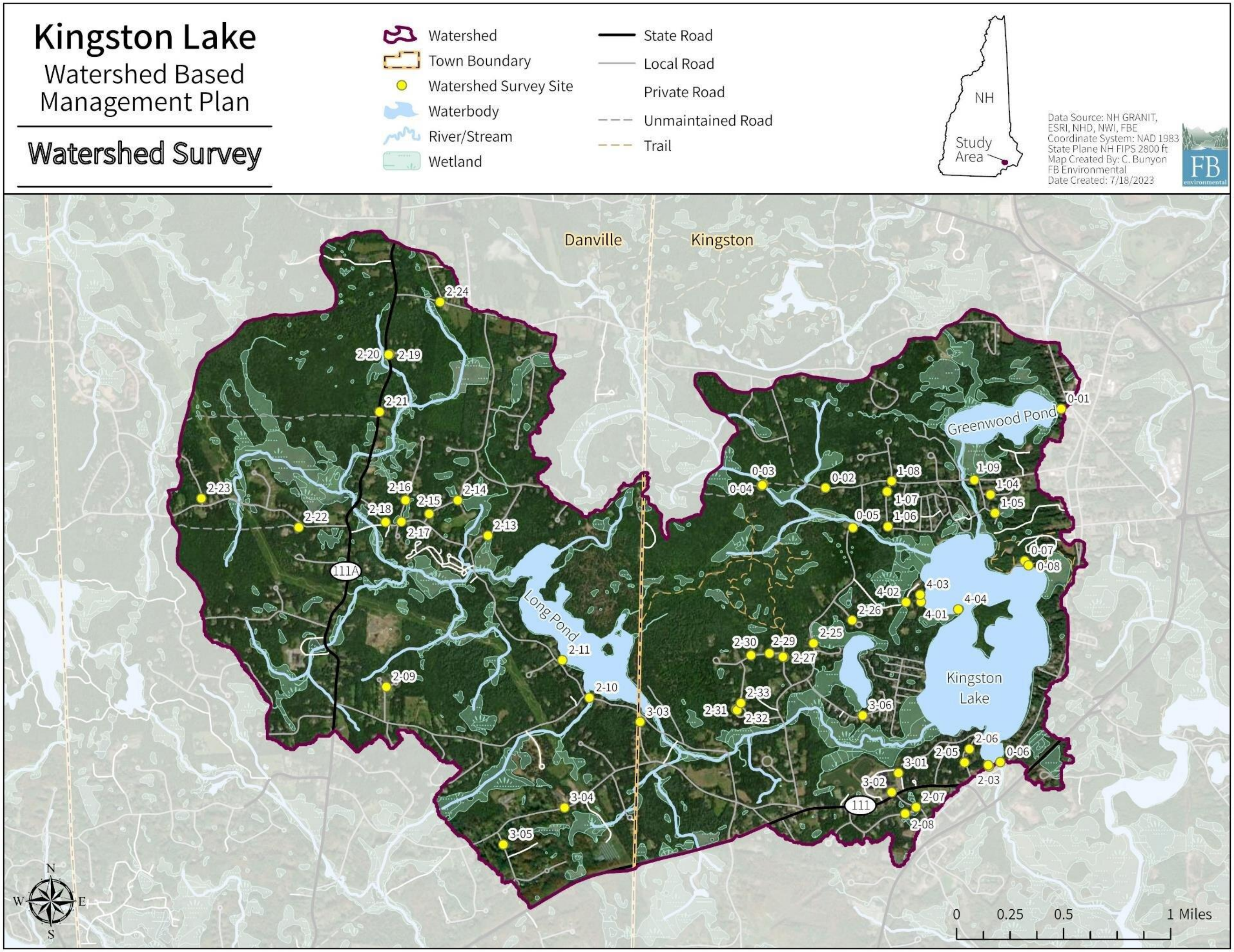


Figure 14. Location of identified nonpoint source sites in the Kingston Lake watershed.

3.1.3 Shoreline Survey

FBE technicalstaff,assistedbyKLAandYMCA CampLincoln,conducteda shorelinesurveyof KingstonLake onJuly 19,2023. The shoreline survey uses a simple scoring method to highlight shoreline properties around the lake that exhibit significant erosion.Thismethodofshorelinesurveyisarapidtechniquetoassesstheoverallconditionofpropertieswithintheshoreland zone and prioritize properties for technical assistance or outreach. One boat was used for surveying parcels with lake frontage. Technical staff and volunteers documented the condition of the shoreline for each parcel using a scoring system that evaluates vegetated buffer, presence of bare soil, extent of shoreline erosion, distance of structures to the lake, and slope. These scores were summed to generate an overall “Shoreline Disturbance Score” and “Shoreline Vulnerability Score” for each parcel, with high scores indicating poor or vulnerable shoreline conditions. Photos were taken at each parcel and werecatalogedbytaxmap-lot number.Thesephotoswill provideKLA with avaluabletool forassessingshorelineconditions over time. It is recommended that a shoreline survey be conducted in mid-summer every five years to evaluate changing conditions.

A total of 86parcels were evaluated along theshoreline of Kingston Lake inKingston, NH (Appendix A, MapA-6). Theaverage ShorelineDisturbanceScore(Buffer,Bare Soil,andShorelineErosion) fortheentirelakewas 6.7(Table12).About 69%of the shoreline (or 59 parcels) scored 7 or greater (Figure 15). Adisturbance score of 7or above indicates shoreline conditions that may be detrimental to lake water quality. These shoreline properties tended to have inadequate buffers, evidence of bare soil, and shoreline erosion. The average Shoreline Vulnerability Score (Distanceand Slope) was 4.0 (Table 12). About 69% (or 59parcels)scored4orgreater(Figure 16).Avulnerabilityscoreof 4orgreaterindicates that theparcelmayhavea homeless than150ft.fromtheshorelineandamoderateorsteepslopetotheshoreline.Parcelswithavulnerabilityscoreof4orgreater aremorepronetoerosionissues whetherornot adequatebuffers andsoilcoveragearepresent.Someparcels areextremely prone to erosion issues,as 21parcels (24%) received the maximum vulnerability score of 6.

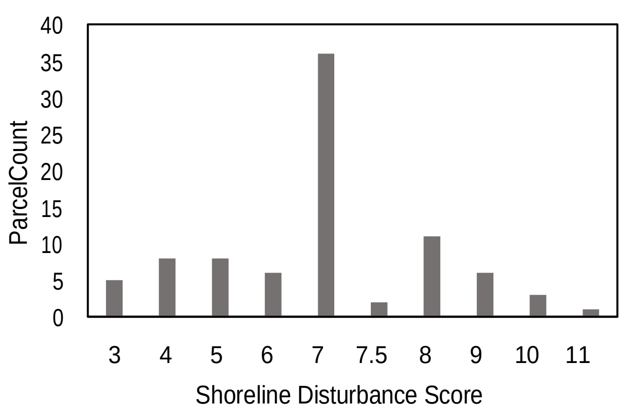


Figure 16. Histogram showing the number of parcels by Shoreline Disturbance Score. The possible range of Shoreline Disturbance Scores is 3-12.

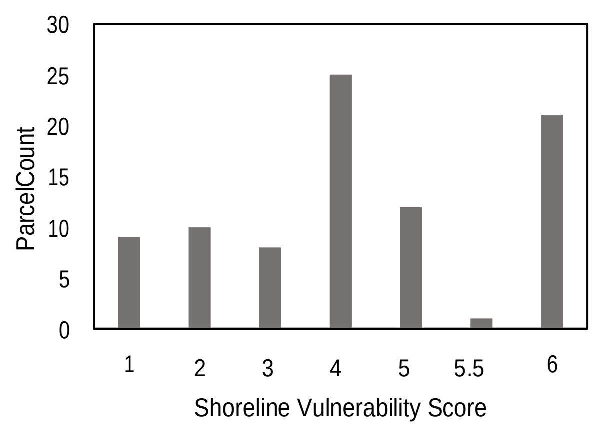


Figure 15. Histogram showing the number of parcels by Shoreline Vulnerability Score. The possible range of Shoreline Vulnerability Scores is 1-6.

Table 12. Average scores foreach evaluated condition criterion and the average Shoreline Disturbance Score and average Shoreline Vulnerability Score for Kingston Lake. Lower values indicateshoreline conditions that are effective at reducing erosion and keeping excess nutrients out of the lake. Note:the numbers in parentheses are the range of possiblescores for that variable.

Evaluated Condition	Average Score	
Buffer (1-5)	3.2	Average Shoreline Disturbance Score (3-12) **6.7**
Bare Soil (1-4)	1.7	
Shoreline Erosion (1-3)	1.7	
Distance (0-3)	2.2	Average Shoreline Vulnerability Score (1-6) **4.0**
Slope (1-3)	1.8	

The pollutant loading estimates are based on the Shoreline Disturbance Scores. The 59 parcels with scores 7-12, are contributing approximately 20.5 kg of phosphorus annually[3]. If shoreline landowners were to create adequate buffers and install other shoreline Best Management Practices (BMPs) on these properties (at a 50% BMP efficiency rate), the annual reduction would be 10.3 kg of phosphorus.

Certain site characteristics, such as slope, can cause shorelines to be naturally more vulnerable to erosion. Other site characteristics such as structure distance to the lake, are often a direct consequence of the historic development on that parcel and cannot be easily changed. Shoreline buffers and amount of exposed soil are more easily changed to strengthen the resiliency of the shoreline to disturbance in the watershed. In summary, the overall average shoreline condition of Kingston Lake is good for erosion issues (average disturbance score below 7), with 59 properties (69%) needing to address erosionissuesthatareimpactingthelake.KingstonLakeisalsogenerallymorepronetoerosionissuesbecausemanyhomes are locatedclosetoshore and on moderateto steep slopes (average vulnerabilityscoreis 4.0).

Scores should be used to prioritize areas of the shoreline for remediation. Recommendations largely include improving shoreline vegetated buffers. Encouraging landowners to plant and/or maintain vegetated buffers as a BMP along their shoreline, particularly in areas of bare soil, will help mitigate erosion and reduce sediment and nutrient loading tothelake.

3.1.4 Soil & Shoreline Erosion

Erosion can occur when ground is disturbed by digging, construction, plowing, foot or vehicle traffic, or wildlife. Rain and associatedrunoffaretheprimarypathwaysbywhicherodedsoilreacheslakesandstreams.Onceinsurfacewaters,nutrients are released from the soil particles into the water column, causing excess nutrient loading to surface waters or cultural eutrophication. Since development demand near lakes is high, construction activities in lake watersheds can be a large sourceof nutrients. Unpavedroads andtrails usedbymotorizedvehicles nearlakes andstreamsareespeciallyvulnerableto erosion. Stream bank erosion canalsohavea rapidandsevere effect onlakewater quality and can betriggered 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 minimizethese effects.

3.1.4.1 Surficial Geology

The composition of soils in the area reflects the dynamic geological processes that have shaped the landscape of New Hampshireovermillions of years.Some 300to 400millionyearsago,muchofthenortheasternUnitedStates was coveredby a shallow sea; layers of mineral deposition compressed to form sedimentary layers of shale, sandstone, and limestone (Goldthwait, 1951). Over time, the Earth's crust then 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 bybursts of moltenmaterialintrusions toform igneous rock, including granitefor which New Hampshire is famous for (Goldthwait, 1951). Erosion has furthermodified andshaped this parent material over the last 200million years.

[3] Based on Region 5 model bank stabilization estimate for fine sandy loams, using 50 ft or 100 ft or 200 ft (length) by 3 ft (height) and moderate lateral recessionrateof0.1ft/yr.

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 meltedand retreated, scouring bedrock and depositing glacialtill tocreatethe deeply scoured basin of theregion'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 ft deep. Glacial till is composed of unsorted material, with particle sizes ranging from loose and sandy to compact and silty to gravely. This material laid the foundation for vegetation andstreams as the depression basinsthroughout the region beganto fill with water (Goldthwait, 1951).

The unique geological formation in this area formed its stratified drift aquifers, comprising of fine-grained, coarse-grained and coarse-grained overlying fine-grained stratified drift aquifers. Several of these aquifers surround Kingston Lake, Greenwood Pond, and Halfmoon Pond in addition to the headwaters of Long Pond as mapped by the US Geological Survey (Stekl & Flanagan, 1988). Saturated thickness was indicated as mostly between 0 to 20 ft; and the aquifers' transmissivities rangefrom lessthan1,000 togreaterthan4,000ft^2/day.Byreceivinggroundwaterfrom stratifieddriftaquifers KingstonLake is a discharge point for these stratified drift aquifers. Any contamination in these aquifers will move quickly due to the high transmissivity of the material and enter Kingston Lake and other surface waters. Therefore, protection of the aquifer is vital to the protection of thelake.

3.1.4.2 Soils and Erosion Hazard

The soils in the Kingston Lake watershed (Appendix A, Map A-7) are a direct result of geologic processes. Of the 23 different soil series present within the Kingston Lake watershed (excluding soils beneath waterbodies), the most prevalent soil group in thewatershedis Chatfield-Hollis-Cantoncomplex, rocky (1,033 acres, 19% of the watershed area),followed by Canton fine sandyloam,verystony(1,013acres,19%),Hennikerloamysand (924acres, 17%),and Freetownmuckypeat (520acres,10%).

Chatfield-Hollis-Campton complex, Canton fine sandy loam and Henniker loamy sand are well drained, while Freetown mucky peat is very poorly drained. The remaining 36% of the watershed (excluding areas identified with soil as "water") is a combination of 19 additionalsoil series rangingfrom 5%to 0.07% of thewatershed.

Soil erosion hazard is dependent on a combination of factors, including land contours, climate conditions, soil texture, soil composition, permeability, and soil structure (O'Geen et al., 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 primarilylow-lyingwetlandareasnearabuttingstreams.Thesoilerosionhazardisdeterminedfromtheassociatedslopeand soil erosion factor K_w[4] used in the Universal Soil Loss Equation (USLE). The USLE predicts the rate of soil loss by sheet or rill erosion in units of tons per acre per year. A rating of "slight" specifies erosion is unlikely to occur under standard conditions. A rating of "moderate" specifies some erosion is likely and erosion-control measures may be required. A rating of "severe" specifies erosion is very likely and erosion-control measures and revegetation efforts are crucial. A rating of "very severe" specifies significant erosionislikelyandcontrolmeasuresmaybecostly. Theseratingsarederivedas partoftheSoilErosion HazardOff-Road/Off-Trail foreachsoilseries.Excludingsoils identifiedas"water","moderate"erosionhazardareasaccount for 43.0% of the Kingston Lake watershed and"slight"erosion hazardareas accountfor46.5% of thewatershed (Appendix A, Map A-8). No areas of the Kingston Lake watershed are identified as having severe or very severe erosion hazard based on soils andslopes (excluding development). Development should be restrictedin areas with moderateto more severe 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 greater negative impact on water quality, more effort and investment are required to maintain its stability and function within the landscape, particularly from BMPs that protect steep slopes from development and/or prevent stormwater runoff from reaching water resources.

3.1.4.3 Shoreline Erosion

Water level fluctuations in lakes and ponds can occur on long- and short-term timescales due to naturally changing environmental conditions or as a response to human activity. The effect of lake level fluctuation on physical and environmental conditions depends on several factors including the degree of change in water level, the rate of change, seasonality, and the size and depth of the waterbody (Leira & Cantonati, 2008; Zohary & Ostrovsky, 2011). Changes in lake level canimpactfloraandfaunamainlybyalteringavailablehabitat,impactingnestinglocations,andalteringavailablefood sources. In addition to impacts to the biological communities, lakes can experience physical impacts on water quality from

[4] K_w =thewholesoil k factor.Thisfactorincludesbothfine-earthsoil fractionandlargerock fragments.

changes in lake level. Frequent lake level fluctuations can impact the shoreline, leading to erosion and increased sedimentationinnear-shorehabitats,inhibitinglightpenetrationandalteringwaterclarity.Exposedshorelinesedimentthat is inundated at high water levels can release phosphorus, leading to alterations in nutrient accumulation and algae populations.Highandlowwaterlevelscanhavedetrimentaleffectsonwatersystems,sofindingabalanceinmanagingwater level atappropriatetimesthroughouttheyeariscriticaltomaintaining ahealthywaterbodyforbothrecreationalenjoyment and aquaticlife use. Management strategies becomeeven morechallengingwhen considering the impact of increased wake boating and extreme weather events (droughts and storms) on water level. Residents of Kingston Lake have expressed concern about enhanced shoreline erosion caused by boat wakes.

3.1.5 Wastewater

3.1.5.1 Septic Systems

> **How Old is Your Septic System?**
>
> Unsure of the age or status of your septic system? Don't worry! You can investigate the age of your septic system by searching your street address on the NHDES Subsurface Application Status OneStop. We recommend entering the town and street name into the query to pull up your property. The approval date associated with your property should reflect how old the system is. Sometimes there is no data on the State's database. This might mean there was a clerical error, or your system is older than the database itself. In this case, call a licensed septic inspector, who can identify the location and status of your septic system. Inspections should be routinely performed every few years, toinform youof thestatus ofyoursystem and toensureit is not failing or underperforming. Pumping the septic tank every 1-3 years can also ensure proper function.

Untreated discharges of sewage (domestic wastewater) are prohibited regardless of source. An example of an NPS discharge of untreated wastewater is from insufficient or malfunctioning subsurface sewage treatment and disposal systems, commonly referred to as septic systems, but which also include holding tanks and cesspools. When properly designed, installed, operated, and maintained, septic systems can reduce phosphorus concentrations in sewage within a zone closetothesystem (depending onthe development and maintenance of an effective biomat, the adsorption capacity of the underlying native soils, and proximity to a restrictive layer or groundwater). Age, overloading, or poor maintenance can result in system failure and the release of nutrients and other pollutants into surface waters (EPA, 2016). Nutrients from insufficient septic systems can enter surface waters through surface overflow or breakout, stormwater runoff, or groundwater.Cesspools areburiedconcretestructuresthatallowsolidsludgetosinktothebottomandsurfacescumtorise to the top and eventually leak out into surrounding soils through holes at the top of the structure. Holding tanks are completely enclosed structures that must bepumped regularly to prevent effluent back-up into the home.

Septic systems along the shoreline pose a great risk to water quality due to the proximity of the septic drainfield to the waterbody compared to others in the watershed. In a conventional septic system, household waste is held in a septic tank, which separates liquids, solids, and oils. Wastewater then flows to the drainfield, where it is dispersed into the soil for treatment through natural filtration. Although the primary public health concern is pathogen treatment, nutrients such as nitrogen and phosphorus are also present in wastewater and pose a risk to water quality if there is inadequate nutrient removal. Since septic systems rely on the soil to treat nutrients, the characteristics of the soil are incredibly important to the transport of nutrients from septic systems to waterbodies. For example, septic systems in coarse-textured soils, soils with shallowwatertable,orbedrocktendtohavealowercapacitytotreatnutrients.Septicsystemscanalsofailastheyage,which leads to wastewater ponding at the drainfield surface. This is largely a public health issue, due to the pathogens in the wastewater, but failing septic systems near the shore can also pose significant nutrient loading issues especially if there is a downslope path wherethe water can beeasilytransported to a waterbody.

Within 250 ft of theKingstonLake shoreline, 93 ofthe 141 total parcels are presumedtohave a septicsystem.Parcelsthat do not havesepticsystems includeundevelopedland,boat launches,rights of way,orhavea septicsystem outsideof the250 ft zone. Over half of the shoreline septic systems (54 systems, or 58%) have a NHDES operating permit, which are accessible either through the NHDES OneStop Database or the Town of Kingston assessing website. Seasonal homes have largely been converted to year-round use along the Kingston Lake shoreline. However, some seasonal homes are required to remain seasonal as a condition of approval for their septic permit and remain as summer cottages today. Many septic systems were originallyconstructedbeforestrictregulationsonsetbackdistancesbetweensepticsystemsandtheKingstonLakeshoreline existed. As they are replaced, most shoreline parcels have septic drainfields located as far from the shoreline as possible based on their property lines. However, older systems may still operate close to the shore if constructed before today's regulations existed.

Septic systems within 250 ft of the shoreline of Kingston Lake are generally old. The median age of systems with an NHDES operatingpermitis19years.Whenconsideringsystemswithoutpermitson file,themedianageofsepticsystemsisestimated to be 27years.Systems without permits were assumedtohave never been replaced, which wouldmeantheageof thehome is the age of the system. Septic systems have a lifespan of 20-25 years before they typically fail and must be replaced. Of the 93 systems presumed to exist, 49 (53%) are older than 25 years old. Only 11 systems (12%) have been replaced in the past decade, with 3 replacements (3%) in the past five years. Given that most homes along the shoreline were built in the mid to late1900s,itisfairtoassumethatmanyshorelinesepticsystemshaveexceededtheirtypicallifespanandarepronetofailure or are already failing.

Due to the small lot sizes in some areas within 250 ft of theshore, some parcels have septic system designs that differ from a conventional septic system. Some parcels have begun to use clustered systems to manage their wastewater. These systems useonelargedrainfieldtotreat thewastewaterfrommultiplehomes andareoftenseeninareas withsmalllotsthatarepart ofthesamesubdivision.Clusteredsystemsarealsousedonparcelswithmultiplecabinsorcamps.Insteadofhavingmultiple drainfieldsforeachstructure,thisapproachallowsthesingulardrainfieldtobesitedfarfromtheshorelineasthewastewater is pumped from septictanks serving each structure to onelocation.

Also present along the shoreline are a few dry well systems. Dry wells are seepage pits filled with a concrete cylinder for wastewater dispersal. Dry wells are well-suited for the disposal of wastewater but may not treat nutrients as well as a conventional system because they tend to have less vertical distance before the wastewater reaches the water table. Dry wells also hydrologically function best in coarse-textured soils, which have limited capacity to retain nutrients such as phosphorus.

The Clean Solution System Model 250 ST by Wastewater Alternatives, Inc. has been installed in a few locations withsmall lot sizes. Advancedtechnologiessuchas this require a smallfootprint areaforthedrainfield, which makes them usefulforsmall lots. The Clean Solution System treats wastewater for biological oxygen demand (BOD) and total suspended solids (TSS) before dispersal into a conventional drainfield. Many advanced technologies also remove nutrients such as nitrogen within the treatment unit. However, review of the brochure for the system shows that there is no mention of nutrient reductions from this technology[5].

The remaining systems are conventional systems and utilize the soil for nutrient and pathogen treatment. Certain soil characteristics tend to lead to more robust nutrient treatment than others. Particularly, coarse-textured soils have a low capacity to treat nutrients (particularly phosphorus), as do soils with shallow separation distances to groundwater or bedrock.Septicsystemdesigns availableontheTownofKingstonassessing websiterevealthesoilcharacteristicsoftestpits dug at the site of each septic system. Most systems are located on well-drained soils, apart from a few with comparatively shallowwatertables.Forreference,onlyfoursystemshada seasonalhigh-watertablelocatedlessthanthree ftfromthesoil surface; typically having at least three ft of soil above the seasonal high groundwater table is considered necessary for adequate phosphorus treatment. These systems often utilize a raised system to achieve a greater vertical separation distance. In about 51% of test pits, site evaluators were unable to locate the seasonal high-water table or another restrictive layer up to a depth of 6 to 16.5 ft. Regarding the treatment of nutrients, having greater depths of unsaturated soils in the drainfield typically indicates better nutrient removal.

ThesoilsalongtheKingstonLakeshorelinearecoarse.Mostsiteevaluationsfoundatopsoillayeroffinesandyloamorloamy sand that overlays medium sand or gravelly sand. Coarse-textured soils such as sand and gravel have less ability to retain nutrients like phosphorus because of the limited surfacearea on each mineral, which is where phosphorus retention occurs. They are also generally less likely to have high concentrations of iron and aluminum, which are essential to phosphorus retention in the drainfield. Fine-textured soils such as the fine sandy loam topsoil are more biologically active and have greater surfacearea toretainphosphorus. However, theseptic drainfields along theKingston Lake shoreline are designed to have this topsoil layer removed during construction. Because of this, wastewater that enters these septic drainfields is only treated by sand and gravel which have a limited capacity to retain phosphorus. The universal presence of coarse sand and

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[5] http://www.thecleansolution.com/brochure03.pdf

gravel likely indicates that septic systems within 250 ft of the lake may pose a phosphorus loading risk along the shoreline due to thecoarse-textured soils found in thedrainfields.

Septicsystemscanimpactwaterqualitynomatterwheretheyareinthewatershed.KingstonLake'sshorelinesepticsystems may pose a nutrient loading concern because of their age and the coarse-textured soils they are located on, which do not treat nutrients as well as other soil textures. The design standards for septic systems often involve removing finer-textured topsoillayerswhich mayhavea bettercapacitytoretainnutrients.Therefore,somenutrient retentioncapacityis lostduring septicsystem construction. Many septicsystems arealsoat risk of failuredue totheir age. Routine inspections and pumping of the septic tank can identify failures and allow the system to function for its entire lifespan. Proper placement of septic systems during design and installation can ensure they are located away from the lake shoreline and on soils suitable for nutrient removal. Systems without permits make up about 42% (39 systems) of the total amount of shoreline systems. Little is known about these systems, though it is possible that they were installed before septic regulations were created and/or may have primitive designs that are ill-suitedtotreat nutrients.

FBE estimated the pollutant loading from shoreline septic systems using default literature values for daily water usage, phosphorus concentration output per person, and system phosphorus attenuation factors. The number of people using shoreline septic systems was calculated by multiplying the number of "old" (>25 years) and "young" (<25 years) shoreline septicsystems usedseasonally or year-round bythe number of bedrooms (as a surrogate fortheaverage numberof persons usingthesepticsystems).Asdetailedinthe Kingston Lake Lake Loading Response Model Report (FBE,2024a),shorelineseptic systemscontribute26.5kg/yroftotalphosphorusloadingtoKingstonLake,comprising9%ofthetotalphosphorusloadfrom all sources to the lake. Septic systems, cesspools, or holding tanks are located within a short distance to the water, leaving little horizontal (and sometimes vertical) space for proper filtration of wastewater effluent. Improper maintenance or siting of thesesystems can cause failures, which leach untreated,nutrient-rich wastewater effluent directly tothe lake.

3.1.6 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. The Town of Kingston fertilizes Kingston Town Plains, Kingston Parks & Recreation(24MainStreet),ChaseStreetRecreationalFields,PineGroveCemeteryonDanvilleRoad,andPlainsCemeteryon Cemetery Lane.

3.1.7 Pets

In residential areas, fecal matter from pets can be a significant contributor of nutrients to surface waters. Each dog is estimated to produce 200 grams of feces per day, which contain concentrated amounts of phosphorus (CWP, 1999). If pet fecesarenot properlydisposed,thesenutrients canbewashedofftheland andtransportedtosurfacewatersbystormwater runoff. Pet feces can also enter by direct deposition of fecal matter from pets standing or swimming in surfacewaters.

3.1.8 Agriculture

Agriculture in the Kingston Lake watershed is minimal (<1%) and includes some cropland, grazing areas, and hayfields. Agricultural activities, including dairy farming, raising livestock and poultry, growing crops, and keeping horses and other animals for pleasure or profit,involve managing nutrients.

Agricultural activities andfacilities withthe potentialto contribute to nutrient impairment include:

- Plowing and earthmoving;
- Fertilizer and manure storageand application;
- Livestock grazing;
- Animal feeding operations and barnyards;
- Paddock and exercise areas for horses and otheranimals;and
- Leachatefrom haylage/silagestoragebunkers.

Diffuserunoffoffarmanimalwastefromlandsurfaces(whetherfrommanurestockpilesorcroplandwheremanureisspread), aswellasdirectdepositionoffecalmatterfromfarmanimalsstandingorswimminginsurfacewaters,aresignificantsources of agricultural nutrient pollution in surface waters. Farm activities like plowing, livestock grazing, vegetation clearing, and vehicle trafficcan also result in soil erosion which can contribute to nutrient pollution.

Excessiveorill-timedapplicationof fertilizerorpoorstoragewhich allows nutrientstowashawaywithprecipitationnot only endangers lakes and other waters, it also means those nutrients are not reaching the intended crop. The key to nutrient application isto apply theright amount of nutrients at theright time.When appropriately appliedtosoil,syntheticfertilizers or animal manure can fertilize crops and restore nutrients to the land. When improperly managed, pollutants in manure can entersurfacewatersthroughseveralpathways,includingsurfacerunoffanderosion,directdischargestosurfacewater,spills and other dry-weather discharges, and leaching into soiland groundwater.

3.1.9 Future Development

Understanding population growth, and ultimately development patterns, provides critical insight to watershed management,particularlyasitpertainstolakewaterquality. AccordingtotheUSCensusBureau,KingstonandDanvillehave experienced moderate but slowing population growth over the last 50 years, increasing from a total of 3,806 people in 1970 to 10,610 people in 2020 (see Section 2.3.2). The Kingston Lake watershed area has long been treasured as a recreational haven for both summer vacationers, young campers, and year-round residents. The area offers fishing, hiking, boating, sailing, canoeing, kayaking, and swimming in the summer, and ice fishing, cross-country skiing, snowshoeing, and snowmobiling in the winter. The desirability of Kingston Lake and the greater New Hampshire Seacoast area as recreational destinations and full-time residence will likely stimulate continued population growth in the future. Growth figures and estimatessuggestthattownsshouldcontinuetoconsidertheeffectsofcurrentmunicipalland-useregulationsonlocalwater resources. As the region’s watersheds are developed, erosion from disturbed areas increases the potential for water quality decline.

3.2 INTERNALPHOSPHORUSLOAD

Phosphorus that enters the lake and settles to the bottom can be re-released from sediment under anoxic conditions, providing a nutrient source for algae, cyanobacteria, and plants, otherwise known as internal phosphorus loading. The watershedmodelinginSection2.3identifiedinternalphosphorusloadasarelativelyminorsourceofphosphorustoKingston Lake though more data are encouraged to determine the internal phosphorus loads from Long and Greenwood Ponds.

3.3 POTENTIALCONTAMINATIONSOURCES

Point source (PS) pollution can be traced back to a specific source such as a discharge pipe from an industrial facility, municipal treatment plant, permitted stormwater outfall, or a regulated animal feeding operation, making this type of pollution relatively easy to identify. Section 402 of the CWA requires all such discharges to be regulated under the National Pollutant Discharge Elimination System (NPDES) program to control the type and quantity of pollutants discharged. NPDES is the national program for regulating pointsources through issuance of permit limitations specifying monitoring, reporting, and other requirements under Sections 307, 318, 402, and405 of theCWA.

NHDES operates and maintains the OneStop database and data mapper, which houses data on Potential Contamination Sources (PCS) within the State of New Hampshire. Identifying the types and locations of PCS within the watershed may help identify sources of pollutionand areas totarget for restoration efforts.

On July 7, 2023, FBE downloaded datasets for aboveground storage tanks, underground storage tanks, automobile salvage yards, solid waste facilities, hazardous waste sites, local potential contamination sources, NPDES outfalls, and remediation sites in the Kingston Lake watershed. Out of the eight possible categories, five occur in the watershed: remediation sites, hazardous waste generators, underground storage tanks, aboveground storage tanks, and local potential contamination sources (Appendix A, MapA-9).

3.3.1 Hazardous Waste Sites

Hazardous waste generating facilities are identified through the EPA’s Resource Conservation and Recovery Act (RCRA) and either require federal or state regulation. None of the four hazardous waste generating facilities within the Kingston Lake watershed are listed as active; three are inactive; and one is declassified.

3.3.2 Underground storage tanks

The underground storage tank layer identifies the locations of registered underground storage tanks in New Hampshire. There are seven underground storage tanks within the Kingston Lake watershed; four are located at two gas stations, and three are located at theFormer Sanborn Regional High School (1) and theDanville Elementary School (2).

3.3.3 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 is only one aboveground storagetank within the Kingston Lake watershed, locatedat a petroleum distribution facility in Kingston.

3.3.4 Local Potential Contamination Sources

Localpotentialcontaminationsourcesaresitesthatmayrepresentahazardtodrinkingwaterqualitysuppliesduetotheuse, handling, or storage of hazardous substances. There may be overlap between local potential contamination sources and otherPCSidentifiedinthissection.Ofthe sixlocalpotentialcontaminationsourceswithinthe KingstonLakewatershed,four can be foundamongst theheadwater streams of Long Pond, and two canbe foundalong NH Route 111.

3.3.5 Remediation sites

The 21 remediation sites present within the Kingston Lake watershed consist of holding tanks (2), leaking underground storagetanks (3), on-premises usefacilities (7),spill or release sites (1), underground injection control (4),and other(4).

3.4 WILDLIFE

Fecal matter from wildlife such as geese, gulls, other birds, 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). Congregations of geese, gulls, and ducks are of concern because they often deposit their fecal matter next to or directly into surface waters. Examples include large, mowed fields adjacenttolakesandstreamswheregeeseandotherwaterfowlgather,aswellastheundersideofbridgeswithpipesorjoists directlyoverthewaterthatattractlargenumbersofpigeonsorotherbirds.Studiesshowthatgeeseinhabiting **riparian**areas increase soil nitrogen availability (Choi et al., 2020), and gulls along shorelines increase phosphorus concentration in beach sand pore water that then enters surface waters through groundwater transport and wave action (Staley et al., 2018). 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 et al., 2019). On a global scale, fluxes of nitrogen and phosphorus from seabird populations have been estimated at 591 Gg N per year and 99 Gg P per year, respectively (with the highest values derived from arctic and southern shorelines) (Otero et al., 2018). Additionally, other studies show greater concentrations of nitrogen, ammonia, and dissolved organic carbon downstream of beaver impoundments when compared to similarstreams with nobeaver activity in New England (Bledzki et al., 2010).

The model estimated that waterfowl are likely contributing 6.7 kg/yr (2%) of the total phosphorus load to Kingston Lake. Beaches along the shoreline of Kingston Lake have notable issues with geese congregations. The Town of Kingston also identifiedbeaverdamsasasignificantconcerninthewatershed.BeaverdamswerenotedalongthePowwowRiver,between Greenwood Pond and Kingston Lake, and between Halfmoon Pond and Kingston Lake.

3.5 CLIMATECHANGE

Climate change will have important implications for water quality that should be considered and incorporated into WBMPs. In the last century, New England has already experienced significant changes in stream flow and air temperature. Out of 28 rural stream flow stations throughout New England, 25 showed increased flows over the record likely due to the increase in frequencyof extremeprecipitationandtotalannualprecipitationintheregion.In 79years of recordedflooding intheOyster River in Durham, NH, three of the four highest floods occurred between 2007-2016 at that time (Ballestero et al., 2017). Mean annual maximum temperatures in New Hampshire have increased 2.0 °F since 1971. Mean annual minimum temperature in New Hampshire has increased 3.1 °F since 1971. There is also significantly more warming occurring in the fall and winter seasons (Lemcke-Stampone, Wake, & Burakowski, 2022). Lake ice-out dates are occurring earlier as warmer winter air temperature melts the snowpack and lake ice; earlier ice-out allows a longer growing season and increases the duration of anoxia in bottom waters. Increasing storm frequencies will flush more nutrients to surface waters for algae to feed on and flourish under warmerair temperatures. Thesetrends will likely continue toimpact both waterqualityand quantity.Climate change models predict a 10-40% increase in stormwater runoff by 2050, particularly in winter and spring and an increase in both flood and drought periods as seasonal precipitation patterns shift. Adding to this stress is population growth and corresponding development in New Hampshire. The build-out analysis for the watershed showed that about 2,220 acres is still developable and up to 414 new buildings could be added to the watershed at full build-out based on current zoning standards. Kingston Lake is at serious risk for sustained water quality degradation because of new development in the watershed unless climate change resiliency and **low impact development** (LID) strategies are incorporated into existing zoning standards.

YMCA Camp Lincoln Work

Erosion issues documented at the YMCA Camp Lincoln have been increasing in severity in recent years due to more frequent and intense storm events. To mitigate this source of nonpoint source pollution to Kingston Lake, the Southern District YMCA received a Community Grant from the EPA to install Best Management Practices to reduce erosion. Practices to be installed include infiltration steps,enhancingthenativeplantbuffer,avegetated swale, and erosion control mulch. In May 2024, volunteers from Bangor Savings Bank constructed the vegetated swaleand began adding native plants to the property. The rest of the project will be completed infall 2024.

Volunteercrewshelping toimplementstormwaterand erosionBMPsintheYMCACampLincolnbeacharea. Photocredit:FBE

4 MANAGEMENT STRATEGIES

Thefollowingsectiondetailsmanagementstrategiesforachievingthewaterqualitygoalandobjectivesusingacombination 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 STRUCTURALNONPOINTSOURCE(NPS)RESTORATION

Structural NPS restorationtechniques are engineered infrastructuredesignedtointercept stormwaterrunoff, oftenallowing 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 BMPs 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 inturn reduces the volume of pollutedrunoff generated,minimizing adverse impacts to receiving waters.

4.1.1 Watershed & Shoreline BMPs

Fifty-five (55) NPS sites identified during the 2023 watershed survey and fifty-nine (59) high/medium impact rated shoreline properties from the 2023 shoreline survey were documented to have some impact to water quality through the delivery of phosphorus-laden sediment (refer to Section 3.1.1-3.1.2). As such, structural BMPs to reduce the external watershed phosphorus loadare a necessary and important component for theprotection of water quality in the watershed.

The following series of BMP implementationaction items are recommended for achieving Objective 1:

- Address the top five high priority sites (and the remaining 50 sites as opportunities arise) identified during the 2023 watershed survey. The sites were ranked based on phosphorus load reduction and waterbody proximity. The full prioritization matrix with recommended improvements isprovided in Appendix B.
- Provide technical assistance and/or implementation cost sharing to one high impact and nine medium impact shoreline properties identified during the 2023 shoreline survey. High and medium impact properties received shoreline disturbance score 11-12 and 9-10, respectively. Encourage landowners to implement stormwater and erosion controls on the 49 low impact shoreline properties identified during the 2023 shoreline survey (shoreline disturbance score of 7-9). Workshops and tours of demonstration sites can help encourage landowners to utilize BMPs on their own property. Conduct regular shoreline surveys to continue prioritizing properties for technical follow-up.

For the proper installation of structural BMPs in the watershed, the committee 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 BMP installed. More specific and additional recommendations are included in Section 5. For helpful tips on implementing BMPs, see Additional Resources.

4.2 NON-STRUCTURALNONPOINTSOURCE(NPS) RESTORATION

Non-structural NPS 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,septicsystemregulation, sanitarysewersystem inspections,fertilizeruseprohibition, pet wastemanagement, agricultural practices, andnuisance 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* (NHDES, 2008) for standard road design and maintenance best practices.

Both watershed towns are required to comply with the six minimum control measures under the New Hampshire Small MS4 General Permit. Kingston is actively involved in maintaining sound stormwater practices through monthly meetings between the town and environmental engineers regarding stormwater practices and according to the town DPW director, Kingston has never had an infraction. An inspection of the town's stormwater infrastructure is conducted annually by an independent contractor. During the inspection, the 136 town-owned drain structures, including 50 catch basins and 37 MS4 regulated outfalls, are cleaned and maintained. This includes the four outfalls discharging to Kingston Lake. If a catchbasin is found to be more than 50% full for two consecutive years, the area is investigated for sources of excessive sediment loading. Danville partners with Comprehensive Environmental, Inc. to monitor and clean catch basins once per year. Additionally, Beach Plain Road, GH Carter Drive, Hersey Road, Kingston Road, Long Pond Road, and Main Street in Danville are swept once per year.

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. Kingston has a street sweeping program to sweep all curbed streets and curbed parking lots within the MS4 area, though this does not include areas within the Kingston Lake watershed. It would be beneficial to street sweep all roads and at a more frequent interval throughout the winter and spring within the watershed area, though the practice can be prohibitively expensive for communities. 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/or training for residents, municipal staff, and stormwater operators, all of which are aimed at minimizing polluted runoff to surface waters. The Town of Kingston also indicated that grass clippings and other organic debris are swept away from impervious areas, surface waters, and catch basins. Salt storage piles are enclosed or covered. The Town of Kingston is sensitive to calibrating salt trucks for proper application on Great Pond Road, Ball Road, and Rockrimmon Road in the watershed.

4.2.2 Zoning and Ordinance Updates

Regulations through municipal zoning and ordinances such as LID strategies that prevent polluted runoff from new and re-development projects in the watershed are equally important as implementing structural BMPs on 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 towns of Kingston and Danville (Table 13). These towns have already incorporated several important regulations into their ordinances (see Kingston in the Example Town Ordinances call-out box to the right). A more robust review of these ordinances is encouraged for more specific recommendations on improving ordinances and regulations related to natural resource protection. The towns should also consider its staffing capacity to enforce existing and proposed regulations.

Example Town Ordinances

1. Shoreland Protection District: Kingston, NH
2. Septic pump-out regulations: Sunapee, NH
3. Zoning overlay districts for environmental protection: Kingston, NH; Portsmouth, NH
4. Wetland protection zoning: Hampton, NH
5. Zoning for groundwater protection: NHDES Model Ordinance, Rollinsford, NH
6. Protection of steep slopes for water quality: Holderness, NH
7. Low impact design: Bedford, NH
8. Fertilizer and pesticide use: Portsmouth, NH

Local land use planning and zoning ordinances should consider incorporating climate change resiliency strategies for protecting water quality and improving infrastructure based on temperature, precipitation, water levels, wind loads, storm surges, wave heights, soil moisture, and groundwater levels (Ballestero et al., 2017). There are nine strategies which can aid in minimizing the adverse effects associated with climate change and include the following (McCormick and Dorworth, 2019).

- **Installing Green Infrastructure and Nature-Based Solutions:** Planning for greener infrastructure requires that we think about creating a network of interconnected natural areas and open spaces needed for groundwater recharge, pollution mitigation, reduced runoff and erosion, and improved air quality. Examples of green infrastructure 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. 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 LID Strategies:** Use of LID strategies requires replacing traditional approaches to stormwater management using curbs, pipes, storm drains, gutters, and retention ponds with innovative approaches such as bioretention, vegetatedswales,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 for their lots by incorporating permeable driveways and walkways.
- **Encouraging Riparian Buffers and Maintaining Floodplains:** Municipal ordinances should forbid construction in floodplains,andinsomeinstances,floodplainsshouldbeexpandedtoincreasethelandareatoaccommodatelarger rainfall events. Riparian (vegetated)buffers and filter strips along waterways should be preserved and/or created to slow runoff andfilter pollutants.
- **ProtectingandRe-establishingWetlands:** Wetlandsareincreasinglyimportantforpreservationbecausewetlands hold water, rechargegroundwater, and mitigate water pollution.
- **EncouragingTreePlanting:**Treeshelpmanagestormwaterbyreducingrunoffandmitigatingerosionalongsurface waters. Trees alsoprovide critical shading and cooling tostreams andland surfaces.
- **Promoting 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 et al., 2012).
- **SlowingDowntheFlowofStormwater:**Toslowandinfiltratestormwaterrunoff,roadsideditchescanbearmored or vegetatedandequipped with turnouts,settlingbasins,check dams, orinfiltrationcatch basins.Raingardens can retainstormwater,whilewaterbarscandivert waterintovegetatedareasforinfiltration.Waterrunning off roofs can be channeled into infiltrationfields and drainagetrenches.
- **Coordinating Infrastructure, Housing, and Transportation Planning:** Coordinate planning for infrastructure, housing, and transportation to minimize impacts on natural resources. Critical resources including groundwater must beconserved and remain free of pollutants especiallyas 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 future generations. For Kingston Lake, 16% (877 acres) of the watershed has been classifiedasconservationland(refertoAppendixA,MapA-10).MajorconservedareasincludetheDanvilleTownForest,NRCS ACEP-WRE 13, Cheney-Griffin Town of Kingston #6, the Rock Rimmon State Forest, the Phyllis Massey Stafford Conservation Area, and the Kingston Lake State Park. All these areas occur in the northern part of the watershed, with contiguous conservation land between the Danville Town Forest and Phyllis Massey Stafford Conservation Area, as well as the NRCS conservation area withthe Rock Rimmon StateForest andthe Town of Kinston #6 Cheney-Griffin property.

Local groups should continue to pursue opportunities for land conservation in the Kingston Lake watershed based on the highestvaluedhabitatidentifiedbytheNewHampshireFish&Game(NHFG). NHFGrankshabitatbasedonvaluetotheState, biological region (areas with similar climate, geology, and other factors that influence biology), and supporting landscape. Thesehabitatrankings arepublishedintheState's 2015WildlifeActionPlan(withupdatedstatisticsanddatalayersreleased inJanuary2020),whichservesasablueprintforprioritizingconservationactionstoprotectSpeciesofGreatestConservation Need in New Hampshire. The Kingston Lake watershed is split between the Gulf of Maine Coastal Lowland and Gulf of Maine CoastalPlainecoregions (NHFG,2015).Approximately219acres (4%) of theKingstonLake watershedareconsideredHighest Ranked Habitat in New Hampshire. There is considerable overlap of Highest Ranked Habitat in New Hampshire and conservationlandwithinthewatershed.A mapof priorityhabitats forconservationbasedontheNHWildlifeActionPlancan be found in Appendix A, MapA-11.

4.2.4 Septic System Regulation

When properly designed, installed, operated, and maintained, septic systems can treat residential wastewater and reduce theimpactofexcesspollutantsingroundandsurfacewaters.Itisimportanttonote,however,thattraditionalsepticsystems 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 recycled in plant growth but is not removed entirely from the watershed system. Nutrient removal can only be achieved through more expensive, alternative septic systems. Proper design, installation, operation, maintenance, and replacement considerations includethe following:

- 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.);
- Propersitingand**installation** meanthatthesystemisinstalledinconformancewiththeapproveddesignandsiting requirements (e.g., setbacks from waterways);
- Proper **operation** includes how the property owner uses the system. While most systems excel at treating normal domestic sewage, disposingof 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 health threats; proper operation also includes how the property owner protects the system;allowingvegetationwithextensiverootstogrowabovethesystemwillclogthesystem;drivinglargevehicles over the system maycrush orcompact piping or leaching structures;
- Proper**maintenance**meanshavingthesepticktankpumpedatregularintervalstoeliminateaccumulationsofsolids and grease in the tank; it may also mean regular cleaning of effluent filters, if installed. The frequency of septic pumping is dependent on the use and total volume entering the system. A typical 3-bedroom, 1,000 gallon tank should be pumpedevery 3 years or more frequently ifwithin the shoreland zone;
- Proper **replacement** of failed systems, which may include programs or regulations to encourage upgrades of conventional systems (or cesspools and holding tanks) tomore innovative alternative technologies.

Management strategies forreducingwaterqualityimpactsfrom septicsystems (as wellas cesspools andholdingtanks)start with education and outreach to property owners so that they are better informed to properly operate and maintain their systems.Othermanagementstrategies includesetting local regulations for enforcing proper maintenance andinspection of septic systems and establishing funding mechanisms to support replacement of failing systems (with priority for cesspools and holding tanks).

4.2.5 Fertilizer Use Prohibition

Management strategies forreducing waterqualityimpactsfrom residential,commercial, andmunicipal fertilizerapplication start with education and outreach to property owners. New Hampshire law prohibits the use of fertilizers within 25 ft of a surface water. Outside of 25 ft, property owners can get their soil tested before considering application of fertilizers to their lawnsandgardenstodeterminewhethernutrientsareneededandifsoinwhatquantityorratio.Asoiltestkitcanbeobtained through theUNH Cooperative Extension. Many New England communities are starting to adopt local regulations prohibiting the use of both fertilizers and pesticides, especially near critical waterbodies. The watershed towns could consider a similar prohibition, at the very least for a watershed zoning overlay of major lakes and ponds. The Town of Kingston annually evaluates lawn maintenance and landscaping activities to include reducing fertilizer use and using no or low nitrogen and phosphorus slow-release fertilizers. Fertilizer is applied on an as-needed basis in fall or spring with preference for fall. In the town's Stormwater Management Plan, there is a goal to "establish requirements for the use of slow-release fertilizers on permittee-owned property currently using fertilizer, in addition to reducing andmanaging fertilizer use."

4.2.6 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 walksandproperlydisposingofpetwasteindumpstersorotherrefusecontainers,canmakeadifference. Itisrecommended that pet owners do not put dog and cat feces in a compost pile because it may contain parasites, bacteria, pathogens, and virusesthatareharmfultohumansandmayormaynotbedestroyedbycomposting. "Pooper-scooper"ordinancesareoften 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 usedto encourage compliance withthese ordinances.

4.2.7 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 hobby farms and any larger-scale operations in the watershed. NRCS is a great resource for such outreach and education to farmers. Larger-scale agricultural operations can work with the NRCS to complete a Comprehensive Nutrient Management Plan (CNMP). 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 (by conducting soil tests and determining proper calibration of nutrient application equipment), and ensuring the proper 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 plan is an ongoing process because it is a working document that changes over time.

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. In areas where wildlife is observed to be a large source of nutrient contamination, such as large and regular congregations of waterfowl, a program of repelling wildlife from surface waters (also called harassment programs) may be implemented. These programs often involve the use of scarecrows, kites, a daily human presence, or modification of habitat to reduce attractiveness of an at-risk area. The Town of Kingston has prohibited the feeding of aquatic birds within the Shoreland Protection District to reduce the adverse effects of large populations of aquatic birds on water quality. 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 impacts to water quality. Public education and outreach on prohibiting waterfowl or other wildlife feeding is an important step to reducing the impact of nuisance wildlife on the lake. Kingston State Park has been actively working to control the geese population, including deterring beach nesting and promoting public awareness. The Kingston Town Beach designed fencing with a 6-in opening on the bottom to deter geese but allow turtle migration.

Beaver dam management may also be necessary in the watershed. Beavers repair their dams if they detect the noise or sensation of flowing water through the dam. If the beaver senses the water level is too low upstream of the dam after constructing a dam, they will abandon the dam and find another suitable site to build a dam. In the context of beaver dam management, this could pose additional issues if beavers relocate to another site along the same stream to build a new dam thus creating additional impoundments and greater flooding potential. Investigating the status of beaver dams in the watershed may be useful to determining if beaver dam management is needed. Options for dam management include installing culverts with beaver exclusion fencing (i.e., the Beaver Deceiver design) and/or other beaver deterrents to maintain a lower water level in the lower dam's pooling area. If the dam is present and active, a more advanced design such as the Clemson Pond Leveler may be necessary to regulate the water level above and below the dam to prevent washouts. The Clemson Pond leveler deceives beavers by releasing water inconspicuously such that beavers are not triggered to repair the dam (thus impounding more water). Physically maintaining the dams to ensure they are not built too high is also a viable option.

Table 13. Ordinance review summary of regulatory and non-regulatory tools for naturalresource protection in Kingston and Danville, New Hampshire.

STRATEGY		KINGSTON	DANVILLE	RECOMMENDATION
REGULATORY TOOLS	Shorelandzoni	5,) ft ftof ack for tative dwaste disposal, andthe disposal/storage ofhazardous materials.	to , ery poorlydrainedsoils, establishes75 ft setback between wetlands andanystructure.	Ifnot present, create a building setback from any Ifnot present, create a building setback from any lake, pond, river, perennial stream, or impoundmentandwetlands of at least 50 ft. Consider expanding the setbackto be greater thanthe state minimum of50 ft from waters greater than 10acor streamsoffourthorderor greater, to possibly100 ft. Consider establishinga vegetatedbuffer requirement ofat least 25 ft along each property'sshoreline.
	elo space or subdivision	"InstallationofWells andSepticSystems" [Article e 3 Buildings andBuilding Lots)indicate each lo have aroadfrontageof200+ ft andminimum of80,000 sqft unlessotherwise the landissubject to a zoning district.	, da the preservationofnatural features andopen space, at least 25% ofcontiguous landarea must be set aside on a minimum lot size of12 acres. No more than four dwellingunits per structure. Discusses setbacks from roads anda 25-foot landscapedbuffer. Establishes criteria for open	e require inspectionsat pointofsale orhome expansion, require certain design criteria in sensitive areas. be recordedin the RegistryofDeeds. Consider increasingthe percentage ofland requiredto be setaside in Danville.

STRATEGY	KINGSTON	DANVILLE	RECOMMENDATION
Zoning districts address environmental protection.	"ShorelandProtection District,""Wetlands Conservation District," "AquiferProtection Ordinance," "Floodplain Development Ordinance," "Groundwater management district"	WetlandConservation District AKAWetlands Ordinance"To controlthe development of structures andland-useson naturallyoccurring wetland. To prevent the destruction ofnatural wetlands which provide wildlife habitat, flood protection, groundwaterrecharge, pollution abatement,andtheaugmentation of stream flow during dryperiods,andwhich are important for such other reasons as those citedin RSA483." Zoning Article VIII	Establish a "Kingston Lake (Great Pond) WatershedOverlayDistrict" where more stringent standards mayapplythat wouldnot be applicable to other waterbodies in the towns. For example, limiting landusesaroundthe shoreline of Kingston Lakeandthe Powwow River to prohibit someofthe non-residential usesstill allowedas part ofthe ShorelandProtection Act. Some overlaydistricts mayinclude stricter standards for development or sewage disposal.
conservation.	"Wetlands Conservation District"[Article 202, effective 1982]applicable to allwetlands and wetlandbuffer zones (buffer size is dependent upon wetlandcharacteristics). Discusses permitted uses, such as conservation areas, forestry, or wildlife refuge, andprohibits new structures withouta conditionaluse permit.	between wetlands andanystructure.	surrounding all wetlands.
Zoning overlaydistricts that protectgroundwater.	The "Aquifer Protection Ordinance" [Article 201, effective 1989]with the goalofencouraginguses that can be safelylocatedin aquifer recharge areas, defines two aquifer areas basedon USGS studies. The ordinancerequires aminimum lot size ofthree (3) acres forresidential development. Minimum lot size for non-residential usesmaybe two (2) acres if locatedoutside ofaquifer zone Aandiswithin a commercial or industrial zoningdistrict. For subdivisions over 10 acres or septic systems with a design flow over 2,400 GPD,ahydrogeologic study must be carriedout. Alot maynot have morethan 15%impervious cover iflocatedin aquifer zone A	None identified. Groundwater ismentionedin the Wetlands Ordinance."To prevent the destructionof natural wetlands which provide wildlife habitat, floodprotection, groundwater recharge, pollution abatement,andtheaugmentation ofstream flow during dry periods,andwhich are important for such other reasons as those citedin RSA483"	Consider implementinga groundwater protection ordinance in Danville similar to that in Kingston with minimum lot sizes, a maximum density per area,and/or withmaximum percent impervious area per lot.

STRATEGY	KINGSTON	DANVILLE	RECOMMENDATION
Protection ofsteep slopes.	None identified.	No steep slope protection ordinance. Slopes are discussedin "Cluster/Open Space Development" [Article IVSection A.3, effective 2005], andin "Senior Housing" [Article IVSection A.5, effective 2005].	Establish a SteepSlope Protection Area including all slopes equal to orgreater than 15%. Some ordinancesonlyapplyto areas with disturbance is greater than a certainarea, andrequire an engineering plan, BMPs,LID techniques, and natural stormwater control measures, and exclude extremelysteep (>25%)slopes from buildable area.
Nutrientloading analysis requiredfor fresh waterbodies.	None identified.	None identified.	Require stormwatermanagement plans or phosphorus control plans to quantify nutrient loading from planneddevelopments andthe estimatedloadreductions fromBMPsandLID
			Update Site Plan Reviewregulations or other
requirements and standards.	stormwater, the storm drainagesystem, or waters ofthe UnitedStates."	None identified.	Update Site Plan Reviewregulations or other ordinancetorequirelow impactdevelopment to the maximum extent practicableto reduce stormwaterrunoffvolumes andmaintain site hydrology. Require or encourageon-site stormwater treatment through vegetationand BMPsto treat pollutants suchassediment, nitrogen, andphosphorus.Require conductinga drainage analysis andother engineeredplans if applicable for a certain site.
Fertilizerand/or pesticide ordinances.	No ordinances,though according to the Town Website, the townannuallyevaluates lawn maintenance andlandscapingactivities to include reducing fertilizer use,using noor low N/P slow-release fertilizers.Theyfertilize at the Kingston	None identified.	Implement a fertilizerordinance.Thismaybe town-wide or withinan overlaydistrict. Stipulations maybe made such that natural fertilizers maybe allowed, or special types of fertilizers maybe usedfor agricultural purposes,

STRATEGY		KINGSTON	DANVILLE	RECOMMENDATION
	Reducing the congreg ofwaterfowl.	"Control andFeeding ofAquaticBirds" [Article 1307, effective 2007] prohibits the feeding of aquatic birds in the ShorelandProtection Distric	None identified.	Model a FeedingofAquatic Birdsarticle for Danville after theone for Kingston with signs postedat waterfrontaccesspoints educating visitors on the implications to water qualityfro feeding andencouraging the congregation of wildlife.
	Implement andenforc Stormwater Managem Plan.	"Stormwater Management" [Article 908, effectiv 2009] requires a stormwater management and erosion control plan for anydevelopment that disturbs over 15,000 sq. ft., involves the constructionofaroad, or isa subdivision ofmo thanthree lots.	"General Provisions" [ZoningOrdinance Article Section E.2.e]requires a Construction Stormwa Management Plan withanyconstruction activit disturbing greater thanoneacreofland, is part RegulatedMS4 area, andisnot associatedwith agricultural use,roadwaymaintenance, or tree trimming.	Decrease the size ofthe areaaffectedby constructionactivities to requirea Stormwate Management Plan in Danville from one acre to 15,000 sqft. In both towns addlanguage to include a plan ifthere will be more than 11,00 ft ofimpervious surfaces.
CONSERVATION FUNDING STRATEGIES	Development transfer overlaydistrict.	None identified.	None identified.	Create a Development TransferOverlayDistric encompassing infrastructure-dense areas and growth areas.Thisoverlaydistrict mayallow a developer to buildatadditionaldensity within these areas upon paymentofa fee, which isth usedto purchase conservation landin areas ric in natural resources orare prioritizedfor conservation.
	Conservation impact	No conservation impact fee, thoughthere is the "Impact Fee Ordinance" [Article405, effective 1991], in which new development is subject to a impact fee basedon theadditional impact to pu resources suchas schools,roads, public safety facilities, andwaste disposal.	No conservation impact fee, thoughthere is the "Impact Fee Ordinance" [ArticleXIV, effective 2 in which new development is subject to an imp fee basedon the additional demandon public resources.	Implement conservation impactfee.
	Wetlandmitigation fu	None identified.	None identified.	Connect with NHDES about Aquatic Resource Mitigation (ARM)funding. There is $4,527,928 i ARM funding available for the Merrimack River

	STRATEGY	KINGSTON	DANVILLE	RECOMMENDATION
	Stormwaterutilitydistric	None identified.	None identified.	Ifmunicipal stormwater management is present, implement a stormwaterutilityfee within a Stormwater UtilityDistrict. The fee is often a single rate chargedto eachhomeowner within th district at the same time as theirproperty taxes. Stormwaterutilityfees cangenerate funds for stormwater infrastructure maintenance, replacement, green infrastructure, andmoreto prevent or mitigatelocalizedflooding, combined sewer overflows,or infrastructure failure.
	Open space ornon-lapsin n f Has a LandUse per RSA79-A:25.	None identified. ent Use Program which includes a fee forlanduse change. Discussedin Open Space Chapter ofMaster Plan.	Yes through Conservation Commission. Yes.Adoptedin 1997 as discussedin Master Plan Chapter 8. Landuse change tax revenue is dedicatedto a Conservation Fundwith the intent of buying parcels oflandto place inpermanent conservation easements.	Establish an open spaceofnon-lapsing Investigate iffunds gatheredin Kingston from landuse change are beinggatheredinto a conservation fund. Consider dedicating alarger percentage ofthe landuse change taxto the conservation fund.
	Participate or collaborate with a local watershed .	Kingston Lake Association, Powwow PondCouncil, CountryPondLake Association	Exeter River WatershedAssociation.	Collaborate withlocal lake associations including the Kingston Lake Association, Long Pond
	Participate or collaborate with a local landtrust.	Friends ofKingston OpenSpace.	Trust for New Hampshire Lands.Societyfor Protection ofNew Hampshire Forests,Southeast LandTrust.	Collaborate with the Southeast LandTrust (SELT) ofNew Hampshire.
NON-	Open space plan.	"Open Space"Chapter ofMasterPlan [2007] includes recommendations for the permanent protection ofopenareas in the Town, suchas the Rockrimmon Area, thearea westofKingston Lake, andthe NorthwestCorneroftheTown. Wetland, water resources,andaquifer protection are prioritized, as well as preservingcontiguous land areasandprime agricultural soils.	"Open Space"Chapter 9ofMaster Plan [2022] includes description ofa ForestManagement Plan [2002],anddiscusses protectingwater resources, farmland, andwetlands.Recommendations from the Open Space Report [2011]are repeated.	Seek funding toupdate the Kingston Open Space Plan.

STRATEGY	KINGSTON	DANVILLE	RECOMMENDATION
AStormwater Management Programor Plan	Yes.Stormwater Management Program completed in 2018 andupdatedin 2021.	Yes.Stormwater Management Plan completedin 2013.	None identified.
Conducta town-wide natural resources inventory.	Completedas part ofthe MasterPlan [2007].	Yes,completedin 1998.	Seek funding toupdate both theKingstonand Danville Natural Resource Inventories.
Incentive-basedprograms for voluntarylow impact development implementation.	None identified.	None identified.	Consider incentive basedprograms that encourage low-impact development.
Incentive-basedprograms for stormwater reduction efforts.	None identified.	None identified.	Consider incentive-basedprograms for stormwaterreductionefforts, such as retrofits or other BMPs.
Have established	Yes.	Yes.	Continue doing great work with the conservation
Incentivize and/or encourage property owners to implement low impact development stormwater practices.	None identified.	None identified.	workshops,or financial incentives.

4.3 OUTREACH &EDUCATION

Awareness through education and outreach is a critical tool to 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. KLA is the primary entity for education and outreach campaigns in the watershed and for development and implementation of the plan. KLA shouldcontinue all aspects of their education and outreach strategies and consider developing new ones or improving existing ones and/or forming new collaborations with other organizations (conservation commissions, neighboring watershed associations, etc.) 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 and through a variety of means, such as websites, newsletters,socialmedia,communityevents,orcommunitygatheringlocations.Additionally,KLAshouldcontinuetoengage with local stakeholders such as conservation commissions, land trusts, municipalities, businesses, and landowners. Educationalcampaignsshouldincluderaisingawarenessofwaterquality,septicsystemmaintenance,fertilizerandpesticide use, pet waste disposal, waterfowl feeding, invasive aquatic species, boat pollution, shoreline buffer improvements, gravel road maintenance, and stormwater runoff controls.

4.4 ADAPTIVEMANAGEMENTAPPROACH

An adaptive management approach, to be employed by the Steering Committee, is highly recommended for protecting Kingston Lake. Adaptive management enables stakeholders to conduct restoration actions in an iterative manner. Through this management process, restoration actions are taken based on the best available information. Assessment of the outcomes following restoration action, through continued watershed and water quality monitoring, allows stakeholders to evaluate the effectiveness of one set of restoration actions and either adopt or modify them before implementing effective measuresinthenextroundofrestorationactions.Thisprocessenablesefficientutilizationofavailableresourcesthrough the combination of BMP performance testing and watershed monitoring activities. Adaptive management features establishing an ongoing program that provides adequate funding, stakeholder guidance, and an efficient coordination of restoration actions. Implementation of this approach ensures that restoration actions are implemented and that surface waters are monitored to document restoration over an extended time. The adaptive management components for implementation efforts should include:

- **Maintaining an Organizational Structure for Implementation.** Communication and a centralized organizational structure are imperative to successfully implementing the actions outlined in this plan. A diverse group of stakeholders through KLA should be assembled to coordinate watershed management actions. This group can includerepresentativesfromstateandfederalagenciesororganizations,municipalities,localbusinesses,andother interested groups or privatelandowners. Refer to Section 6.1: Plan Oversight.
- **Establishing a Funding Mechanism.** A long-term funding mechanism should be established to provide financial resources for management actions. In addition to initial implementation costs, consideration should also be given to the type and extent of technical assistance needed to inspect and maintain structural BMPs. Funding is a key element of sustaining the management process, and, once it is established, the plan can be fully vetted and restoration actions can move forward. A combination of grant funding, private donations, and municipal funding should be used toensure implementation of theplan. Refer to Section 6.3for a list of potential fundingsources.
- **Determining Management Actions.** This plan provides a unified watershed management strategy with prioritized recommendations for restoration using a variety of methods. The proposed actions in this plan should be used as a starting pointfor grant proposals. Oncea fundingmechanism is established, designs forpriority restoration actions on a project-areabasis can be completedand their implementation scheduled. Referto Section 5: ActionPlan.
- **Continuing and Expanding the Community Participation Process.** Plan development has included active involvement of a diversity of watershed stakeholders. Plan implementation will require continued and ongoing participation of stakeholders, as well as additional outreach efforts to expand the circle of participation. Long-term community support and engagement is vital to successfully implementing this plan. Continued public awareness and outreach campaigns will aid in securing this engagement. Refer to Section 4.3: Outreach & Education.
- **Continuing and/or Establish Long-Term Monitoring Programs.** A water quality monitoring program is necessary to track the health of surface waters in the watershed. Information from the monitoring programs will provide feedback on the effectiveness of management practices.Refer to Section 6.4: MonitoringPlan.

- **Establishing Measurable Milestones.** A restoration schedule that includes milestones for measuring restoration actions and monitoring activities in the watershed is critical to the success of the plan. In addition to monitoring, severalenvironmental,social,andprogrammaticindicators have beenidentifiedtomeasureplanprogress.Referto Section 6.5: Indicators to Measure Progress and Section 2.4: Establishment of Water Quality Goal for interim milestones.

StreamintheKingstonLakewatershed.© FBE.

5 ACTION PLAN

5.1 ACTIONPLAN

TheActionPlan(Table14)outlinesresponsibleparties,approximatecosts[6],animplementationschedule,andpotentialfundingsourcesforeachrecommendationwithin the following major categories: (1) Watershed & Shoreline BMPs; (2) Road Management; (3) Municipal Operations; (4) Municipal Land Use Planning & Zoning; (5) Land Conservation; (6) SepticSystem Management; (7) Agricultural Practices; and (8) Education and Outreach.The planis designed tobe implementedfrom 2024-2033and is flexible toallow for new priorities throughout the 10-year implementation period as additional data are acquired.

Table 14. Action plan for theKingston Lake watershed.

		Estimated Cost / Schedule	
Watershed & Shoreline BMPs			
Complete designand construction of mitigationmeasuresat thetop 17 highand medium priority sites identified in the watershedsurvey including adoptingthe conceptual designs forthe Greenwood Pond Town Beach. **Achieves 19% (8.7 kg/yr P of 46.4kg/yr P) of Objective 1 for Kingston Lake and 7% (2.8 kg/yr P of 41.5 kg/yr P) of Objective 1for Long Pond.**	KLA, Municipalities, private landowners	$211K-$421K ($30K-$50K Greenwood Pond Town Beach) 2024-30	CWSRF, Grants (319, Moose Plate, NFWF 5-Star, ILFP), Municipalities, private landowners
Complete designand construction of mitigationmeasuresat 25 low priority sites identified in the watershedsurvey as opportunities arise and monitor the 13 BMP sites already addressedby municipalities (refer toAppendix B for complete list). **Achieves 11% (4.9 kg/yr P of 46.4 kg/yr P) of Objective 1 for Kingston Lake and 6% (2.4 kg/yr P of 41.5kg/yr P) of Objective1 for Long Pond.**	KLA, RCCD, Municipalities, private landowners	$211K-$381K 2024-33	CWSRF, Grants (319, Moose Plate, NFWF 5-Star, ILFP), Municipalities, private landowners
Promote theLakeSmart program evaluations and certifications through NH Lakes to educate property owners about lake-friendly practices such as revegetating shoreline buffers withnativeplants, avoiding large grassyareas, and increasing mower blade heights to 4 inches. Coordinate with NHDES Soak Up the Rain NH program for workshops and trainings. Cost assumes coordination of and materials	KLA, RCCD, NH Lakes, NHDES Soak Up the Rain NH, Municipalities	$10K 2024-33	NH Lakes, NHDES Soak Up the Rain NH, Grants (319, Moose plate), CWSRF, Municipalities

[6] Costestimatesforeachrecommendationwill needtobeadjustedbasedonfurther researchandsitedesignconsiderations.

		Estimated Cost / Schedule	
Provide technical assistanceand/or implementation cost sharing to watershed/shoreline property owners to install stormwater and/or erosion controls such as rain gardens andbuffer plantings. Prioritize high impact properties identified during the shoreline survey. Cost assumes technical assistanceand implementation cost sharing provided to the one highimpact shoreline property. **Achieves 1% (0.6 kg/yr P of 46.4 kg/yr P) of Objective 1.**	KLA, RCCD, Municipalities	$10K 2024-27	Grants (319, Moose plate), CWSRF
Implement stormwater and erosion controls on watershed/shoreline properties. Prioritize medium impact properties identified during theshoreline survey. Cost assumes landowner implementation costs (budget:$3K each) for thenine medium impact shoreline properties and 49 low impact shoreline properties. **Achieves 21% (9.7 kg/yr P of 46.4 kg/yr P) of Objective1.**	Landowners, KLA	$174K 2024-33	Landowners
Conduct a shoreline survey of **Long Pond**. Use the results to target education and technical assistance for high impact sites. Cost assumes hired consultant forsurvey and summation of shoreline survey results.	KLA, Long Pond Protective Association, Town of Danville	$5K 2025	Town of Danville, Grants (Moose plate), CWSRF
Conduct a shoreline survey of **Greenwood Pond**. Use the results totarget education and technicalassistancefor high impact sites. Cost assumes hired consultant for survey and summation of shoreline survey results.	KLA, Town of Kingston	$5K 2025	Town of Kingston, Grants (Moose plate), CWSRF
Repeat theshoreline surveys in 5-10 years when updatingthe WBMP. Use the results to target education andtechnical assistancefor high impact sites. Cost assumes hired consultant for survey and summation of shorelinesurvey results.	KLA, Long Pond Protective Association, Municipalities	$15K 2027, 2032	Municipalities, Grants (Moose plate), CWSRF
Coordinate water quality monitoring of Greenwood Pond with VLAP, the Lakes Lay Monitoring Program (LLMP),or FBE tooccur each year.	KLA, Municipalities	5-10K/year Beginning 2025	Municipalities
Further investigatesources of nutrient loading between Greenwood Pond and Kingston Lake in theform of residential BMPs andseptic loads. Recommendand implement mitigation measures. Cost assumes stormwater retrofit inventory and expanded septic inventory.	KLA, Municipalities	$10-15K 2025	Municipalities, Grants (319)
Road and Driveway Management			
Review practices for roadanddrainage maintenancecurrently used by publicand private entities/groups and determine areas for improvement.	Municipalities, KLA, RCCD	$3K 2025	CWSRF, Municipalities, Grants (MoosePlate,NFWF 5-Star)
Continue providing education and training to contractors and municipal staff on protocols for roadmaintenance best practices.Assumes one workshop. Consider holding joint workshop withother municipalities orlake associations (or other wider	Municipalities, KLA, RCCD	$15K 2024	CWSRF, Municipalities, Grants (MoosePlate,NFWF

		Estimated Cost / Schedule	
Develop and/or update a written protocol for road maintenance best practices.	Municipalities, KLA, RCCD	$20K 2025	CWSRF, Municipalities, Grants (MoosePlate,NFWF 5-Star)
Incorporate water quality considerations and strategies into roadway evaluations and action plans (e.g., Sanbornton Roadway Evaluation).	Municipalities, KLA, RCCD	N/A 2024-33	Municipalities
Establish inspection and maintenance agreements for private unpaved roads. Cost does not includethe implementation of proper roadmaintenance by private landowners and assumes that municipalities can accommodate this additional effort in current budgets.	Municipalities, private landowners	N/A 2024-33	Municipalities, private landowners
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 andwalkways. Cost assumes up to five workshops.	KLA, RCCD, Municipalities, private landowners	$10K 2024-33	CWSRF, Municipalities, Grants (MoosePlate,NFWF 5-Star), private landowners
Continue contacting theNH State DOT regarding decreasing their road salt storage within the watershed,and road salt usage onstate roadswithin the watersheddue to current trends in water quality. Confirm secure road salt storage is occurring with no leaching and discuss reduced salt areas and low-salt approaches.	Municipalities, NH DOT	N/A 2024-2027	Municipalities
Establish a street sweeping program tosweep municipal paved roads and parking lots. Consider purchasing a street sweeping machine withneighboring municipalities tosweep uproad salt andsand in dry weather periods between winter storms as our winters see more rain between snowevents. Encourage homeowners to sweeptheir impervious surfaces after each snowmelt.	Municipalities	TBD 2024-2030	Municipalities
Municipal/State Operations			
Review and optimize MS4 compliance for towns (regardless of MS4 designation), including infrastructure mapping, erosion and sediment controls, illicit discharge programs, and goodhousekeeping practices such as regular catchbasin cleaning.	Municipalities (Public Works/Highway)	TBD 2024-33	Municipalities
Participate in Green SnowPro training. Become Green SnowPro Certified according to program rules set by theJoint Legislative Committeeon Administrative Rules.	Municipalities (Public Works/Highway)	Est. $150-$250/person 2024-33	Municipalities
Review and update winter operations procedures tobe consistent withGreen SnowPro best management practices for winter road, parking lot, and sidewalk maintenance. Continue practicing low salt application practices inthe watershed.	Municipalities (Public Works/Highway)	N/A 2025	Municipalities
Collaborate withthe NH DOT on establishing low saltingareas with postedsignage	Municipalities (Public	N/A	

		Estimated Cost / Schedule	
In Kingston and Danville, adopt policies to either eliminatefertilizer applications on town properties or implement best practices forfertilizermanagement (tominimize application andtransport ofphosphorus). Consider extending these regulations to private properties as well.	Municipalities (Public Works/Highway)	N/A 2024-27	Municipalities
For Kingston, workwith either the Kingston or Newton Transfer Station, andfor Danville, workwith the Town of Raymond Transfer Station, to adopt a program to accept residential yard wasteat respective transfer stations for composting.	Municipalities (Public Works/Highway)	TBD 2024-27	Municipalities
Develop best practice designstandards for stormwater control measures,including deep sump catchbasins.	Municipalities (Public Works/Highway)	N/A 2025	Municipalities
Municipal Land Use Planning & Zoning			
Present WMP recommendations to Select Boards/City Council and Planning Boards in Kingston and Danvilleanddiscuss the connection between municipal land use planning and water quality.	KLA, Conservation Commissions	$1K 2024	Grants (319), CWSRF
Meet with municipalstaff to review recommendations to improve or develop ordinances addressing setbacks, buffers, lot coverage, lowimpact development, and open space.Encouragemunicipalities toset standards more stringent thanthe statebaseline.	KLA, Municipalities	$3K 2024-27	Municipalities, Grants (319), CWSRF
Incorporate WBMP recommendations into municipalmaster plans and encourage regular review of the WBMP action plan.	Municipalities	N/A 2024-27	Municipalities
Adopt/strengthen zoning ordinance provisions and enforcement mechanisms (if not already in place): 1) to promote LID practices and reduce impervious areas; 2) torequire stormwater regulations that align with MS4 Permit requirements; 3) topromote or require vegetative buffers around lake shore and tributary streams;	Municipalities	N/A 2024-33	Municipalities

		Estimated Cost / Schedule	
Increase municipal staff capacity through code enforcers/building inspectors for inspections and enforcement of stormwater regulations onpublic and privatelands.	Municipalities	TBD 2024-33	Municipalities
Land Conservation			
Update the NRI for theTown of Kingston (2000). Inquire about the Danville NRI update mentioned inthe 2022 master plan. Original NRI is from 1998.	Municipalities, Conservation Commissions	$12-25K per municipality 2024-27	Municipalities, Grants (NFWF NEFRG), CWSRF
Create a priority list of watershed areas that need protection based on NRIs. Refer to Section 4.2.3 to understandcurrent conservation lands and valuable habitats and wildlife in the watershed that can be usedto helpidentify potential areas totarget for conservation.	KLA, Municipalities, Conservation Commissions, Southeast Land Trust of New Hampshire or other localland trusts	$4-8K 2024-27	Grants (NFWF NEFRG, NAWCA), CWSRF, Municipalities
Identify potential conservation buyers and property owners interested in easements within the watershed. Useavailable fundingmechanisms,such as theRegional Conservation Partnership Program (RCPP)and theLand and Community Heritage Investment Program (LCHIP),to provide conservation assistance tolandowners.	KLA, Municipalities, Conservation Commissions, Southeast Land Trust of New Hampshire or other localland trusts	N/A 2024-27	Grants (MoosePlate,LCHIP, RCCP, NAWCA, LWCF, ACEP, CSP, EQIP)
Maximize conservation of intact forest andother ecologically important properties though education, zoning, and public or private conservation.	KLA, Municipalities, Conservation Commissions, Southeast Land Trust of New Hampshire or other localland trusts, private landowners	TBD 2024-33	Grants (Moose Plate,LCHIP, RCCP, NAWCA, LWCF, ACEP, CSP, EQIP, NFWF NEFRG), Municipalities, private landowners
Enhance community education regarding private land conservation easements. Host workshops educating landowners on the benefits.	KLA, Conservation Commissions	TBD 2024-2035	Grants (MoosePlate,LCHIP, RCCP, NAWCA, LWCF, ACEP, CSP, EQIP, NFWF NEFRG), Municipalities, private landowners
Continue inspecting wetlands for Prime Wetland Designations including Bayberry Pond and others. Provide greater supporttothe KingstonConservation Commission	Municipalities, Southeast Land Trust of New Hampshire,	TBD 2024-2035	Municipalities

		Estimated Cost / Schedule	
The Kingston Master Plan identifies a goal of 25% of thetown to be heldwithin permanent protection. Currently, around 20-23% of thetown is conserved. Consider raising this percentageto increase your goaland continuepreserving land for its many ecosystem benefits.	Municipalities, Conservation Commissions	TBD 2024-2035	Grants (MoosePlate,LCHIP, RCCP, NAWCA, LWCF, ACEP, CSP, EQIP, NFWF NEFRG), Municipalities, private landowners
Septic System Management			
Replace malfunctioning septic systems inthe shoreland zone of Kingston Lake and Long Pond. Cost assumes 49and 21 old septicsystems around Kingston Lake and Long Pond, respectively, are inspected and replaced as necessary. **Achieves 11% (4.9 kg/yr P of 46.4kg/yr P) of Objective1 for Kingston Lake and 5% (2.1 kg/yr P of 41.5kg/yr P) of Objective 1 for Long Pond.**	Landowners	TBD 2024-33	Landowners, Grants
Distribute educational materials toproperty owners aboutseptic system function and maintenance.	Municipalities, KLA	$3K 2024, 2029, 2034	Municipalities, Grant (319), CWSRF
Look into whether any septicpumping companies wouldgive a quantity discount or a discount to members toincentivize septic system pumping.	KLA	N/A 2024-27	CWSRF
Evaluatelocations of older and/or noncompliant septicsystems (including cesspools or holding tanks) to identify clusters where conversion to community septic systems might be desirable.	KLA, Municipalities	TBD 2024-25	CWSRF, Municipalities
Institute a minimum pump-out/inspection interval for shorefront septicsystems (e.g., once every 3-5 years). Pump-outs (~$250 persystem)are the responsibility of the owner.	Municipalities	N/A 2024-27	Municipalities
Create ordinances that require the inspection of septicsystems for all home conversions (from seasonalto permanent residences)and property sales to ensure systems are sizedand designed properly. Require upgrades if needed. Consider modeling an ordinance on Kingston's and Danville's septicsystem regulations pertaining to the Kingston Lake watershed area.	Municipalities	N/A 2024-33	Municipalities
If not already in place, develop a program to evaluatethe sanitary sewer system and reduce leaks and overflows, especially in theareas near waterbodies. Include periodic inspections of the sewer line.	Municipalities	TBD 2024-27	Municipalities
Develop and maintain a towns-wide septicinventory database base tofacilitate code enforcement of any septic system ordinances.	Municipalities	$5K 2024-33	Municipalities, CWSRF
Conduct a septic system riskassessment to identifyareas in town which may be more susceptible tosepticsystem malfunction due tohighgroundwater, soil	Municipalities	$15K-$20K	Municipalities

		Estimated Cost / Schedule	
Agricultural Practices			
Workwith NRCS to implement soilconservation practices such as cover crops, no-till methods, and others which reduce erosion and nutrient pollution tosurface waters from agriculturalfields.	NRCS, farm owners	TBD 2024-33	Grants, NRCS
Education and Outreach			
Share additional/dynamic information on theKLA website,such as water quality data, weather conditions, and webcam, togeneratemoretrafficto thewebsite.	KLA	TBD 2024-27	Grants
Combine education opportunities by theKLA and Conservation Commissions regarding eagles, osprey, loons, water quality,and how humans can help the ecosystem through initiatingLakeSmart, Soak Up the RainNH, municipal regulations, and proper septic practices,togenerate largeraudiences. Consider repeating workshop topics every few years as newmembers and new homeowners enter the watershed.	KLA, Conservation Commissions	TBD 2024-30	Municipalities, Grants
Host a collaborative workshop between thePollinator Pathways Subcommittee and KLA regarding native plants and pollinators along shorelines.	KLA, Conservation Commissions	N/A 2024-2030	Municipalities
Educatemanagers of privateboat launches about invasivespecies management, in addition tothe existinglake host program that operates at public boat launches.	KLA	$10K 2024-25	Grants (NHDES AIPC)
Offer workshops for landowners with 10 acres or moreforNRCS assistance withland conservation. Cost assumes up to twoworkshops.	KLA	$5K 2024-27	Grants (RCCP, ACEP, CSP, EQIP)
Encourage private property owners to hire Green SnowPro certified commercialsalt applicators.	KLA, RCCD, Municipalities	N/A 2024-31	Grants, Municipalities
Educate contractors and municipal staff about erosionand sediment control (ESC) practices required on plans.Workwith municipalities to ensure that there are sufficient resources toenforce permitting conditions.	Municipalities, KLA, RCCD	$6K 2024-27	Municipalities, Grants (319), CWSRF
Create flyers/brochures or other educational materials through printed or online mediums, regarding topics such as stormwater controls, road maintenance, buffer improvements, fertilizer andpesticide use, pet waste disposal, boat pollution, invasive aquatic species, waterfowl feeding, and septic system maintenance. Consider creating a "watershed homeowner" packet that covers thesetopics andis distributed (mailed separately or in tax bills or postedat community gathering locations or events) toexisting and new property owners, as well as renters. Hold1-2 informational workshops peryear to updatethe public on restoration progress and ways that individuals can help. Cost is highly variable.	Municipalities, KLA, RCCD	$20K-$60K 2024-33	Municipalities, Grants (319), CWSRF

		Estimated Cost / Schedule	
Hold quarterly meetings between the KLA andtown conservation commissions regarding joint educational opportunities to bolstersupport and assistanceto each organization. Invite other lake/river associations to joinsuch as the Long Pond	KLA, Municipalities, Conservation commissions	N/A 2024-2030	Municipalities

5.2 POLLUTANTLOAD REDUCTIONS

To meet the water quality goal, Objective 1 set a target phosphorus load reduction of 46.4 kg/yr to achieve an in-lake total phosphorus concentration of 10.7 ppb, which meets state water quality standards for mesotrophic waterbodies and is anticipated to substantially reduce the likelihood of cyanobacteria blooms in Kingston Lake. Additionally, Objective 1 set a target phosphorous load reduction of 41.5 kg/yr for Long Pond to achieve an in-lake total phosphorus concentration of 11.6 ppb. The following opportunities for phosphorus load reductions to achieve Objective 1 were identified in the watershed based on fieldand desktopanalyses:

- Remediating the 55 watershed survey sites could prevent up to **13.7 kg/yr** and **5.1 kg/yr** of phosphorus load from entering Kingston Lake and Long Pond, respectively.
- Treatingshorelinesitescouldreducethephosphorusloadto KingstonLakeby**0.6kg/yr**fortheonehighimpactsite (disturbancescore 11+),**2.6kg/yr**forthe ninemedium impact sites (disturbancescorebetween 9-10),and**7.1kg/yr** for the 49low impact sites (disturbance scorebetween 7-8)identified from the shorelinesurvey.
- Upgrading the 49 shorefront septic systems older than 25 years is estimated to reduce the phosphorus load to Kingston Lake by **4.9 kg/yr**.
- Upgrading the 21 shorefront septic systems older than 25 years is estimatedto reduce the phosphorus load to Long Pond by **2.1 kg/yr**.

Addressing these field-identified phosphorus load reduction opportunities coming from the external watershed load (i.e., watershed and shoreline sites and shorefront septic systems) could reduce the phosphorus load to Kingston Lake by 28.9 kg/yr, 2.8 kg/yr of which has already been addressed by the Kingston DPW on washed out roads from the 2023 storms. In addition to the 17.5 kg/yr total phosphorus reduction that could come from Long Pond if the goal is met, this would meet 100% of the needed reductions to achieve Objective 1 for Kingston Lake (Table 15). In the Long Pond watershed, 7.2 kg/yr in total phosphorus load reduction opportunities were identified, equating to 17% of the goal. Additional pollutant load reduction opportunities should be identified specifically for Long Pond, including conducting a watershed survey specific to theLongPondwatershedandashorelinesurvey. PollutantloadreductionopportunitiesfromtheseplanningeffortsforLong Pond may provide additional recommendations for improving stormwater management and reducing phosphorus loading toLongPond. ThoughwedidnotprovideaseparateanalysisandgoalforGreenwoodPond,werecommendthatfuturework focus on evaluating and remediating sources of phosphorus to Greenwood Pond for the benefit of the pond’s water quality itself as wellas for Kingston Lake.

Objective 2(preventingoroffsettingadditionalphosphorus loading from anticipatednewdevelopment) canbe met through ordinance revisions that implement LID strategies and encourage cluster development with open space protection and/or through conservation of key parcels of forestedand/or open land.

It is important to notethat, while the focus of the objectives for this plan is on phosphorus, thetreatment of stormwater and sediment erosion will result in the reduction of many other kinds of pollutants that may impact water quality. These pollutants would likely include other nutrients (e.g., nitrogen), petroleum products, bacteria, road salt/sand, and 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 availablethatcanestimatereductionsinthesepollutantsdependingonthetypesofBMPsinstalled.Thesereductionscanbe tracked to helpassess long-term response.

Table 15. Breakdown of phosphorus load sources and modeled water quality for current and target conditions that meet the water quality goal (Objective 1) and that reflect allfieldidentified reduction opportunities in the watershed. Reduction percentages arebased onthecurrent condition value for each parameter.

Parameter	Unit	Current Condition	WQ Goal & Estimated Reduction Needed		Field Identified Reduction Opportunities	
			Target Condition	**Reduction (Unit, %)**	**Target Condition**	**Reduction (Unit, %)**
Kingston Lake						
Total P Load(AllSources)[3]	kg/yr	289.0	242.6	-46.4 (16%)	257.1	-31.9 (11%)
(A) Background P Load[1]	kg/yr	62.9	62.9	0.0 (0%)	62.9	0.0 (0%)
(B) Disturbed (Human)P Load[2]	kg/yr	226.1	179.7	-46.4 (21%)	194.2	-31.9 (14%)
(C) Developed Land Use P Load	kg/yr	99.8	75.8	-24.0 (24%)	75.8	-24.0 (24%)
(D) Septic System PLoad	kg/yr	26.5	21.6	-4.9 (18%)	21.6	-4.9 (18%)
(E) Long Pond Land/Septic PLoad	kg/yr	78.5	61.0	-17.5 (22%)	75.5	-3.0 (4%)**
(F) Internal P Load	kg/yr	21.3	21.3	0.0 (0%)	21.3	0.0 (0%)
In-Lake TP*	ppb	16.1	13.4	-2.7 (17%)	14.2	-1.9 (12%)
In-Lake Chl-a*	ppb	4.1	3.1	-1.0 (24%)	3.4	-0.7 (17%)
In-Lake SDT*	meters	2.7	3.2	+0.5 (19%)	3.0	+0.3 (11%)
In-Lake Bloom Probability*	days	21	6	-15 (71%)	9	-12 (57%)
Long Pond						
Total P Load (AllSources)[3]	kg/yr	166.0	124.5	-41.5 (25%)	158.8	-7.2 (4%)
(A) Background P Load[1]	kg/yr	37.9	37.9	0.0 (0%)	37.9	0.0 (0%)

[1] Sumofforested/water/natural landuseload,waterfowl load,andatmosphericload
[2] Sumofdevelopedlanduseload, shorefrontsepticsystemload,andinternal load (B=C+D+E+F)
[3] TotalP Load(All Sources)=A+B
* Waterqualityparameterswere sourcedfromthe model.
** AccountsforattenuationfromLong PondoutlettoKingstonLake

6 PLAN IMPLEMENTATION & EVALUATION

Thefollowingsectiondetailstheoversightandestimatedcosts(withfundingstrategy)neededtoimplementtheactionitems recommended in the Action Plan (Section 5), as well as the monitoring plan and indicators to measure progress of plan implementation over time.

6.1 PLANOVERSIGHT

The recommendations of this plan will be carried out by a joint committee made up of representatives from a diverse stakeholder group, including KLWA, YMCA Camp Lincoln, municipalities (e.g., select boards, planning boards), conservation commissions, state and federal agencies or organizations, nonprofits, land trusts, schools and community groups, local business leaders, and landowners. The committee will need to meet regularly and workhard to coordinate resources across stakeholder groups to fund and implement the management actions. The Action Plan (Section 5) will need to be updated periodically (typically every 2, 5, and 10 years) to ensure progress and to incorporate any changes in watershed activities. Measurable milestones (e.g.,number of BMP sites, volunteers, funding received, etc.) should be tracked by the committee.

The Action Plan (Section 5) identifies the stakeholder groups responsible for each action item. Generally, the following responsibilities are notedforeach key stakeholder:

- KLAandYMCACampLincolnwillbegenerallyresponsibleforestablishingthejointcommitteeforplanoversightand implementation of the plan. KLA will assist with water quality monitoring, facilitate outreach activities and watershed stewardship, and raise funds for stewardship work.
- Municipalities will work to address NPS problems identified in the watershed, including conducting regular best practices maintenance on roads, adopting ordinances for water quality protection, and addressing other recommended actions specified in the Action Plan. KLA and other local groups can work with each municipality to provide support in reviewing and tailoring therecommendations tofit thespecific needs of each community.
- Conservation Commissions will work with municipal staff and boards to facilitate the implementation of the recommended actions specified in the Action Plan.
- RCCDcanprovideadministrativecapacityand canhelpacquiregrant fundingforBMP implementationprojects and education/outreach towatershed residents and municipalities. Outreachto theRCCD is needed.
- NHDES can provide technical assistance, permit approval, and the opportunity for financial assistance through the 319 Watershed Assistance Grant Program and other funding programs. Application tothose programs is needed.
- Privatelandownerswillseekopportunitiesforincreasedawarenessofwaterqualityprotectionissuesandinitiatives and conduct activities in a manner that minimizes pollutant impact tosurfacewaters.

The success of this plan is dependent on the continued effort of volunteers and a strong and diverse committee that meets regularly to coordinate resources for implementation, review progress, and make any necessary adjustments to the plan to maintainrelevant actionitems andinterim milestones.Areductioninnutrient loading is noeasytask,andbecausethereare many diffuse sources of phosphorus reaching the rivers, lakes, and ponds from existing development, roads, septic systems, and other land uses in the watershed, it will require an integrated and adaptive approach across many different parts of the watershed communityto besuccessful.

6.2 ESTIMATEDCOSTS

The strategy for reducing pollutant loading to Kingston Lake to meet the water quality goal and objectives set in Section 2.4 will be dependent on available funding and labor resources but will includeapproaches that address sources of phosphorus loading, as well as water quality monitoring and education and outreach. Additional significant but difficult to quantify strategies forreducingphosphorus loading tothelakearerevising localordinances suchas settingLIDrequirements onnew construction, identifying andreplacing malfunctioningsepticsystems, performingproper road maintenance,and improving agricultural practices (refer to Section 5: Action Plan for more 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 Kingston Lake in the next 10 years. **The cost of successfully implementing the plan is estimated to be at least $0.8-$1.4 million over the next 10 or more years** (Table 16). However, many costs are still unknown or were roughly estimated and should be updated as information becomes available. In addition, costs to private landowners (e.g., septic system upgrades, private road maintenance, etc.) are not reflected inthe estimate.

Table 16. Estimatedpollutant reduction (TP) in kg/yr and estimatedtotaland annual 10-year costs for implementation of the Action Plan tomeet the water qualitygoaland objectives for the Kingston Lake watershed. The light grayshaded planning actions are necessary to achieve thewater quality goal. Other planning actions are important but difficult to quantify for TP reduction andcosts, thelatter of which were roughly estimated hereas general placeholders.

	TP Reduction (kg/yr)		
Watershed & Shoreline BMPs	**18.8**	$701,000 - $1,136,000	$70,100 - $113,600
Road Management	TBD	$48,000	$4,800
Municipal Operations	TBD	$1,500-$2,500	$150-$250
Municipal Land Use Planning & Zoning	**13.0***	$4,000	$400
Land Conservation		$28,000 - $58,000	$2,800 - $5,800
Septic System Management	**7.0**	$23,000 - $28,000	$2,300 – $2,800
Agricultural Practices	TBD	TBD	TBD

* Estimatedincreaseinphosphorusloadfromnew developmentinthe next10 years.

6.3 FUNDING STRATEGY

It is important that the committee 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 property owners. 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 the committee with future water quality and watershed workon Kingston Lake.

Funding Options:

- **EPA/NHDES 319 Grants (Watershed Assistance Grants)** – This NPS grant is designed tosupport local initiatives to restoreimpairedwaters(priorities identifiedintheNPSManagementProgramPlan,updated 2024)andprotecthigh qualitywaters. 319grantsareavailablefortheimplementationof watershed-basedplansandtypicallyfund$50,000 to $150,000 projects over the course of two years. https://www.des.nh.gov/business-and-community/loans-and-grants/watershed-assistance
- **NH State Conservation Committee (SCC) Grant Program (Moose Plate Grants)** – County Conservation Districts, municipalities (including commissions engaged in conservation programs), and qualified nonprofit organizations areeligibletoapplyfortheSCCgrantprogram.Projectsmustqualifyinoneofthefollowingcategories:WaterQuality andQuantity;WildlifeHabitat;SoilConservationandFlooding;Best Management Practices;ConservationPlanning; and Land Conservation. The total SCC grant request per application cannot exceed$40,000. https://www.mooseplate.com/grants/
- **Land and Community Heritage Investment Program (LCHIP)** – This grant provides matching funds to help municipalities and nonprofits protect the state's natural,historical, and cultural resources. https://www.lchip.org/index.php/for-applicants/general-overview-schedule-eligibility-and-application-process
- **Aquatic Resource Mitigation Fund (ARM)** – This grant provides funds for projects that protect, restore, or enhance wetlands andstreamstocompensateforimpactedaquaticresources.Thefundis managedbytheNHDESWetlands Bureauthatoverseesthestateln-LieuFee(ILF)compensatorymitigation program.Apermitteecanmakeapayment

to NHDES to mitigate or offset losses to natural resources because of a project's impact to the environment. https://www.des.nh.gov/climate-and-sustainability/conservation-mitigation-and-restoration/wetlands-mitigation

- **New England Forest and River Grant (NFWF NEFRG)**– This grant awards $50,000 to $200,000 to projects that restore and sustain healthy forests and rivers through habitat restoration, fish barrier removal, and stream connectivity such as culvert upgrades. https://www.nfwf.org/newengland/Pages/home.aspx
- **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. https://www.des.nh.gov/business-and-community/loans-and-grants/rivers-and-lakes
- **Clean Water State Revolving Fund (NHDES CWSRF)** – This fund provides low-interest loans to communities, nonprofits, and other local government entities to improve and replace wastewater collection systems with the goal of protecting public health and improving water quality. A portion of the CWSRF program is used to fund NPS pollution prevention, watershed protection and restoration, and estuary management projects that help improve and protect water quality in NH. https://www.des.nh.gov/business-and-community/loans-and-grants/clean-water-state-revolving-fund
- **Regional Conservation Partnership Program (RCCP)** - This NRCS grant provides conservation assistance to producers and landowners for projects carried out on agricultural land or non-industrial private forest land to achieve conservation benefits and address natural resource challenges. Eligible activities include land management restoration practices, entity-held easements, and public works/watershed conservation activities. https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/rcpp/
- **Agricultural Conservation Easement Program (ACEP)** - This NRCS grant protects the agricultural viability and related conservation values of eligible land by limiting nonagricultural uses which negatively affect agricultural uses and conservation values, protect grazing uses and related conservation values by restoring or conserving eligible grazing land, and protecting, restoring, and enhancing wetlands on eligible land. Eligible applicants include private landowners of agricultural land, cropland, rangeland, grassland, pastureland, and non-industrial private forestland. https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/acep/
- **Conservation Stewardship Program (CSP)** - This NRCS grant helps agricultural producers maintain and improve their existing conservation systems and adopt additional conservation activities to address priority resource concerns. Eligible lands include private agricultural lands, non-industrial private forestland, farmstead, and associated agricultural lands, and public land that is under control of the applicant. https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/csp/
- **Environmental Quality Incentives Program (EQIP)** - This NRCS grant provides financial and technical assistance to agricultural producers and non-industrial forest managers to address natural resource concerns and deliver environmental benefits. Eligible applicants include agricultural producers, owners of non-industrial private forestland, water management entities, etc. https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/eqip/
- **National Fish and Wildlife Federation (NFWF) Five Star and Urban Waters Restoration Grants (NFWF 5-Star)** - Grants seek to address water quality issues in priority watersheds, such as erosion due to unstable streambanks, pollution from stormwater runoff, and degraded shorelines caused by development. Eligible projects include wetland, riparian, in-stream and/or coastal habitat restoration; design and construction of green infrastructure BMPs; water quality monitoring/assessment; outreach and education. https://www.nfwf.org/programs/five-star-and-urban-waters-restoration-grant-program
- and-urban-waters-restoration-grant-program
  matching grants program that supports public-private partnerships carrying out projects in the United States that further the goals of the North American Wetlands Conservation Act (NAWCA). These projects must involve long-term protection, restoration, and/or enhancement of wetlands and associated uplands habitats for the benefit of all wetlands-associated migratory birds. https://www.fws.gov/service/north-american-wetlands-conservation-act-nawca-grants-us-standard
- **National Park Service** - Land and Water Conservation Fund Grant Program (LWCF) - Eligible projects include acquisition of parkland or conservation land; creation of new parks; renovations to existing parks; and development of trails. Municipalities must have an up-to-date Open Space and Recreation Plan. Trails constructed using grant funds must be ADA-compliant. https://www.nhstateparks.org/about-us/community-recreation/land-water-conservation-fund-grant

6.4 MONITORING PLAN

A long-term water quality monitoring plan is critical to evaluate the effectiveness of implementation efforts over time. KLA, in concert with the VLAP, should continue the following annual monitoring protocol:

- VLAP monitors two deep spot stations in Kingston Lake (North and South) as well as the deep spots of Long Pond, Greenwood Pond, and Halfmoon Pond, three to five times each summer (June-September or October) for total phosphorus (epilimnion, metalimnion, and hypolimnion, chlorophyll-a (composite or epilimnion), Secchi disk transparency, and dissolvedoxygen-temperature profiles.
  - Ensure that dissolved oxygen-temperature profiles are being collected concurrently with sampling of lake deep spot stations and consider collecting profiles at a higher frequency (e.g., every two weeks from May-October).
- VLAPmonitorscollectmonthlysamplesforspeciationandenumerationofphytoplanktonviaagrabsamplerorcore and zooplankton by tows in the water column.
- Volunteers collect additional Secchi disk transparency readings at the two deep spot stations in Kingston Lake, as well as four nearshore sites (GRTKINSEC01, GRTKINSEC02/03, GRTKINSEC04, and GRTKINPAB) throughout the summer season (ideally every other week and more frequently during a bloom if safe). These data would be important to track theonset,duration, and extent of a bloom throughout theseason.
- Continue to monitor the lake for cyanobacteria blooms and alert NHDES immediately. Coordinate with NHDES to collect samples foranalysis.
- Consider measuring specific conductivity or collecting samples for chloride at all tributary stations and throughout the water column at thelakedeep spot stations.
- If the lake association has access to a dissolved oxygen and temperature meter, we recommend that profiles are collected biweekly from June1 to September 30betweenthe hours of 10am and 2pm.
- Collect Secchi disk transparency with each profile ortotalphosphorus sample.
- Additional profiles from surrounding waterbodies, such as Long Pond and Greenwood Pond would help better characterize thewatershed.
- If additional funding is available, we also recommend the following to better characterize the contribution of phosphorus from internalloading:
  - Discrete grab samples for total phosphorus collected every 2 meters from the surface (1 meter) to the bottom (15 meters) at both deep spots of Kingston Lake, for a total of 2-3 times in August through September.
  - Sediment samples (top 4 inches) collected from both deep spots of Kingston Lake to analyze elemental ratios of phosphorus, aluminum, and iron and characterize biologicallylabilefractions of phosphorus.
- Create a water quality monitoring program at the Greenwood Pond deep spot. Baseline parameters should include at a minimum, water temperature and dissolved oxygen profiles, total phosphorus, and chlorophyll-a. Samples should be collected at least once a month from May through September for 5 years to create a baseline analysis of the pond. If VLAP cannot conduct this sampling, consider contacting the Lay Lakes Monitoring Program (LLMP) throughtheUNHCooperativeExtension,orcontractinganenvironmentalconsultanttodothemonitoringeachyear.

6.5 INDICATORSTOMEASUREPROGRESS

The following environmental, programmatic, and social indicators and associated numeric targets (milestones) will help to quantitatively measure the progress of this plan in meeting the established goal and objectives for the Kingston Lake watershed (Table 17).Thesebenchmarks represent short-term(2025),mid-term (2028),andlong-term (2033)targets derived directly from actions identified in the Action Plan (Section 5). Setting milestones allows for periodic updates to the plan, maintainsandsustainstheactionitems,andmakestheplanrelevanttoongoing activities.Thecommitteeshouldreviewthe milestones for each indicator on an ongoing basis to determine if progress is being made, and then determine if the plan needs to berevised becausethe targets are not being met.

EnvironmentalIndicatorsareadirectmeasureofenvironmentalconditions.Theyaremeasurablequantitiesusedtoevaluate the relationship between pollutant sources and environmental conditions. They assume that recommendations outlined in the Action Plan (Section 5) will be implemented accordingly and will result in the improvement of water quality. Programmaticindicatorsareindirectmeasuresofwatershedprotectionandrestorationactivities.Ratherthanindicatingthat water quality reductions are being met, these programmatic measurements list actions intended to meet the water quality goal. Social Indicators measure changes in social or cultural practices and behavior that lead to implementation of management measures andwater quality improvement.

Table 17. Environmental, programmatic,and social indicators for the Kingston Lake Watershed-Based Management Plan.

	M
	2025
E [illegible] sed on model results	
Achieve an average summerdeep spot epilimniontotalphosphorus concentration of 10.7 ppb at the deep spot stations in Kingston Lake	<13.4 ppb
A [illegible] concentration of 11.6 ppb at the deep spot station in Long Pond	< 15.5 ppb
Maintain an averagesummerdeep spot epilimnion chlorophyll-a concentration of less than 4.8ppb at the deepspot stations in Kingston Lake	<4.1 ppb
Maintain an averagesummerdeep spot epilimnion chlorophyll-a concentration of less than 4.8ppb at the deepspot stationin Long Pond	<4.3 ppb
Reduce the occurrence of cyanobacteria or algal blooms in Kingston Lake	21 days/yr
Reduce the occurrence of cyanobacteria or algal blooms in Long Pond	25 days/yr
Achieve an average summerwater clarity of 6 m or deeper at the deepspot stations in KingstonLake	2.7 m+
Achieve an average summerwater clarity of 3 m or deeper at the deepspot station in Long Pond	2.8 m+
Prevent and/or control the introduction and/or proliferation of new invasive aquaticspecies in all waterbodies (currently no effective treatment for Asian clam or Chinese mystery snail)	No new invasives
PROGRAMMATIC INDICATORS	
Amount of funding securedfrom municipal/private work, fundraisers, donations, and grants	$100,000
Number of NPS sites remediated (55 identified)	10
Linear ft of buffers improved in the shoreland zone	800
Percentage of shorefront properties with LakeSmart certification	10%
Number of watershed/shoreline properties receiving technical assistancefor implementation cost sharing	2
Number of workshops and trainings for stormwater improvements to residential properties (e.g., NHDES Soak Up the Rain NH program)	1
Number of updated or new ordinances that target water quality protection	1
Number of new municipal staff for inspections and enforcement of regulations	1
Number of voluntary or required septic system inspections (seasonal	[illegible]

	Milestones*		
Number of new best practices for road management andwinter maintenance	2025	2028	2033
Number of new best practices for road management andwinter maintenance implemented on publicand private roads by themunicipalities	2	5	10
Number of municipalities fully implementing key aspects of the MS4 program	2	2	2
[illegible] related tothe WBMP	4	12	30
Number of CNMPs completedor NRCS technical assistanceprovided for farms in the watershed	1	2	3
[illegible]			
Number of new associationmembers	5	10	25
Number of volunteers participating in educational campaigns	6	12	25
Number of people participating in informational meetings,workshops, trainings, BMP demonstrations, or group septicsystem pumping	25	50	100
Number of watershed residents installing conservation practices ontheir property and/or participating in LakeSmart	5	25	50
Number of municipal DPW staff receiving Green SnowPro training	1	3	5
Number of groups or individuals contributingfunds for plan implementation	25	50	100
Number of newly trained water quality and invasive species monitors	2	4	6

*Milestonesarecumulativestarting atyear 1.

ADDITIONALRESOURCES

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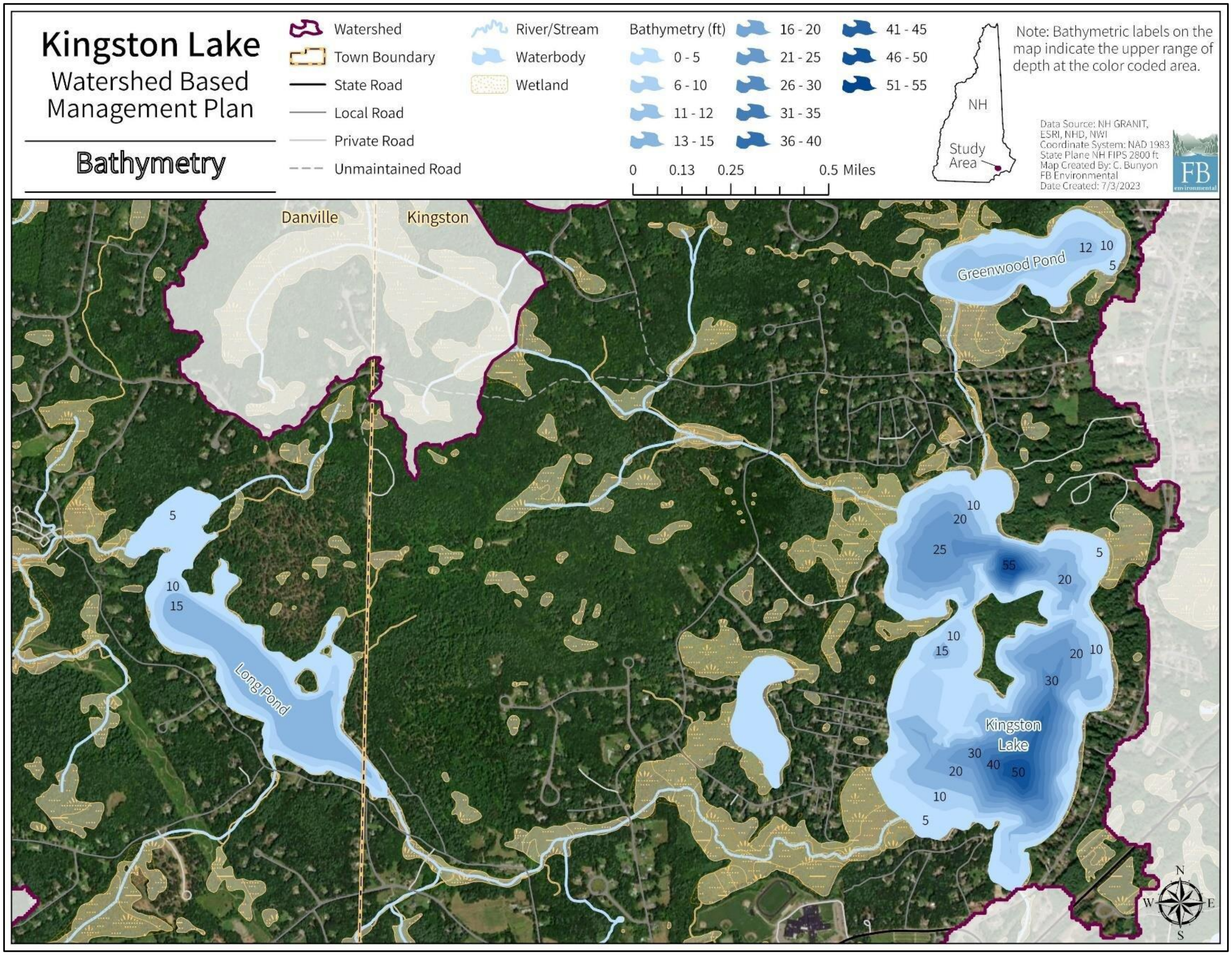
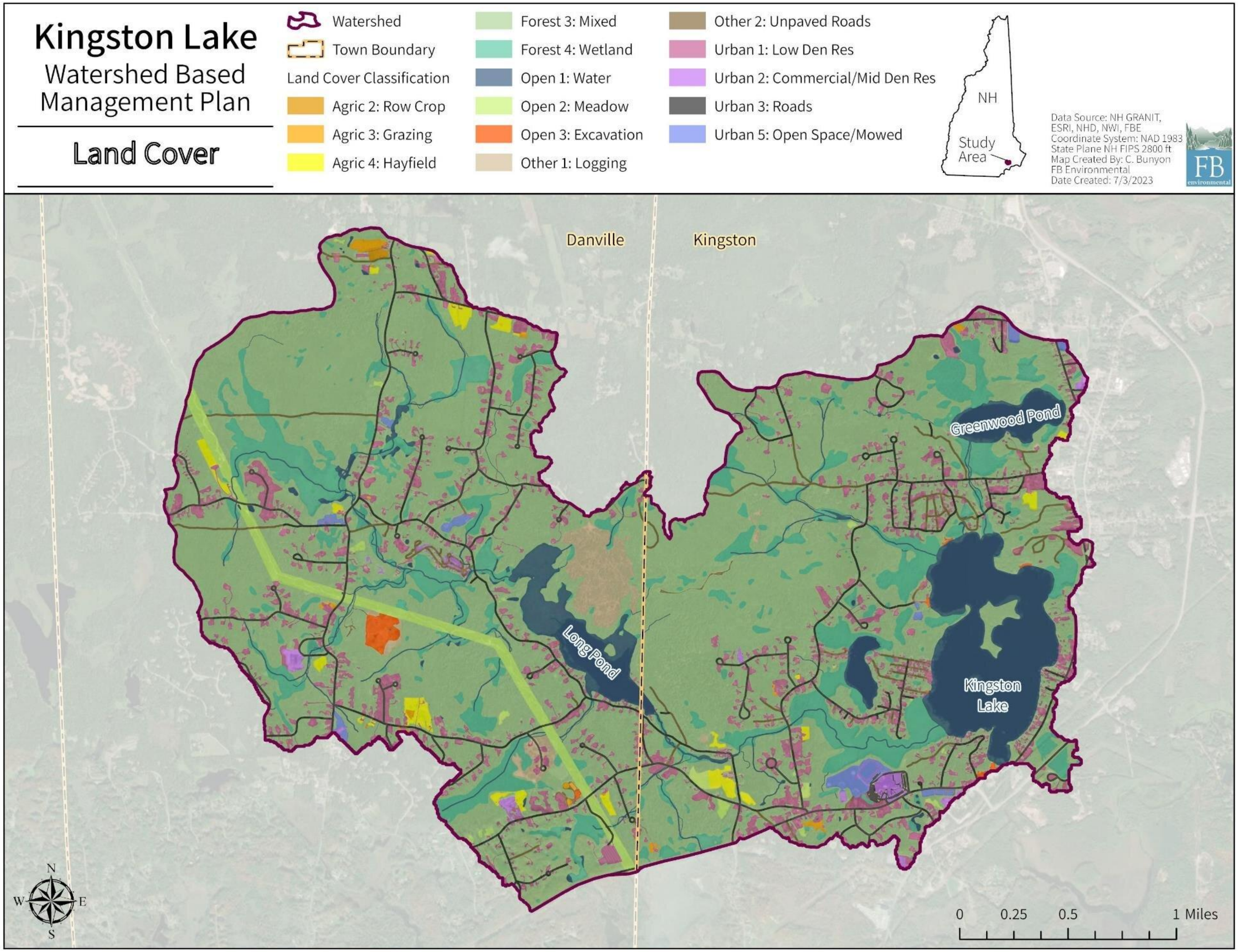
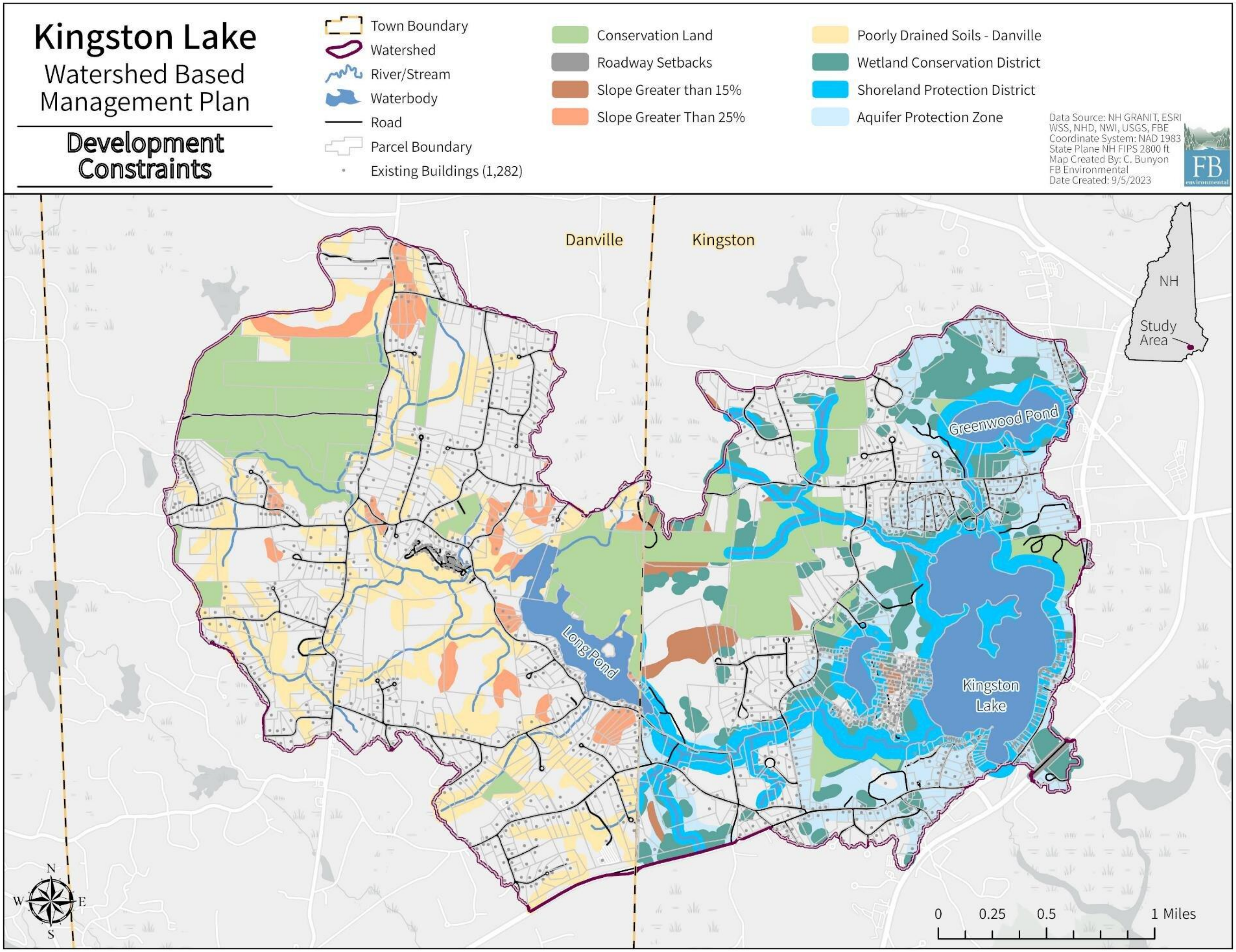
APPENDIX A: SUPPORTING MAPS



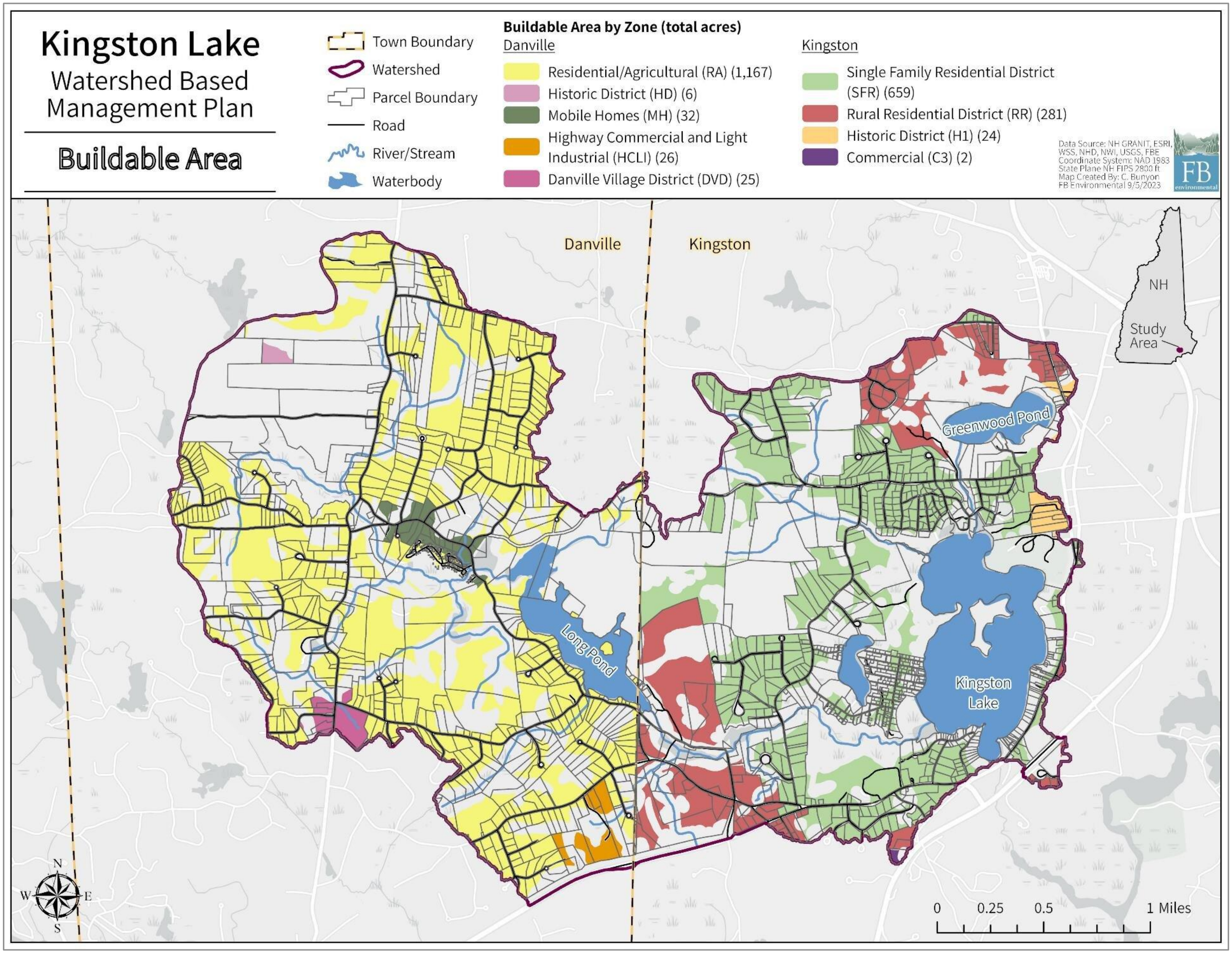
Map A-1. Bathymetry as 5-foot depthcontours for KingstonLake, Long Pond, and Greenwood Pond.



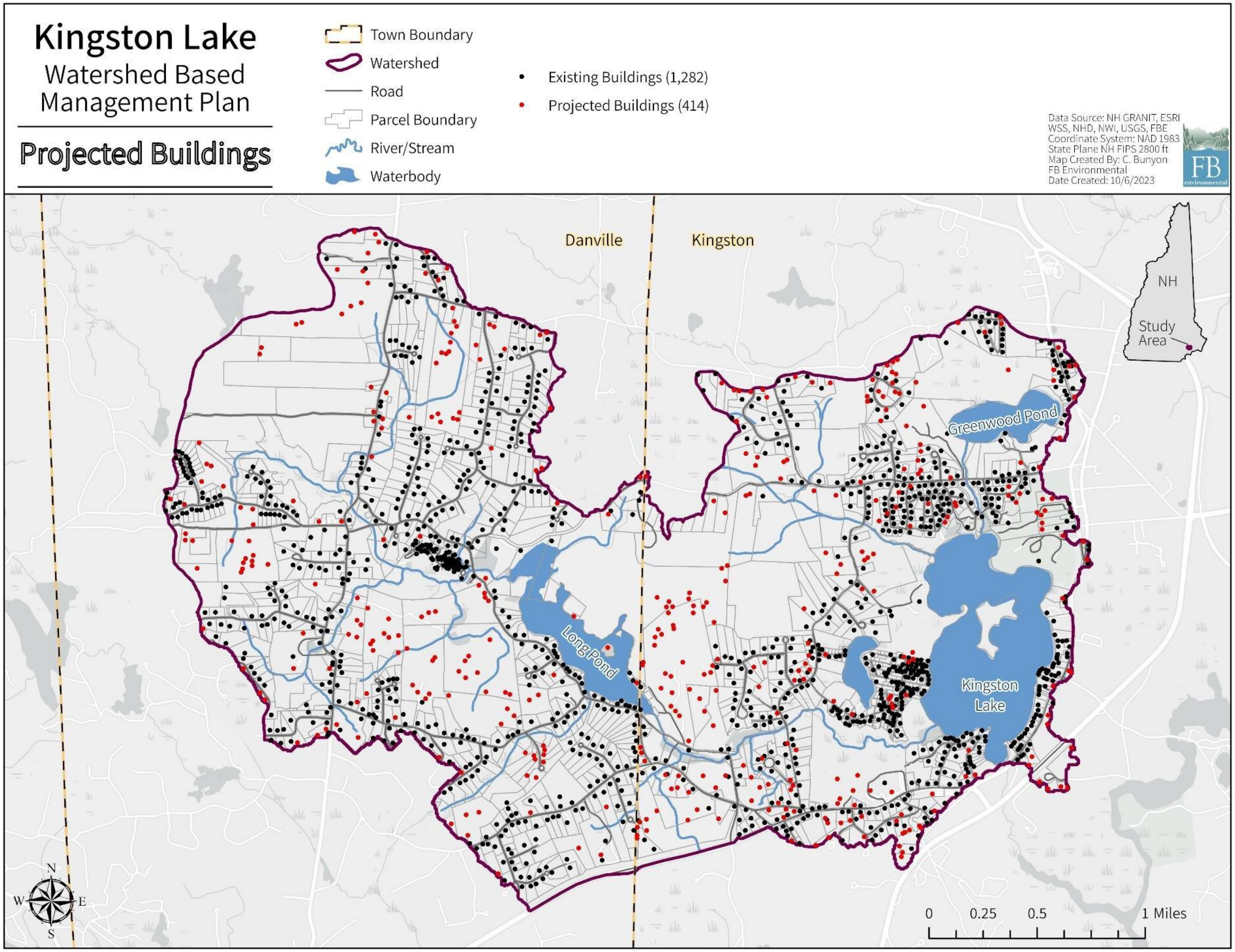
Map A-2. Land cover for the Kingston Lake watershed.



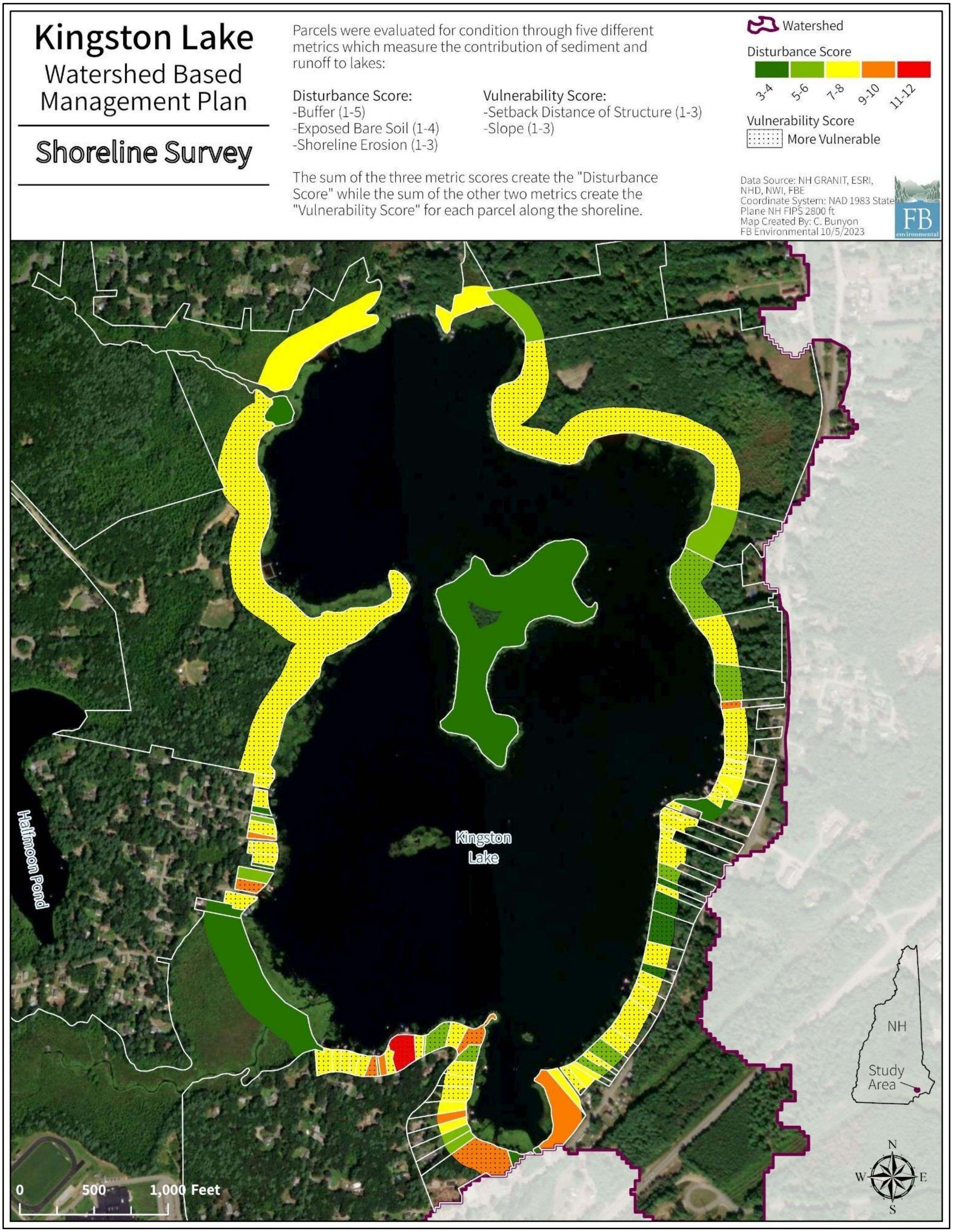
Map A-3. Development constraints (including existing buildings) in the Kingston Lake watershed in Kingston and Danville, New Hampshire.



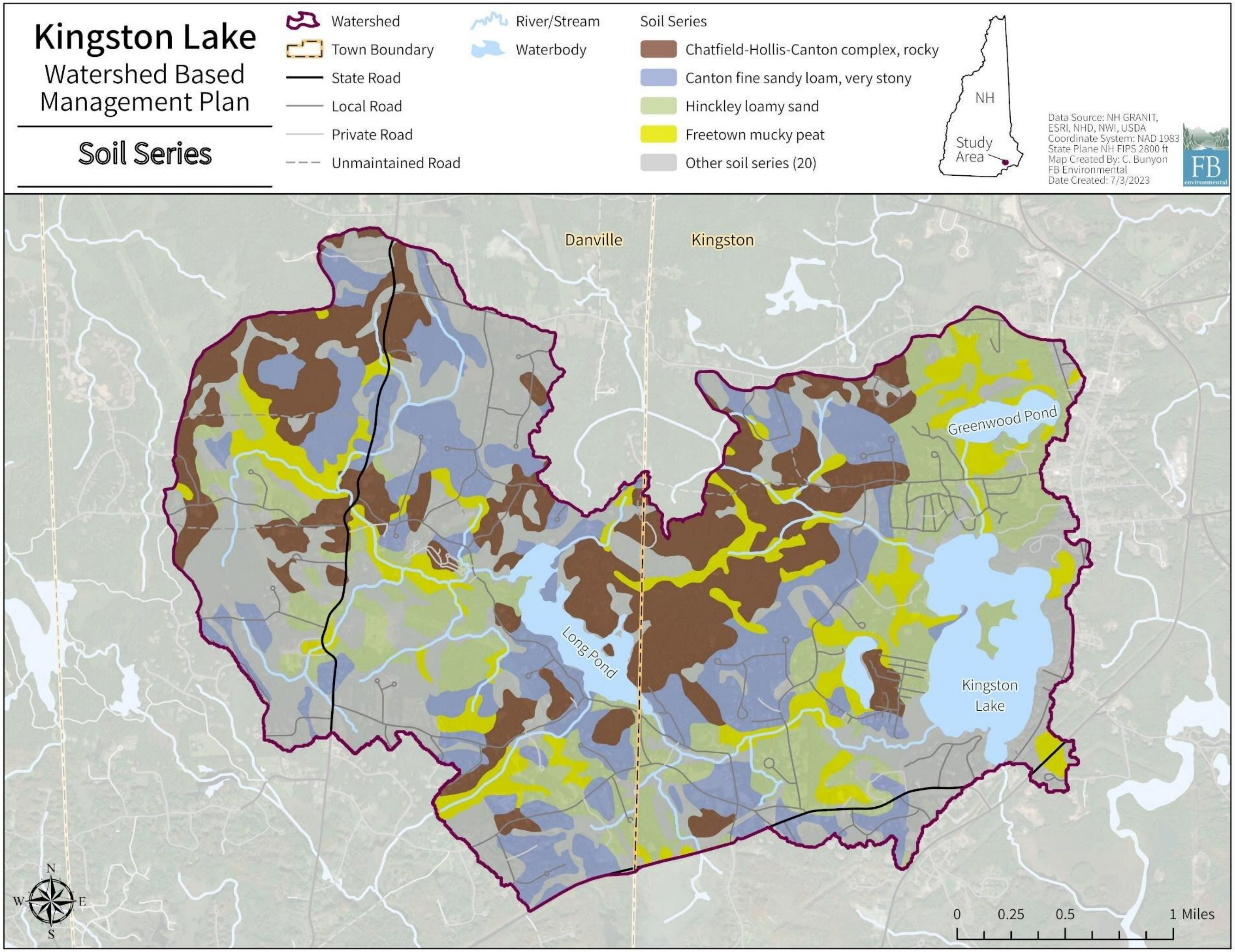
Map A-4. Buildable areaby municipal zone in the KingstonLake watershed in Kingston and Danville, New Hampshire.



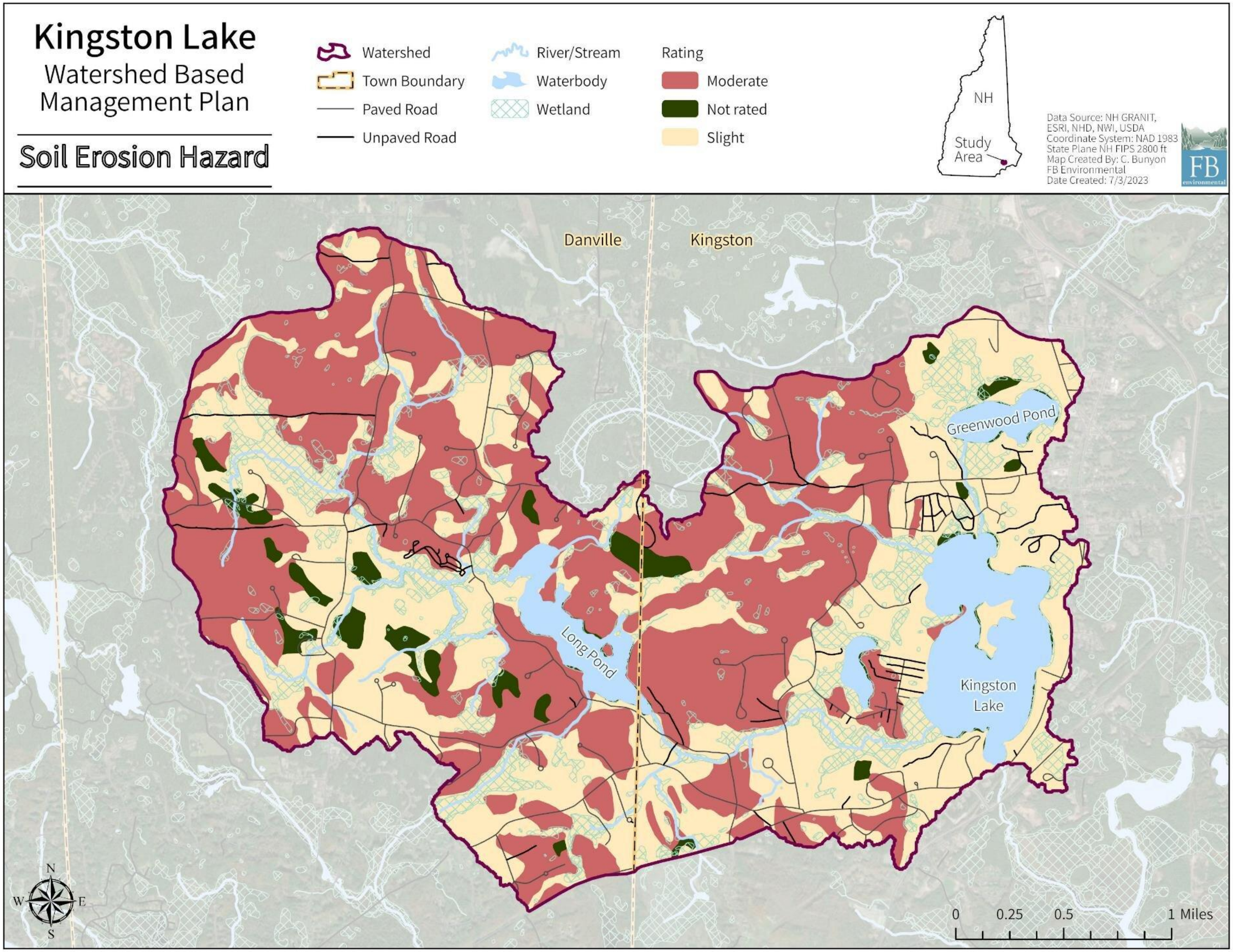
Map A-5. Projectedbuildings in the Kingston Lake watershed in Kingston andDanville, New Hampshire.



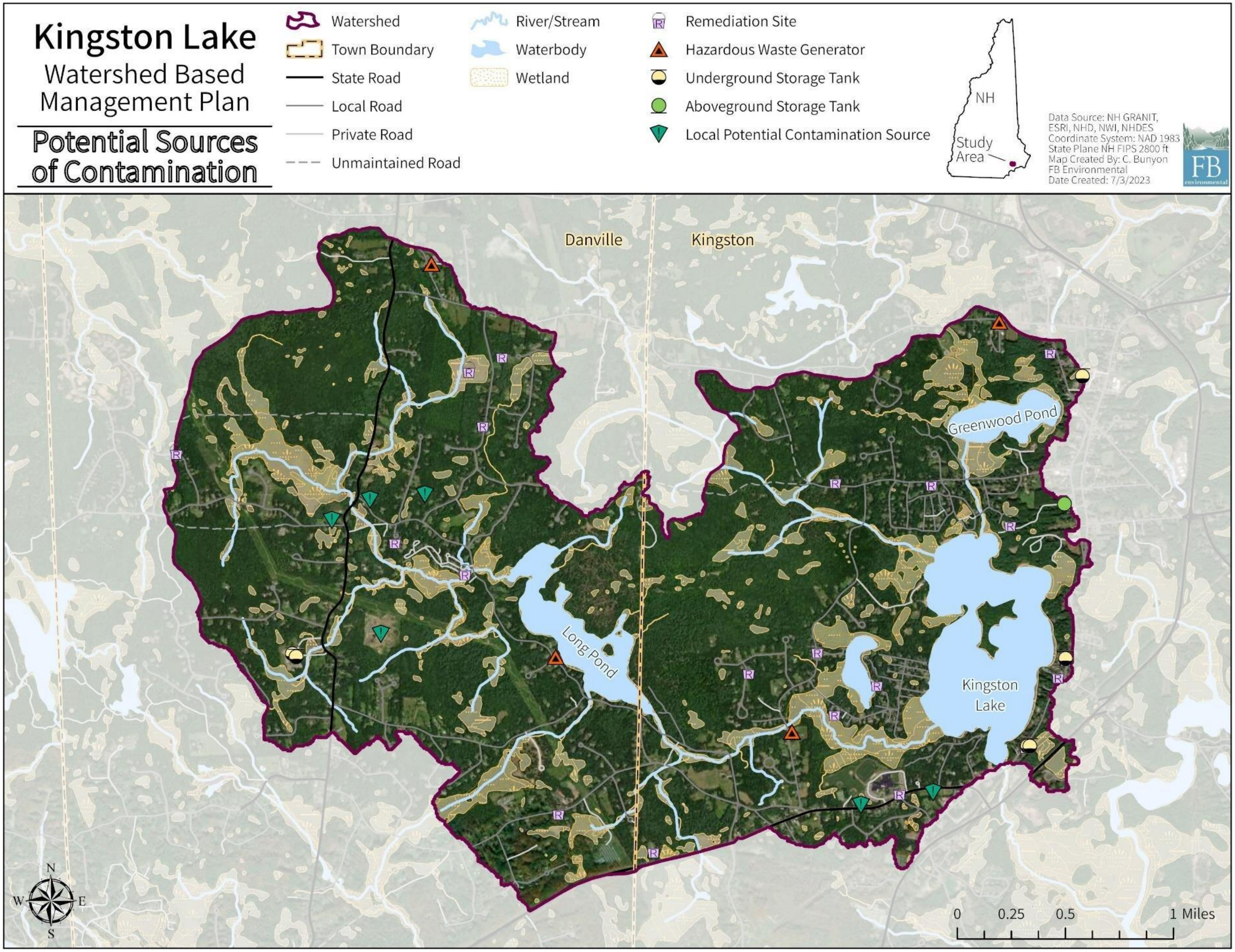
Map A-6. Shoreline Disturbance Score for parcels with frontage on Kingston Lake.



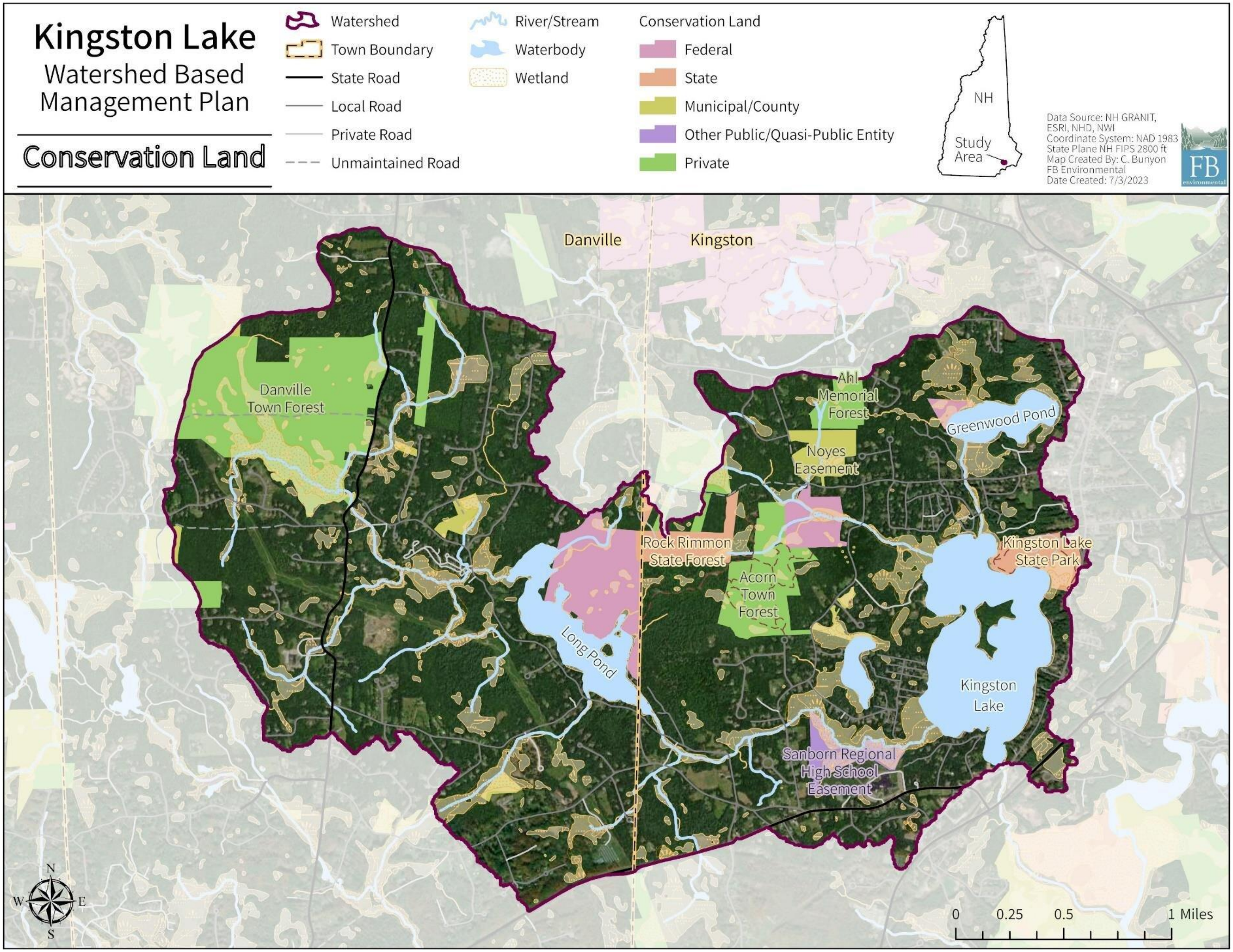
Map A-7. Soilseries in the Kingston Lake watershed.



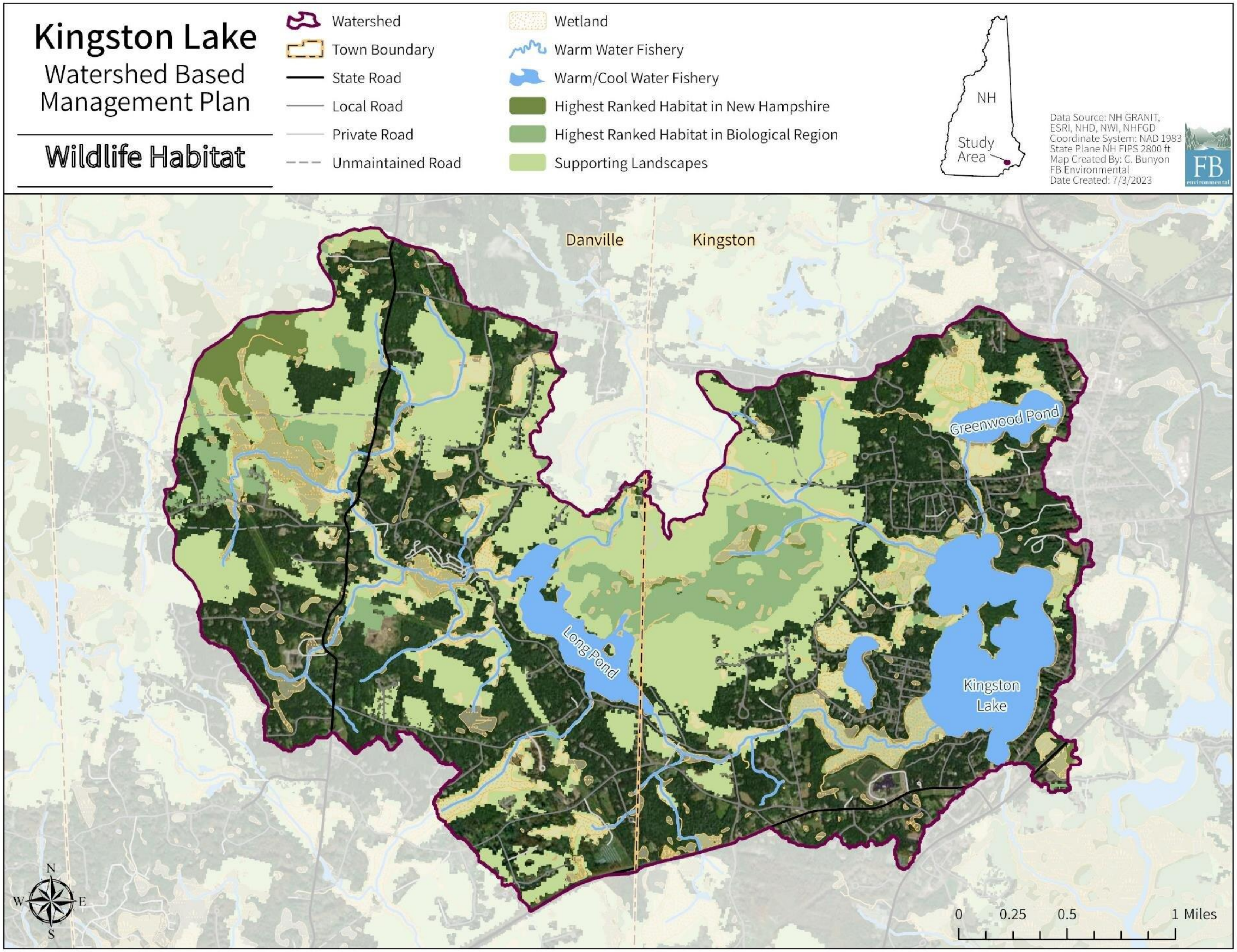
Map A-8. Soil Erosion Hazard in the Kingston Lake watershed.



Map A-9. Potentialsources of contamination in the Kingston Lake watershed.



Map A-10. Conservation landwithin the Kingston Lake watershed.



Map A-11. High value habitat in the Kingston Lake watershed according tothe 2020New Hampshire Wildlife Action Plan.

APPENDIX B: BMP MATRIX

TableB-1. SiteID,locationdescription,transporttowater,waterqualityimpact,estimatedloadreduction,implementationcosts,andrankingforthe55nonpointsource sitesidentifiedintheKingstonLakewatershed.Pollutantloadreductionandcostestimatesarepreliminaryandareforplanningpurposesonly.Costestimatesarebased onpre-COVID19 ranges (adjustedfor 2023inflation),andthus actualconstructioncostscouldbehighlyvariableatthistime. Sitesarepriorityrankedfrom1-55forlowest to highest cost per pound of phosphorus load reduced with remediation. The top sites are highlighted in grey. Note: Rockrimmon Rd is a Class VI roa d and is restricted by state lawto maintain, sothe town would need emergency approval through a public hearing process to access it for completingany work.

SITE	LOCATION	TRANSPORTTO WATER	IMPACT	LOADREDUCTION			ESTIMATEDCOST			RANK
				TSS (metrictons/yr)	TP (kg/yr)	TN(kg/yr)	Est.Low Cost	Est.HighCost	Est.Avg.Cost	
0-07	KingstonStatePark Lawn	DirectFlow	Medium	0.000	0.260	1.240	$500	$1,000	$750	1
2-20	CoburnHill RoadtoMainStreet	DirectFlow	Medium	0.411	0.476	0.951	$5,000	$15,000	$10,000	2
2-10	Long PondRoadfromPineStreet	DirectFlow	Medium	1.833	0.707	1.414	$5,000	$10,000	$7,500	3
2-03	KingstonLakeTownBeach - Adjacent	DirectFlow	High	3.450	1.330	2.660	$20,000	$40,000	$30,000	4
0-08	KingstonStatePark Shoreline	DirectFlow	High	3.938	1.518	3.036	$30,000	$50,000	$40,000	5
4-02	CampLincolnRoadways	DirectFlow	Medium	1.724	0.747	1.494	$5,000	$15,000	$10,000	6
4-03	CampLincolnPathways	DirectFlow	Medium	0.181	0.498	0.181	$5,000	$10,000	$7,500	7
4-01	CampLincolnBeach	DirectFlow	High	2.903	1.214	2.429	$25,000	$50,000	$37,500	8
2-24	Happy Hollow Road	DirectFlow	Medium	1.233	0.476	0.951	$10,000	$20,000	$15,000	9
4-04	CampLincolnTrails	DirectFlow	Medium	1.181	0.455	0.911	$10,000	$20,000	$15,000	10
0-01	GreenwoodPondTownBeach	DirectFlow	High	2.812	1.186	2.371	$30,000	$50,000	$40,000	11
0-06	KingstonLakeBoatLaunch	DirectFlow	High	0.635	0.283	0.567	$5,000	$15,000	$10,000	12
1-01	TheEndofRockrimmonRd	DirectFlow	Medium	2.167	0.835	1.671	$10,000	$20,000	$15,000	13
2-18	Long PondRdnearMitchellsWay	DirectFlow	Medium	2.458	0.569	1.137	$20,000	$50,000	$35,000	14
2-11	Long PondBoatRamp	DirectFlow	High	0.454	0.181	0.363	$5,000	$10,000	$7,500	15
1-07	Winslow ParkRd	DirectFlow	Small	0.611	0.236	0.471	$5,000	$8,000	$6,500	18
0-03	RockrimmonRoadStreamCrossing	DirectFlow	Small	0.158	0.061	0.121	$5,000	$10,000	$7,500	19
2-13	RockrimmonRoadNearRubyDrive	DirectFlow	Small	0.750	0.289	0.578	$40,000	$60,000	$50,000	20
1-09	Corner ofToppanRdandRockrimmon	Limited	Small	0.075	0.272	1.270	$2,500	$5,000	$3,750	21
2-23	Boulder Drive	Limited	Small	0.492	0.190	0.379	$2,500	$5,000	$3,750	22
2-14	DiamondRoadNearBallPark Way	Limited	Small	0.400	0.154	0.308	$2,000	$5,000	$3,500	23
3-06	GreatPondRoad	Limited	Small	0.091	0.318	1.257	$5,000	$10,000	$7,500	24
1-04	ColcordRoad	Limited	Small	0.236	0.273	0.546	$5,000	$8,000	$6,500	25
2-15	DiamondRoadExposedBank	Limited	Small	0.635	0.253	0.506	$12,000	$2,000	$7,000	26
2-16	HawkeLane	Limited	Small	0.323	0.125	0.249	$2,000	$5,000	$3,500	27
3-05	HuntingtonHill Road	Limited	Small	0.967	0.373	0.745	$8,000	$15,000	$11,500	28
2-22	Hersey RoadnearGHCarterDrive	Limited	Small	0.635	0.258	0.517	$8,000	$15,000	$11,500	29
2-17	Corner ofHawkeLane	Limited	Small	0.014	0.017	0.051	$500	$1,500	$1,000	30
2-26	PhoenixRoad	Limited	Small	0.056	0.119	0.382	$5,000	$10,000	$7,500	31
2-06	WadleighPointRd2	Limited	Small	0.129	0.050	0.100	$2,500	$5,000	$3,750	32
1-06	Corner ofBeachDr&Winslow Park Rd	Limited	Small	0.181	0.045	0.136	$2,000	$5,000	$3,500	33
3-01	SchoolParking Lot	Limited	Small	0.193	0.383	0.907	$20,000	$40,000	$30,000	34
1-05	Thayer RoadDriveway Erosion	Limited	Small	0.045	0.045	0.227	$2,500	$5,000	$3,750	35

SITE	LOCATION	TRANSPORTTO WATER	IMPACT	LOADREDUCTION			ESTIMATEDCOST			RANK
				TSS (metrictons/yr)	TP (kg/yr)	TN(kg/yr)	Est.Low Cost	Est.HighCost	Est.Avg.Cost	
1-08	Winslow ParkRd&RockrimmonRd	Limited	Small	0.596	0.230	0.459	$10,000	$30,000	$20,000	36
			Small	0.419	0.162	0.323	$12,000	$18,000	$15,000	37
			Small	0.195	0.075	0.151	$5,000	$10,000	$7,500	38
			Small	0.017	0.021	0.045	$1,500	$3,000	$2,250	39
			Small	0.083	0.269	0.882	$20,000	$40,000	$30,000	40
			Small	0.635	0.251	0.501	$30,000	$60,000	$45,000	41
			Small	0.016	0.018	0.045	$2,500	$5,000	$3,750	42
3-04	KingstonRoadby Verrill Farm	Limited								
2-09	Corner ofAppaloosa Way &ClydesdaleDr	Limited								
3-02	SchoolParking LotTreeIsland	Limited								
3-03	Nearinter.ofLong PondRd&Cheney Rd	Limited								
2-21	MainStreetatYeOldeMeeting House	Limited								
0-04	RockrimmonRoadNeartheBoulder	Limited								
According totheKingstonDPW,thefollowing siteshavealready beenaddressed.										
2-28	AcornStreetCatchBasinandGully	DirectFlow	Medium	1.250	0.482	0.964				
2-25	Ball Road,NorthofHalfMoonLane	DirectFlow	Small	0.238	0.275	0.549				
2-27	AcornStreetCatchBasin	DirectFlow	Small	0.091	0.045	0.045				
2-07	Kelly RoadtoWetland	DirectFlow	Small	0.625	0.241	0.482				