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Lida Lakeshed Assessment

Lida Lakes Improvement District
Funded by the Clean Water Land and Legacy Amendment

April 28, 2026

CLEAN WATER LAND & LEGACY AMENDMENT

Acknowledgements

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April 28, 2026

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Executive Summary

Lake Lida, located in northwestern Otter Tail County, Minnesota, consists of two connected basins—North Lida and South Lida—and supports extensive recreational use, residential development, and valuable aquatic and shoreline habitat. While recent monitoring shows that both basins currently meet state water quality standards for phosphorus, chlorophyll-a, and water clarity, increasing development pressure and aging infrastructure present long-term risks to lake health. This study was conducted to proactively assess current conditions, identify sources of phosphorus loading, and develop clear, science-based strategies to protect and improve water quality.

In 2025, the Lake Lida Lake Improvement District (LLID) received a Board of Water and Soil Resources (BWSR) grant to complete a comprehensive water quality study. Houston Engineering, Inc. (HEI) conducted an integrated assessment including a lakeshed analysis, septic system review, shoreline survey, phosphorus budget modeling, and evaluation of implementation scenarios. Together, these components provide a technical foundation for prioritizing actions and pursuing future implementation funding.

The lakeshed assessment found that the watershed is dominated by open water and forest, with relatively small proportions of cropland (approximately 5%) and developed land (approximately 6%). However, shoreline development is substantial, with 831 parcels located within 1,000 feet of the lake. Agricultural runoff, developed land runoff, septic systems, and shoreline erosion were all identified as manageable sources of phosphorus loading.

A review of septic system records showed that out of 685 septic systems around the lake, 129 (19%) were installed prior to 1990 and are likely nearing or exceeding their typical lifespan. These older systems represent a measurable risk for phosphorus inputs, particularly in nearshore areas. Shoreline surveys using the Minnesota DNR "Score the Shore" protocol revealed a distinct contrast between basins: approximately two-thirds of North Lida shoreline was rated low or very low quality due to vegetation removal and structural alterations, while South Lida retains a higher proportion of natural shoreline, largely influenced by Maplewood State Park.

Phosphorus budgets developed using the BATHTUB lake response model indicate that atmospheric deposition is the largest overall source of phosphorus, but it is not manageable locally. The most effective opportunities for reduction are failing septic systems, agricultural runoff, shoreline erosion, and developed land runoff.

Overland total phosphorus loading was estimated at approximately 4,819 lbs/yr for North Lida and 1,172 lbs/yr for South Lida. A realistic 10-year management goal of a 5% reduction corresponds to reductions of 240 lbs/year and 57 lbs/year, respectively (Table 1).

Table 1. Phosphorus budget and reduction goals for North and South Lida lakes.

	Total Phosphorus Existing Loads	10-Year Goal for Reduction
North Lida	4,819 lbs/yr	240 lbs/yr (5%)
South Lida	1,172 lbs/yr	57 lbs/yr (5%)

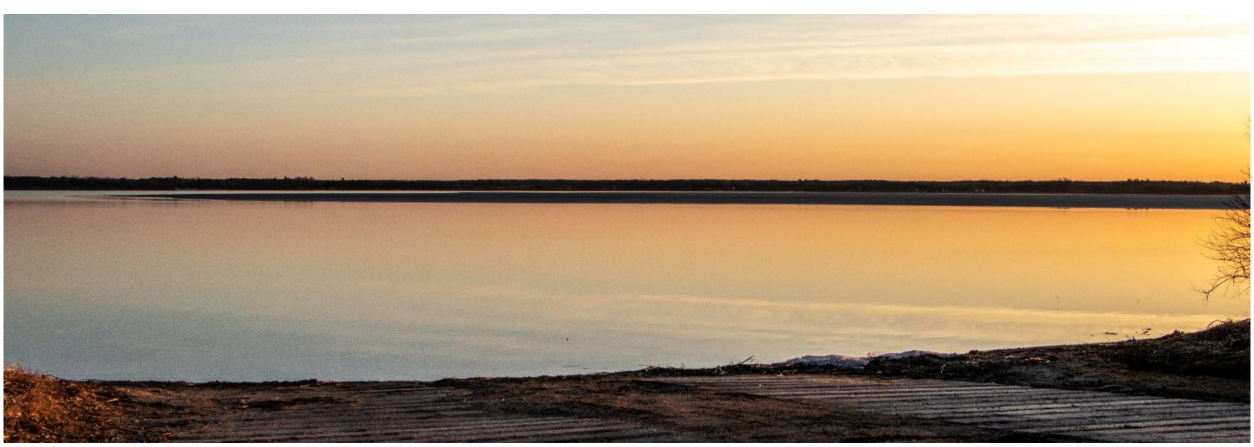
Modeling results show that a combined implementation approach—repairing half of the pre-1990 septic systems, restoring half of the eroding shoreline, and installing high-priority agricultural best management practices—would result in measurable improvements. These actions are projected to reduce in-lake phosphorus concentrations, lower algal biomass, and increase water clarity by approximately one foot on average.

Based on these findings, the study recommends focusing on four priority action areas over the next decade:

- repairing or replacing aging septic systems,
- restoring and protecting shoreline vegetation,
- implementing targeted agricultural best management practices, and
- protecting forested and riparian lands through conservation programs.

These actions will be supported through partnerships with Otter Tail County and the West Otter Tail Soil and Water Conservation District.

This study positions Lake Lida for strategic, cost-effective implementation that protects existing water quality while addressing emerging risks. By acting proactively, the LLID and its partners can sustain Lake Lida's ecological health, recreational value, and community benefits well into the future.



Section 1. Introduction

Introduction

Lake Lida is located in northwestern Otter Tail County approximately five miles east of Pelican Rapids, MN. North Lida Lake is connected to South Lida Lake by a navigable culvert under State Highway 108 along the south shoreline (Figure 1). North Lida Lake is also connected to Lizzie Lake via a non-navigable culvert under County Road 4.

A majority of the shoreline on North and South Lida Lake has been developed, except for Maplewood State Park. Homes, cottages, and resorts compose most of the development. A DNR owned concrete public water access is located off County Road 4 along the north shoreline.

Large stands of hardstem bulrush are scattered throughout the lake. Emergent aquatic plants such as bulrush provide valuable fish and wildlife habitat, and are critical for maintaining good water quality. They protect shorelines and lake bottoms, and can actually absorb and break down polluting chemicals.

A majority of the east shoreline is located within the boundaries of Maplewood State Park. A DNR owned public water access is located within the state park along the southeast shoreline. A public swimming beach and campground are also located along the east shoreline in the state park.

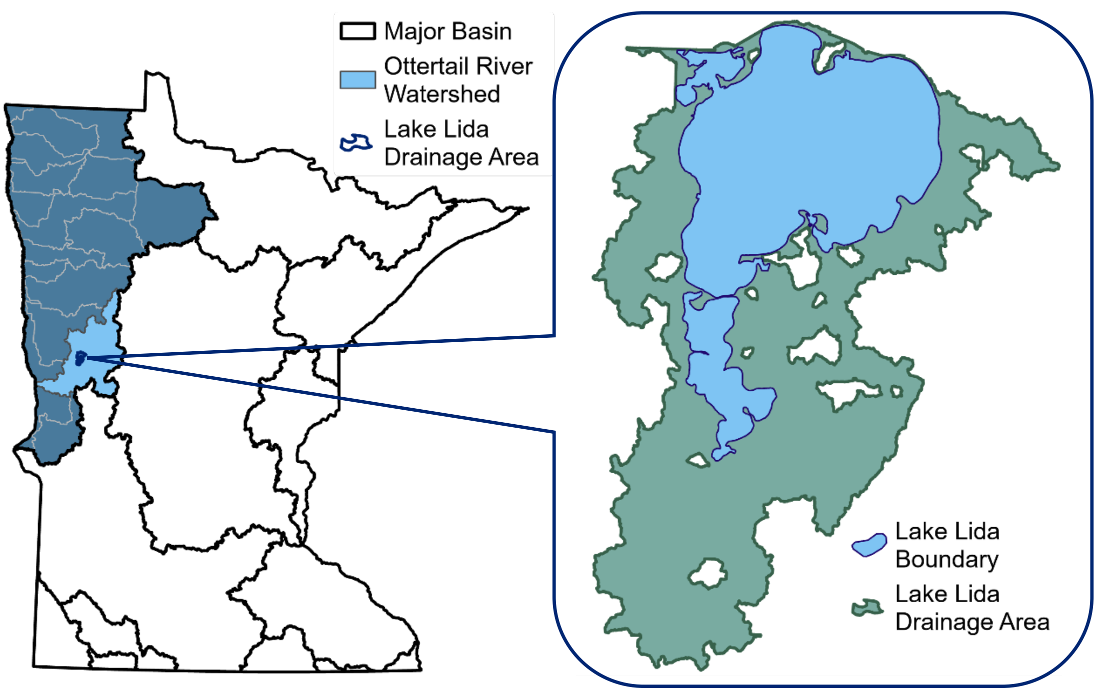


Figure 1. Basins and watershed in Minnesota.

Funding and Goals for the Study

In 2025, the Lake Lida Lake Improvement District (LLID) applied for and was awarded a Board of Water and Soil Resources (BWSR) grant in the amount of $57,000 to support a comprehensive lake water quality study. The grant requires a 10 percent local match totaling $5,700, which was provided by the LLID. The total project budget is $62,700. This investment supports a targeted, science-based assessment to inform future water quality protection and improvement efforts.

STUDY GOALS

1. Evaluate current condition of the lake
2. Develop a phosphorus budget (where phosphorus is coming from)
3. Identify specific projects to improve water quality.

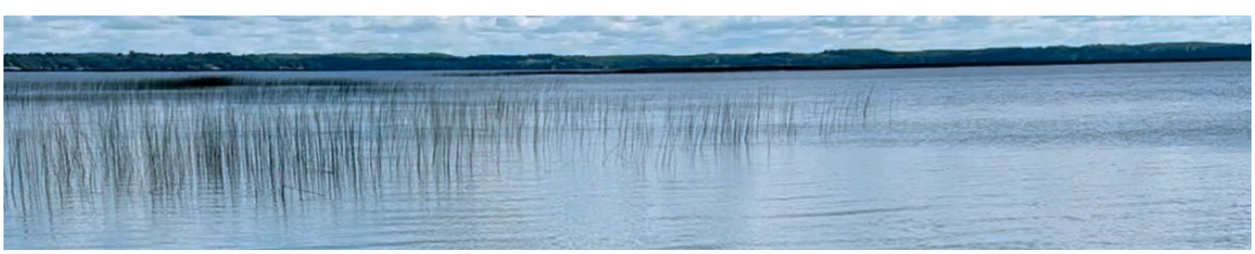
The purpose of the study is to establish a clear understanding of the lake's current condition and to identify practical strategies for improving water quality. The study provides the technical foundation needed to guide management decisions, prioritize projects, and position the lake for future implementation or restoration funding.

The first objective of this study was to evaluate current lake conditions. This includes reviewing existing data and conducting additional analyses as needed to assess key water quality indicators. Establishing current conditions creates a baseline to measure change over time and helps clarify the most significant factors affecting lake health.

The second core objective is the development of a phosphorus budget. Because phosphorus is a leading contributor to excessive algal growth and water quality degradation, the study identified and quantified major phosphorus sources to the lake. These may include watershed runoff, shoreline inputs, precipitation, and internal loading. Understanding the relative contribution of each source is critical to identifying effective management strategies.

The third objective is to identify specific projects to improve water quality. Using results from the lake condition assessment and phosphorus budget, the study will recommend targeted actions designed to reduce phosphorus loading and protect lake resources. Recommended projects will be practical, prioritized, and intended to provide measurable water quality benefits.

Overall, this study represents a proactive step toward long-term lake protection. By combining condition assessment, nutrient source analysis, and project identification, the study will support informed decision-making and help guide future investments aimed at improving and maintaining lake water quality.



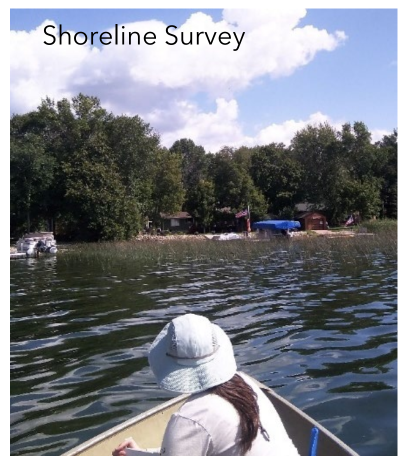
Study Components

The lake study consists of five coordinated components designed to identify nutrient sources, assess existing conditions, and support effective water quality improvements. Together, these elements inform the phosphorus budget and guide implementation planning.

The **Lakeshed Assessment** evaluates the land area draining to the lake to understand how watershed characteristics influence nutrient loading. This analysis considers watershed boundaries, land use, soils, drainage patterns, and surface water connections. The assessment identifies areas with higher potential for phosphorus runoff and helps prioritize locations where management actions can have the greatest water quality benefit.

The **Septic System Records** review examines subsurface sewage treatment systems located within the lakeshed, with particular attention to shoreline and near-shore areas. Available records from Otter Tail County were reviewed to assess system type, age, inspection history, and compliance status. Because failing or outdated systems can contribute phosphorus to surface waters, this component helps determine whether septic systems may be a significant nutrient source and whether additional investigation or upgrades may be warranted.

Shoreline Surveys document physical and vegetative conditions along the lake shoreline. Surveys evaluate shoreline slope, erosion, vegetation coverage, and the presence of structural alterations such as retaining walls. Shoreline conditions directly affect near-shore water quality, habitat, and nutrient inputs. This component identifies erosion problem areas and opportunities for shoreline restoration or improved buffers to reduce phosphorus runoff.



The **Lake Model** integrates monitoring data, watershed information, and phosphorus source estimates to evaluate how nutrients move through the lake system. The model quantifies external and internal phosphorus loading and estimates the lake's response under current conditions. This analysis provides a technical basis for understanding water quality trends and predicting outcomes of management actions.

Finally, **Implementation Scenarios** are developed using results from the lake model and supporting analyses. These scenarios evaluate potential management strategies—such as watershed runoff reduction, septic improvements, or shoreline projects—and estimate their expected water quality benefits. The scenarios support project prioritization and selection of cost-effective actions to improve and protect lake water quality. These results will be shared with the West Otter Tail Soil and Water Conservation District for technical and financial assistance.

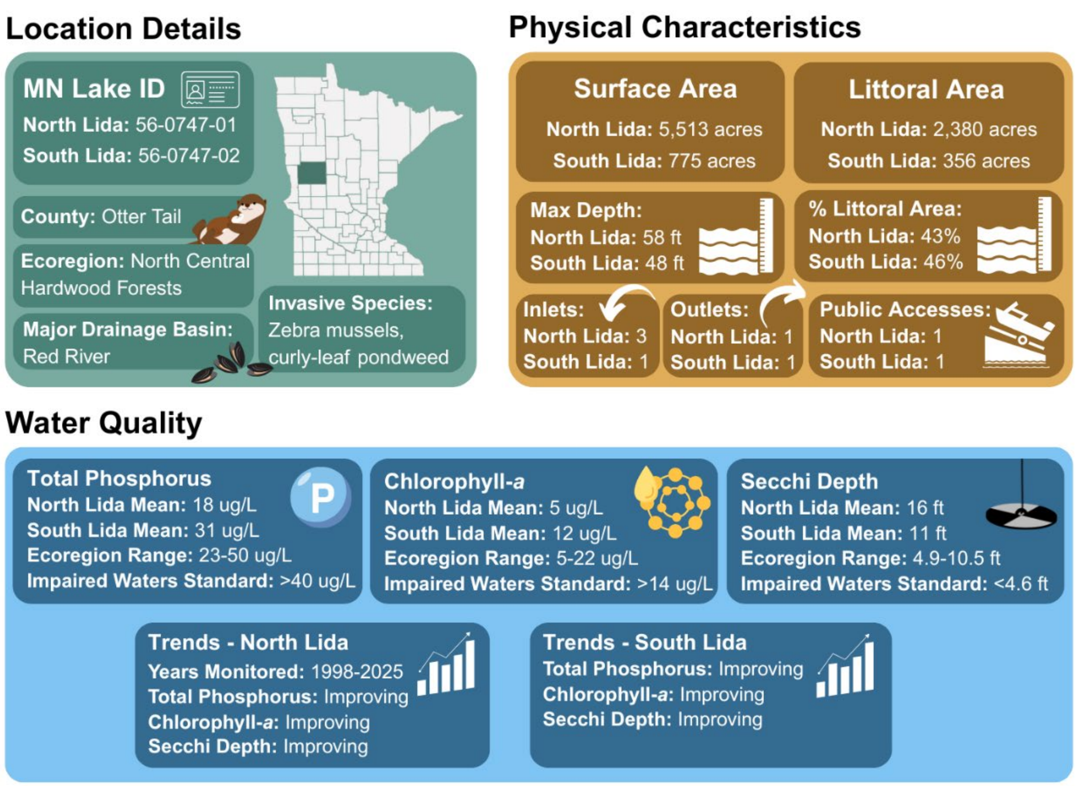
Collectively, these study components provide an integrated framework for understanding lake conditions and identifying practical, science-based solutions to support long-term lake health.

Section 2. Lakeshed Assessment

Lake Lida Stats

Together the lakes have a combined surface area of 6,288 acres, with a max depth of 58 feet in North Lida. There is one public access site per lake and 1 outlet in each. Lake Lida is home to four dominant fish species including Black Crappie, Bluegill, Northern Pike, and Walleye. Invasive species that have been found in the lakes are Curly-leaf pondweed and Zebra mussels.

Water quality trends for both lakes are showing water quality improvements for total phosphorous, chlorophyll-*a* concentrations, and water clarity.



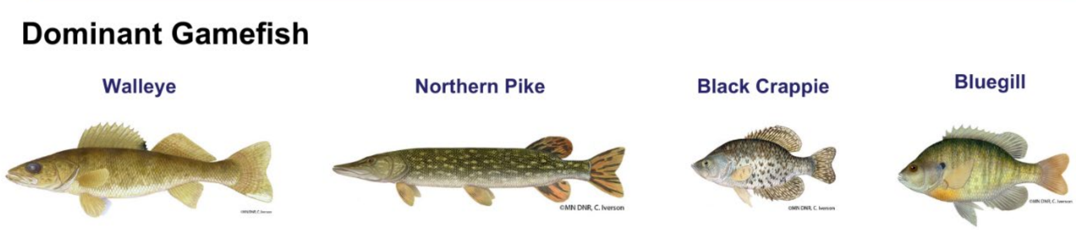


Photo credit: Minnesota DNR; C. Iverson

Land Use

Within the drainage basin, most of the area is made up of open water and forest. Approximately 6% of the area is developed and 5% is forested (Figure 2).

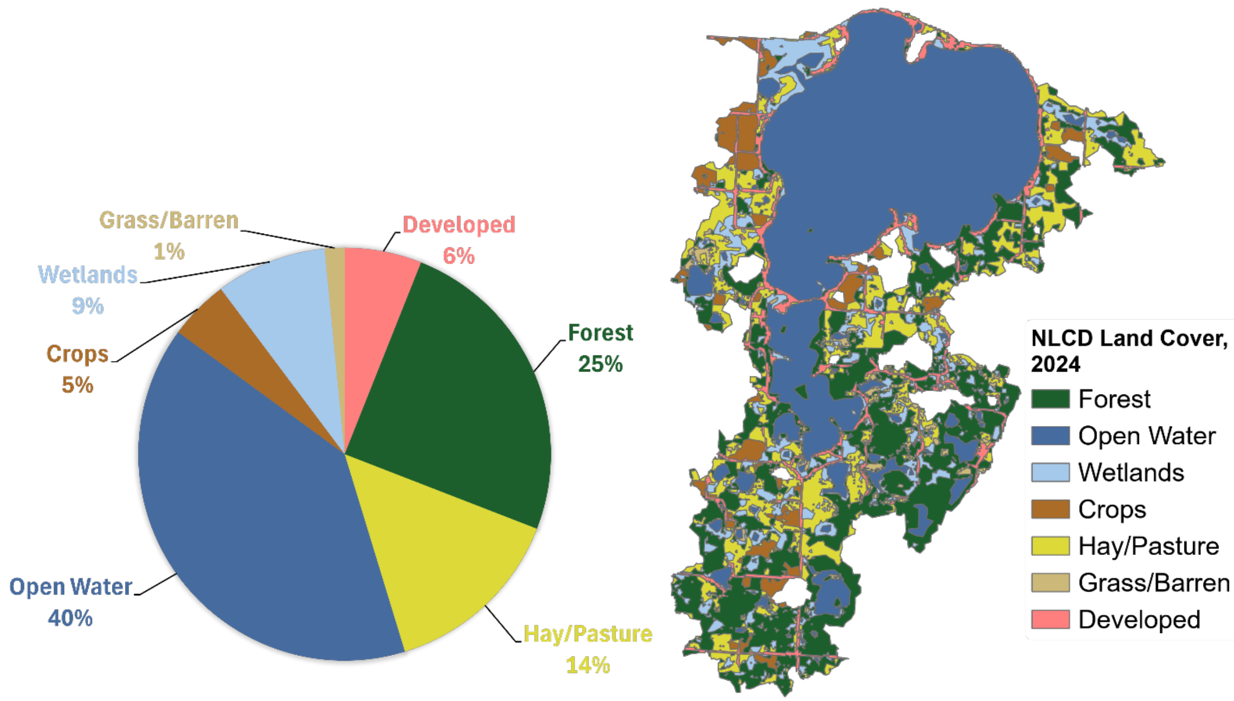
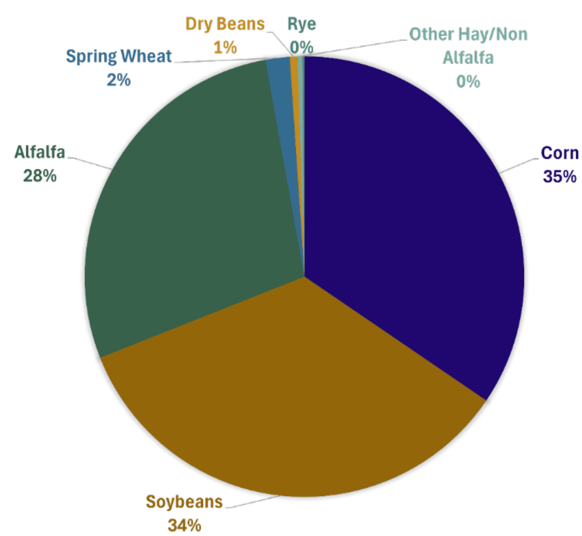


Figure 2. National Land Cover Dataset (2024) distribution within watershed.

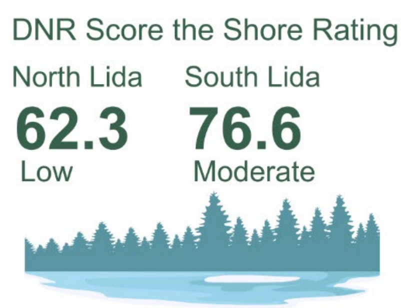
Within the 5% of cropland, the dominant crop types include corn, soybeans, and alfalfa, with small amounts of spring wheat, dry beans, rye and other types of hay/alfalfa (Figure 3).

Figure 3. Crop type distribution within watershed.



Development

Development around both lakes make up 6% of the total drainage area. There are 831 parcels within a 1,000-foot buffer of the lakes resulting in a lake shoreline development classification of general development (Figure 4). This means there is a moderate to high level of development along the shorelines of the lakes, which can increase human impacts on water quality. Dock density is 29 per mile of shoreline for North Lida and 12 per mile for South Lida.



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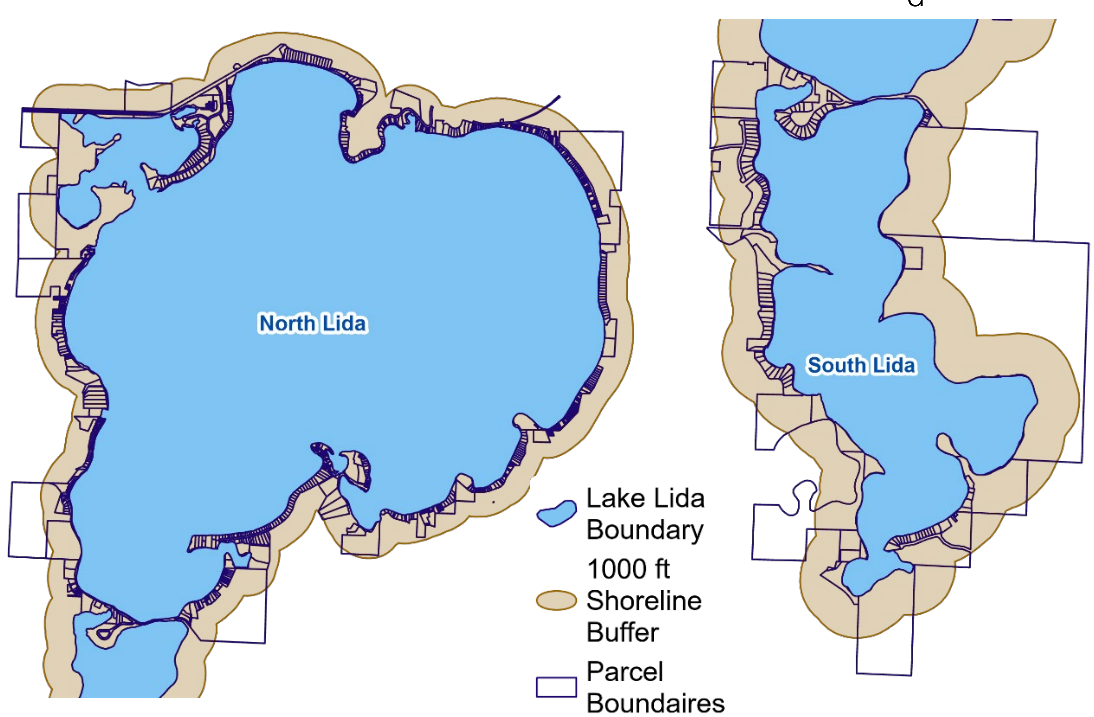


Figure 4. Parcels surrounding Lake Lida

Section 3. Septic Systems

All the properties in the LLID use a septic system or holding tank. These can be referred to as a Subsurface Sewage Treatment System (SSTS). The typical lifespan of an SSTS near a lake in Minnesota—or similar regions—depends on several factors, including the type of tank, installation quality, soil conditions, and maintenance practices. See Figure 5 for an illustration of a septic system and drain field (leach field).

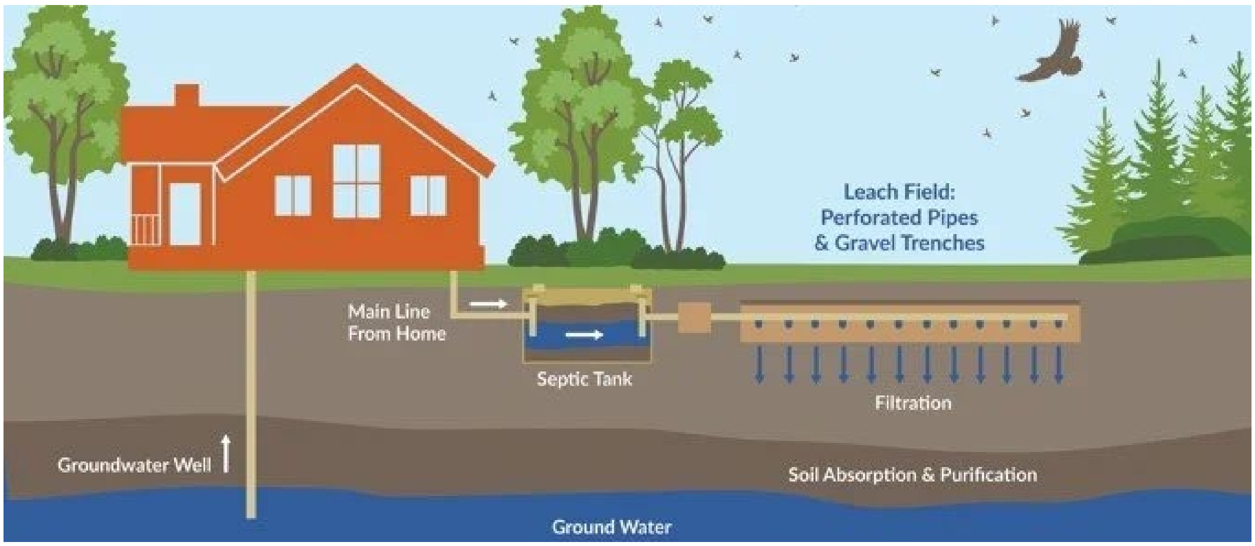


Figure 5. Illustration of a septic system and drain field. Source: https://www.lakesunapee.org/septic-systems.

Septic/Holding Tank Lifespan by Material

Source: upfrontseptic.com

- Concrete tanks: 30–40+ years with proper maintenance.
- Fiberglass or plastic (HDPE): 30+ years.
- Steel tanks: 15–20 years due to corrosion risk.

Drain Field (Leach Field) Lifespan

- Typically 20–30 years, but can vary widely based on usage and soil conditions. [buildingadvisor.com]
- The drain field is often the first component to fail, especially if overloaded or poorly maintained.

Key Factors Affecting Lifespan

- Proximity to water: Systems near lakes are more vulnerable to water table fluctuations and contamination risks.
- Usage: Seasonal homes may have longer-lasting systems than full-time residences.
- Maintenance: Regular pumping (every 2–3 years), inspections, and avoiding harsh chemicals or solids can significantly extend life. [pca.state.mn.us]

- Installation quality: Proper design and installation are crucial for longevity. [buildingadvisor.com]

Methods

The Otter Tail County mapping website has the capability to look up previous SSTS records for each parcel around the lake. These records were used to compile and summarize the ages of the SSTS around North and South Lida Lakes (Figure 6 and Figure 7).

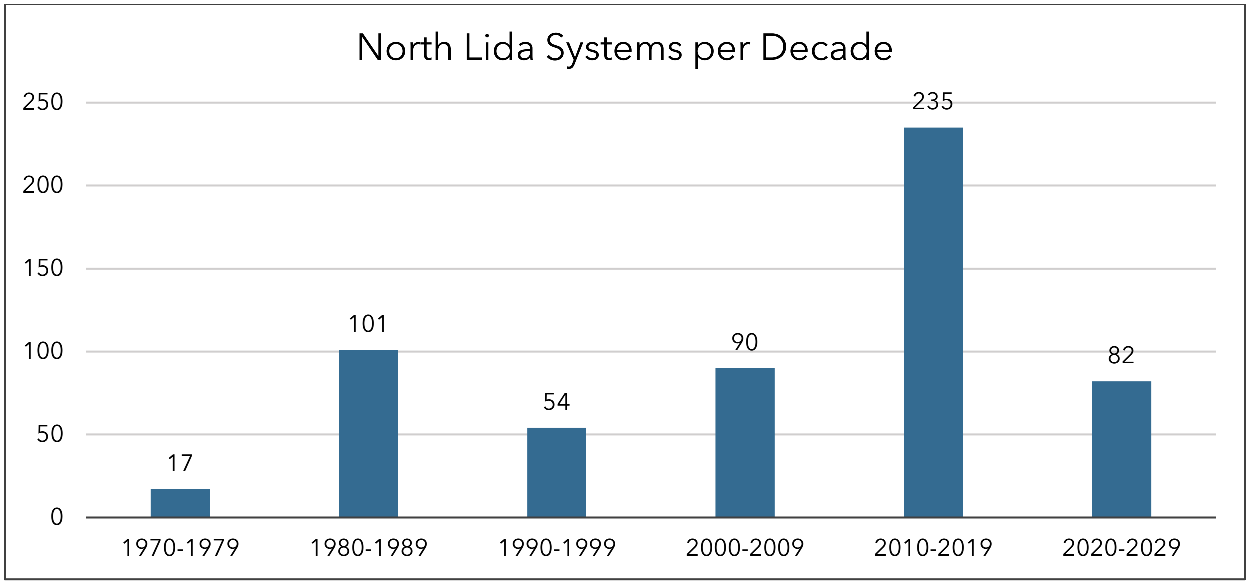


Figure 6. Ages of septic systems and holding tanks in North Lida Lake.

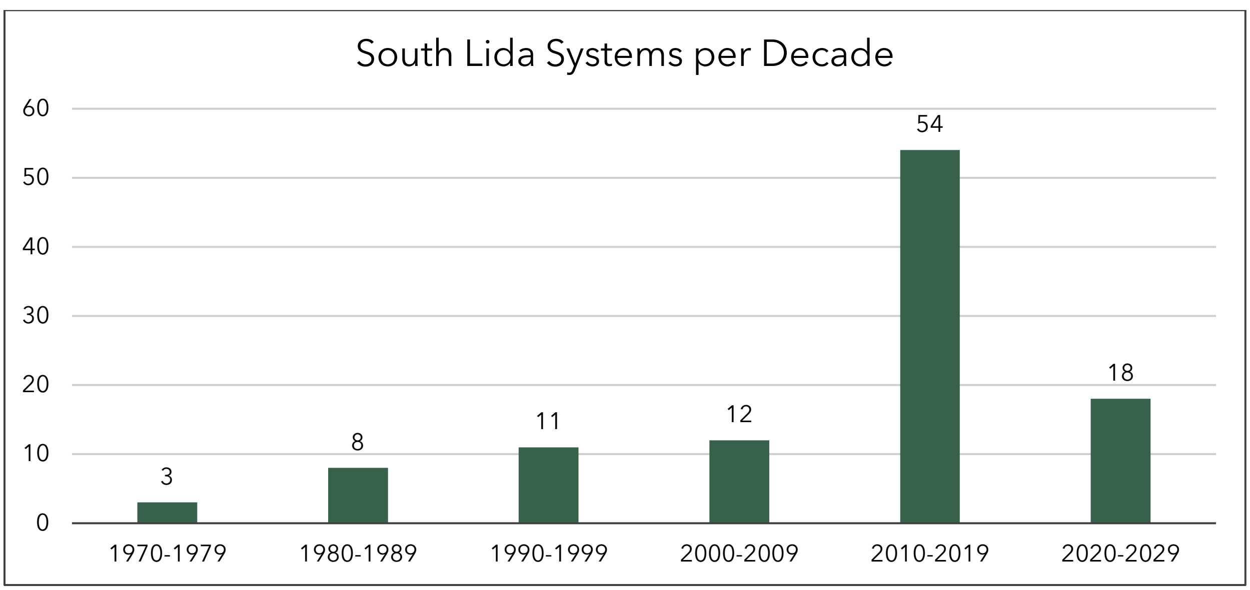


Figure 7. Ages of septic systems and holding tanks in South Lida Lake.

The results showed that out of 807 total parcels around both lakes, there were 685 SSTS (Figure 8). Of these 685 systems, 129 (19%) are older than 1990 (Table 2). 1990 was used as a cutoff because it is within the typical 30-40 year lifespan. These 129 SSTS older than 1990 were simulated in the lake model for phosphorus contribution to the lake (Chapter 4).

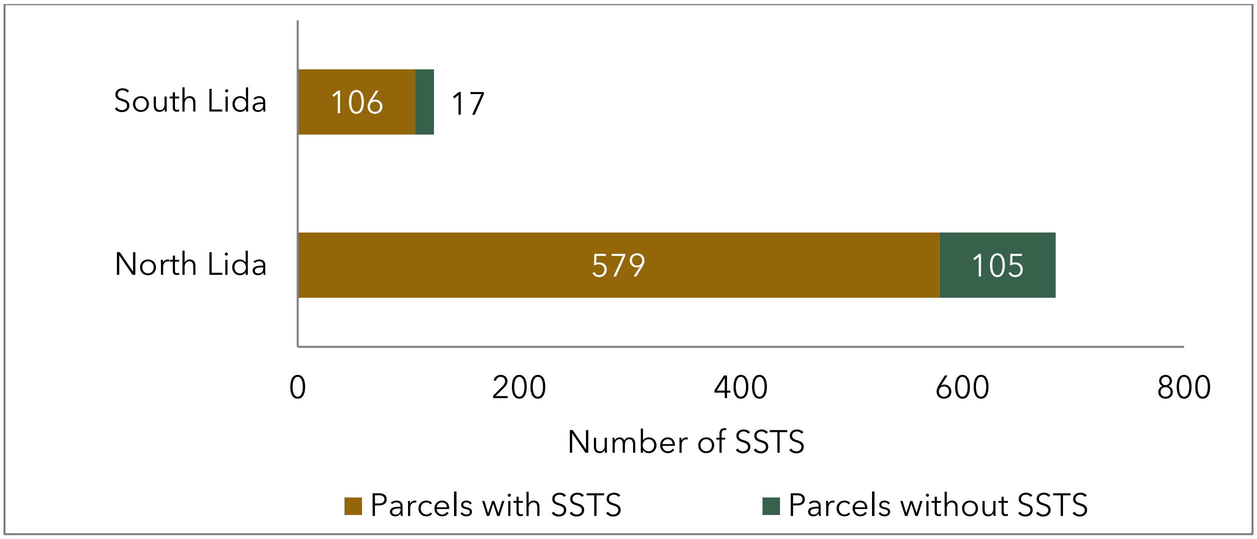


Figure 8. Number of parcels per lake with and without SSTS.

Table 2. Septic and holding tank statistics for North and South Lida Lakes.

	Total Parcels	Parcels without septic systems	Total Septic Systems/Holding Tanks	Total pre 1990
North Lida	684	105	579	118
South Lida	123	17	106	11
Totals	**807**	**122**	**685**	**129**

Chapter 4. Shoreline Survey

Purpose and Importance

The shoreline survey was conducted to evaluate the condition and quality of near-shore habitat around the lake and to assess how shoreline development and vegetation influence water quality and habitat quality. The shoreline zone plays a critical role in protecting lakes by stabilizing soils, filtering runoff, providing wildlife habitat, and moderating near-shore water temperatures. Alteration of natural shoreline vegetation—particularly the replacement of native plants with turf grass or structural shoreline treatments—can significantly increase erosion and phosphorus runoff to the lake.

This shoreline survey provides a systematic assessment of shoreline condition and identifies areas where restoration or management actions could reduce phosphorus runoff and improve overall lake health. Results from this component directly support the phosphorus budget and help inform implementation scenarios developed later in the study.

Survey Methods

The shoreline survey was conducted using the Minnesota Department of Natural Resources "Score the Shore" rapid assessment protocol: a standardized, lakewide method designed to evaluate lakeshore habitat condition through visual observation from a boat. The protocol is intended to assess habitat quality and results are reported in aggregate to protect landowner privacy. Survey sites were assessed during the growing season, when terrestrial and aquatic vegetation could be readily observed.

At each site, habitat conditions were evaluated across three distinct zones (Figure 9).

Upland Zone – extending landward from the shoreline, roughly equivalent to the shoreland setback area where development pressure is highest.

Shoreline Zone – the transition area between upland and water, extending from the bank to the water's edge.

Aquatic Zone – extending lakeward approximately 50 feet into shallow waters where emergent and floating-leaf vegetation and aquatic habitat are present.

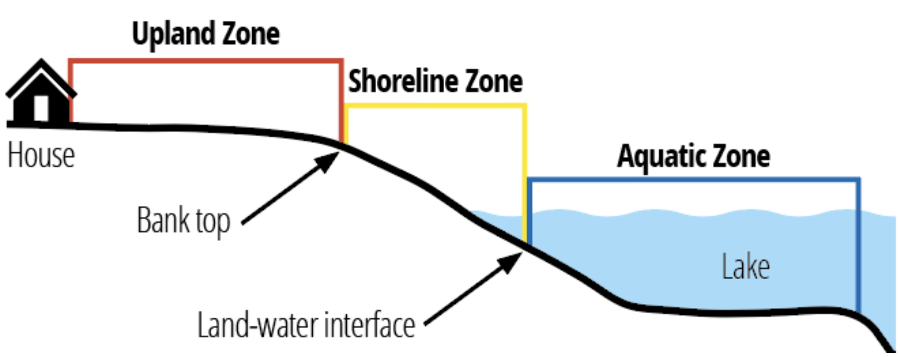


Figure 9. Shoreline zones evaluated during the shoreline survey.

Within each zone, surveyors visually estimated vegetation coverage and habitat features using broad cover classes. Features evaluated included the presence of trees, shrubs, natural ground cover, overhead woody habitat, downed woody habitat, aquatic vegetation, and the extent of human disturbance such as docks, cleared vegetation, or engineered shoreline structures. Scores from individual features were combined into a site habitat score and then summarized lakewide.

For reporting purposes, shoreline vegetation quality was categorized as Very Low, Low, Moderate, High, or Very High, reflecting the degree to which natural vegetation remains intact.

Figure 10. Examples of shoreline ratings.

Results

Survey results indicate substantial variability in shoreline condition around the lake, with marked differences between shoreline segments.

North Lida Results

North Lida Lake exhibited a high proportion of disturbed shoreline conditions (Figure 11). Approximately 54% of surveyed shoreline segments were rated as Very Low quality, indicating extensive vegetation removal, limited natural ground cover, or structural alterations such as retained or armored shorelines. An additional 12% of shoreline segments were rated Low quality. Together, these categories indicate that roughly two-thirds of the north shoreline is heavily altered and offers minimal buffering capacity for runoff and erosion.

Moderate quality shoreline accounted for approximately 10% of the shoreline, while High and Very High quality segments represented only about 25% combined. These higher-quality areas tended to retain a more natural mix of trees, shrubs, and ground cover, providing better erosion control and habitat function.

The dominance of low-quality shoreline indicates an important opportunity for targeted shoreline improvements.

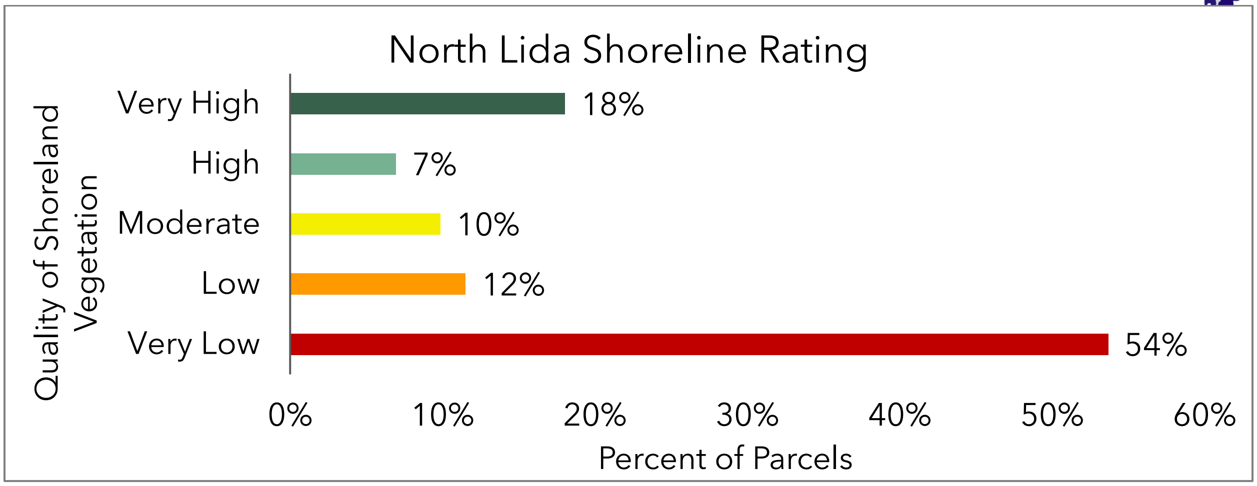


Figure 11. Shoreline rating for North Lida.

South Lida Results

In contrast, South Lida showed a notably different pattern (Figure 12). Approximately 56% of shoreline segments were rated as Very High quality, although this does include Maplewood State Park. An additional 8% were classified as High quality, resulting in nearly two-thirds of the shoreline exhibiting strong habitat and buffering function.

Lower-quality conditions were still present, with 15% rated Very Low, 10% rated Low, and 10% rated Moderate. These areas represe nt localized opportunities for improvement but do not dominate the shoreline as they do on North Lida.

Overall, South Lida retains a significantly higher level of natural vegetation and shoreline integrity, providing better protection against erosion, phosphorus runoff, and habitat degradation.

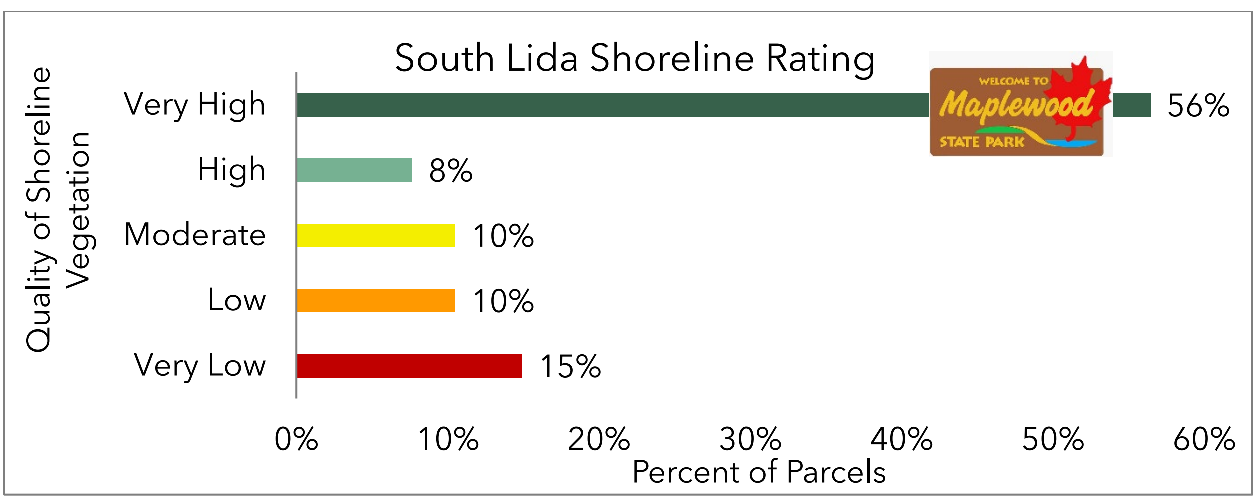


Figure 12. Shoreline rating for South Lida.

Interpretation and Water Quality Implications

The shoreline survey highlights a clear contrast between developed and less-disturbed portions of the lake, with shoreline quality closely tied to land use patterns and vegetation management. Areas characterized by turf-dominated lawns, reduced tree canopy, and hardened shorelines consistently scored lower, while areas retaining native vegetation and structural complexity scored higher.

Low-quality shoreline with just turf grass and no trees offer limited capacity to intercept rain runoff, trap sediment, or stabilize soils. These areas are more vulnerable to erosion and are more likely to contribute phosphorus to the lake, particularly during storm events or periods of high runoff.

Conversely, high-quality shoreline areas demonstrate the benefits of maintaining natural vegetation. These segments provide effective filtering of runoff, more stable shorelines, and improved habitat for fish and wildlife, while also enhancing aesthetic and recreational values.

Results from the shoreline survey identify significant opportunities for shoreline restoration and protection. Potential strategies include:

- Restoring native shoreline vegetation buffers
- Reducing turf grass extent near the water's edge
- Encouraging retention of trees, shrubs, and woody habitat
- Providing landowner education and incentives for shoreline improvements

Because shoreline restoration projects typically address phosphorus loading directly at the lake edge, they can provide measurable water quality benefits and complement watershed-scale management actions.

The West Otter Tail Soil and Water Conservation District offer technical and financial assistance to landowners for these types of projects. [https://www.wotswcd.org]

The photos below show how one property can improve from very low to high quality vegetation.

*photos B and C were modified by AI.

Section 5. Lake Response Model

BATHTUB Lake Response Model

The BATHTUB lake response model (version 6.1) was used to model conditions within South and North Lida Lakes. This type of model is used to estimate how phosphorus loads in the lake and delivered to the lake affect water quality factors such as phosphorus and chlorophyll-a concentration and water clarity, which can be indicators of overall lake health. The model can then also be used to see how water quality conditions could be expected to change under several land management scenarios aimed at reducing phosphorus load from entering the lakes.

The main categories of phosphorus loading quantified in the model are septic system leaching, shoreline runoff, atmospheric deposition, agricultural runoff, and upland runoff (Figure 13).

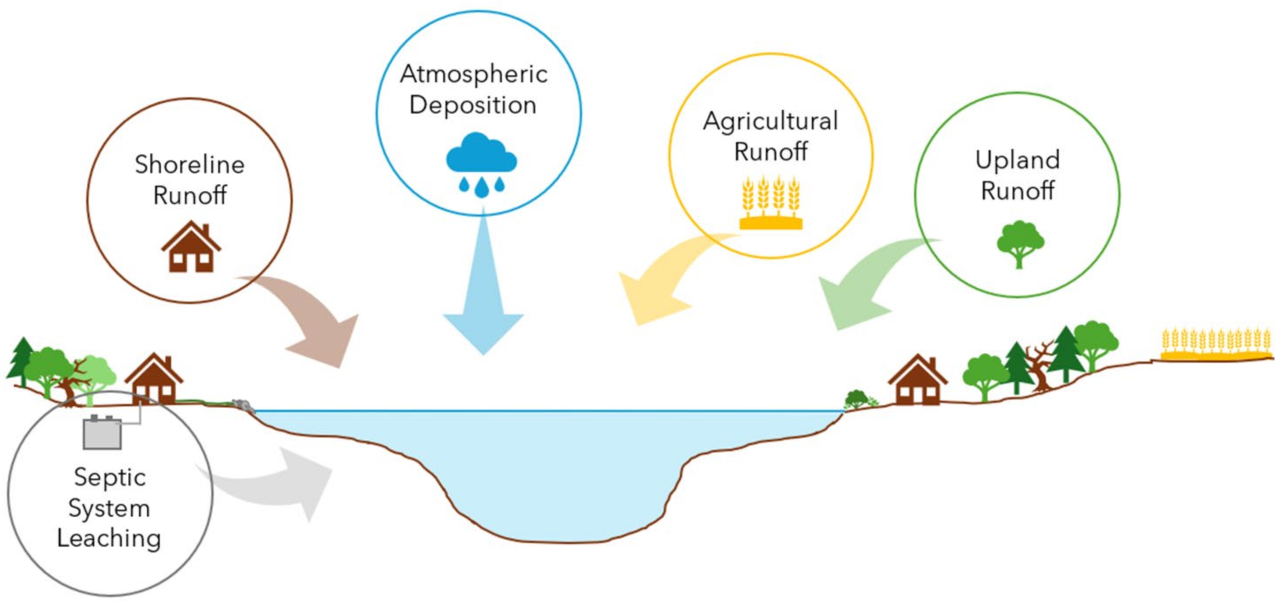


Figure 13. Diagram of what the lake model quantifies for the phosphorus budget.

Baseline Model Creation

The BATHTUB model requires several inputs to accurately model real-world conditions in the lakes. The process of creating a model for South and North Lida Lakes began by defining the annual precipitation in the area as well as the physical and chemical characteristics of the lakes including their surface areas, mean depths, dimensions, average phosphorus and chlorophyll-a concentrations, and average measured Secchi depth.

Once the climate and lake characteristics are defined, the interconnected network of tributaries and other sources of phosphorus to the lakes are defined within the model. This network determines how water and nutrients are routed across the landscape, through the tributaries, and within the lakes of the model. Watershed loads of water and phosphorus are quantified by estimating nutrient loads from direct runoff, tributaries, atmospheric deposition, and point sources. Estimates of phosphorus yield from the landscape surface were taken from the Hydrological Simulation Program FORTRAN (HSPF), a surface water quality model that was available for the area. Phosphorus yields were calculated separately for cultivated agricultural lands and for all other land use types. Those values serve as the basis for estimating non-point source loads from the areas draining to the lakes. Point source loads for failing septic systems and lakeshore erosion were also included in the overall inputs of phosphorus to the lakes. These were explained in previous sections.

BATHTUB uses empirical relationships and mass-balance equations to simulate how the water volume and phosphorus loads delivered to the lake relate to in-lake concentrations and water quality parameters under steady-state conditions. Each water quality component has its own set of equations that are used to estimate conditions in the lake.

Model calibration is a critical step that ensures that results from the model reflect real-world conditions in the lakes. To calibrate BATHTUB, the observed water quality data from the lakes (phosphorus, chlorophyll-a, and Secchi depth measurements collected over multiple seasons or years) are compared to the output estimates of the same parameters. Hydrologic data such as inflow and outflow volumes and water residence time in the lakes are also reviewed, since they determine the rate that water and phosphorus move through the system. Model coefficients were adjusted until the predicted phosphorus, chlorophyll-a, and Secchi depth measurements matched the observed (measured) values. This calibrated model then became the current conditions version of the model. It serves as the version of the model that can be used for evaluating different management scenarios such as reducing phosphorus loads or altering hydrologic conditions in the watershed. To test different scenarios, all values in the calibrated model are held constant except for the phosphorus source(s) that are being altered as part of the scenario.

Management Scenarios

The calibrated BATHTUB model that was set up for baseline conditions within the lakes and watershed was adjusted to meet several potential future condition scenarios to see how water quality conditions in the lakes may respond to the different management conditions of those scenarios.

There are five scenarios in addition to the current conditions model. Each of these scenarios alters the load of phosphorus to the lake(s) from one or more sources within the watershed.

- **Scenario 1** represents the baseline (current) conditions (budget) for the lake.
- **Scenario 2** represents agricultural best management practice (BMP) scenarios.
    - Scenario 2a highlights the effects that implementing the 20 "best" BMPs would have on phosphorus loading to the lake, as measured and prioritized using the available Prioritize, Target, and Measure Application (PTMApp) data.

    - Scenario 2b, on the other hand, shows the impact that implementing all feasible BMPs could have on loading to the lake.
- **Scenario 3** represents conditions where all eroding shoreline is protected, thus reducing sediment and phosphorus erosion to the lake from that source.
- **Scenario 4** shows the impact that repairing all failing septic systems around the lake would have on probable phosphorus loading to the lake.
- **Scenario 5** is the suggested long-term goal for this analysis, which combines aspects of several other scenarios. It represents phosphorus loading conditions if half of the failing septic systems are repaired, half of the eroding shoreline was protected, and the 20 best agricultural BMPs are implemented.

North Lida

The current annual phosphorus budget for North Lida Lake is shown in Figure 14. The highest source of phosphorus to the lake is atmospheric deposition. The sources of phosphorus that have the potential to be reduced are circled in red: shoreline erosion (45.2 kg/yr), failing septic systems (152 kg/yr), and agricultural runoff (267 kg/yr). Projects on South Lida will also help North Lida as 533 kg/yr of phosphorus are moving from South into North Lida.

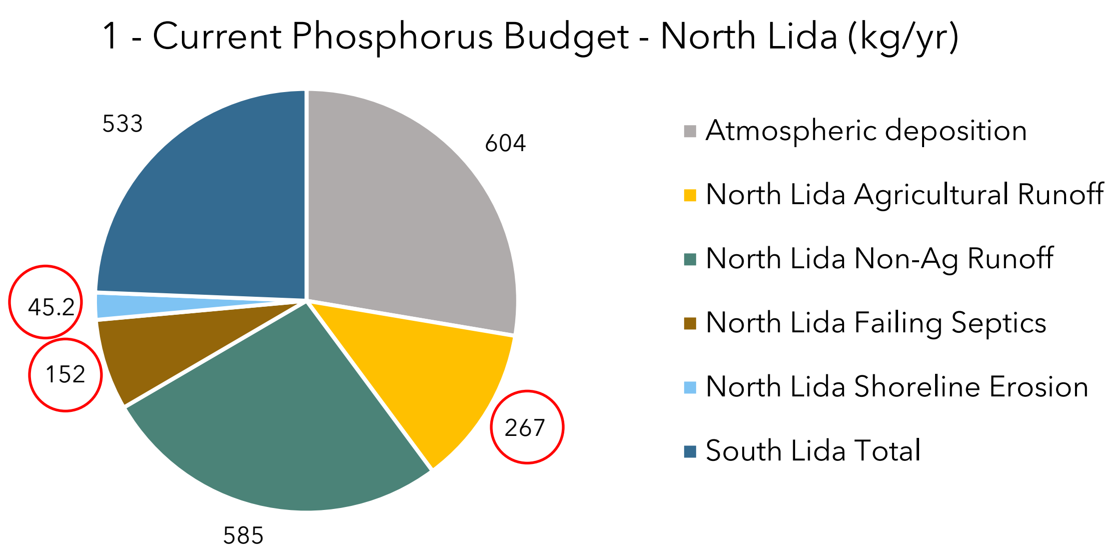


Figure 14. Baseline phosphorus budget for North Lida.

Goal Setting

The total phosphorus load to North Lida Lake is 2,186 kg/yr. If we were to set a 10-year goal of 5% phosphorus reduction, that would be a reduction of 109 kg (240 lbs) to the lake. Sources for reduction would be focused on the red circled numbers above. Table 3 shows how the phosphorus changes under the different scenarios modeled.

Total Load: 2,186 kg/yr
10-Year Goal:
5% Reduction = 109 kg (240 lbs)

Table 3 Total annual phosphorus loads to North Lida Lake for each of the management scenarios.

Scenario	1	2a	2b	3	4	5
	kg/yr of phosphorus load					
Atmospheric Deposition	604	604	604	604	604	604
North Lida Agricultural Runoff	267	154	0	267	267	154
North Lida Non-Ag Runoff	585	585	516	585	585	585
North Lida Failing Septic	152	152	152	152	0	76.1
North Lida Shoreline Erosion	45.2	45.2	45.2	0	45.2	22.6
South Lida Input	533	533	461	523	504	513
Total Load to North Lida	2,186	2,073	1,778	2,131	2,005	1,955

South Lida

The current annual phosphorus budget for South Lida Lake is shown in Figure 15. The highest source of phosphorus to the lake is non-ag runoff. The sources of phosphorus that we have the potential to reduce are circled in red: shoreline erosion (9.9 kg/yr), failing septic systems (29 kg/yr), and agricultural runoff (71 kg/yr).

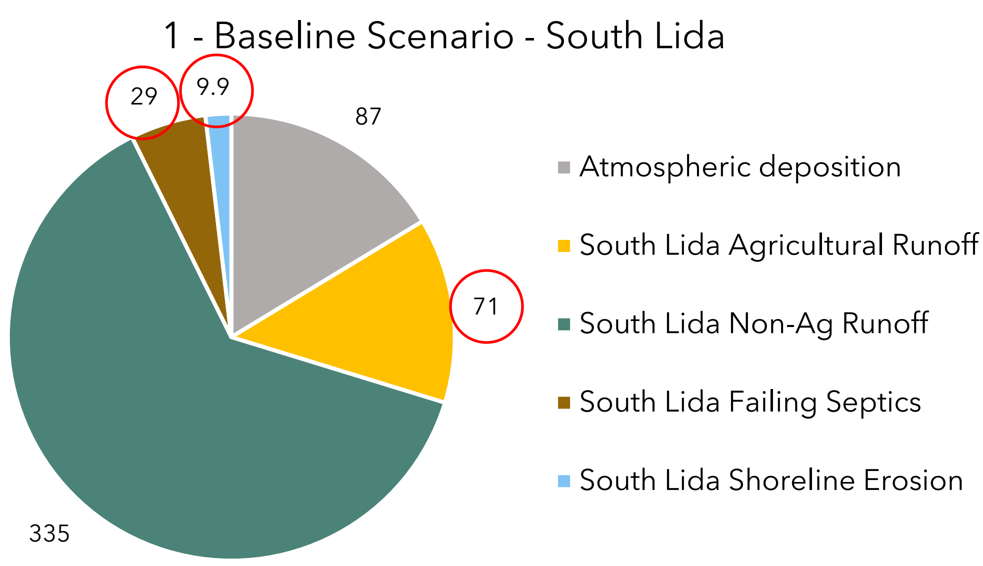


Figure 15. Baseline phosphorus budget for South Lida Lake.

Goal Setting

The total phosphorus load to South Lida Lake is 532 kg/yr. If we were to set a 10-year goal of 5% phosphorus reduction, that would be a reduction of 26 kg (57 lbs) to the lake. Sources for reduction would be focused on the red circled numbers above. Table 4 shows how the phosphorus changes under the different scenarios modeled.

Total Load: 532 kg/yr
10-Year Goal:
5% Reduction = 26 kg (57 lbs)

Table 4. Total annual phosphorus loads to South Lida Lake for each of the management scenarios.

Scenario	1	2a	2b	3	4	5
	kg/yr phosphorus load					
Atmospheric deposition	87	87	87	87	87	87
South Lida Agricultural Runoff	71	71	0	71	71	71
South Lida Non-Ag Runoff	335	335	335	335	335	335
South Lida Failing Septic	29	29	29	29	0	14.6
South Lida Shoreline Erosion	9.9	9.9	9.9	0	9.9	5.0
Total Load to South Lida	532	532	461	522	503	513

Water Quality Changes

The reduction of phosphorus delivered to South and North Lake Lida from these scenarios will result in changes to the measured water quality parameters. This change was modeled using BATHTUB and the results are presented in Table 5 and Figure 16.

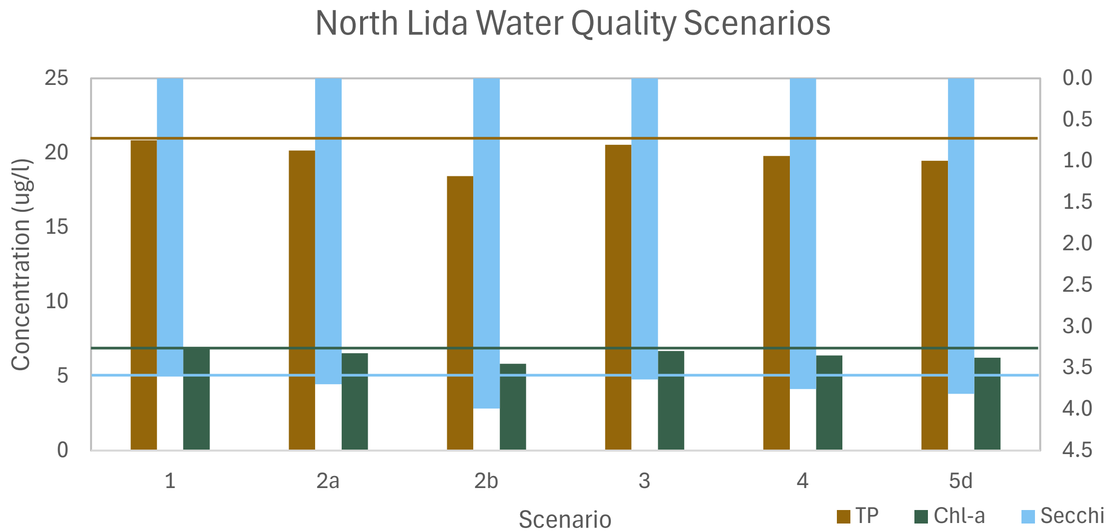
Table 5 Modeled water quality parameters for the existing conditions and each management scenario for North Lida (A) and South Lida (B). Scenario 1 is showing observed values, not modeled values.

A. North Lida

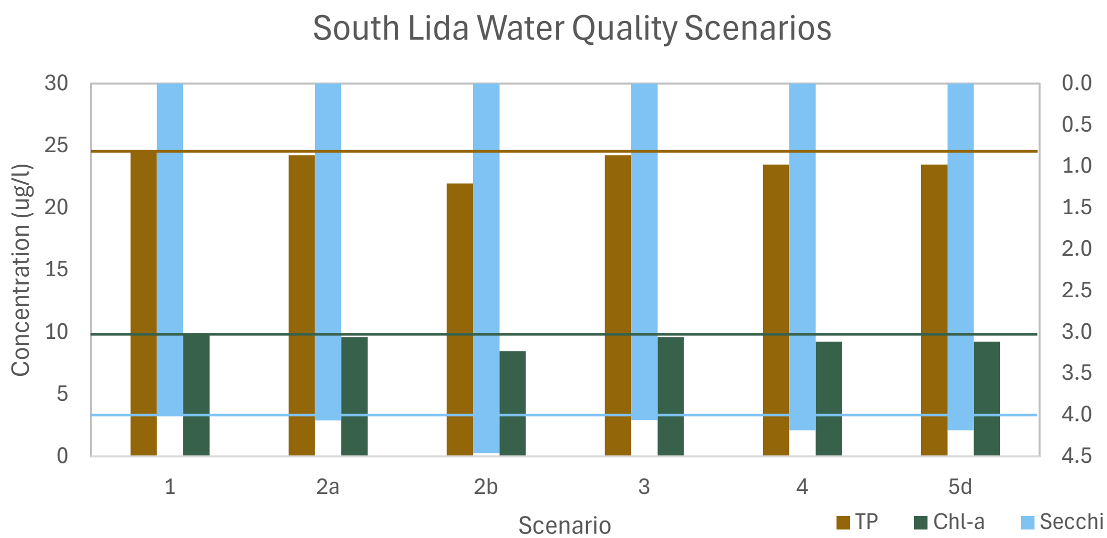
Scenario	1	2a	2b	3	4	5
TP (µg/l)	19.8	20.2	18.4	20.5	19.8	19.5
Chl-a (µg/l)	6.3	6.5	5.8	6.7	6.4	6.2
Secchi (m)	3.6	3.7	4.0	3.6	3.8	3.8

B. South Lida

Scenario	1	2a	2b	3	4	5
TP (µg/l)	32.2	24.2	22.0	24.2	23.5	23.5
Chl-a (µg/l)	13.9	9.6	8.5	9.6	9.2	9.2
Secchi (m)	3.1	4.1	4.5	4.1	4.2	4.2



A.



B.

Figure 16 Expected change in measured water quality parameters from each management scenario for North Lida (A) and South Lida (B). Horizontal lines show baseline (current) conditions.

Implementing the actions that are part of Scenario 5, the 10 year goal for this project, would result in an overall decrease in total phosphorus concentration in the lakes by 1.3 µg/l, a 0.6 µg/l decrease in chlorophyll-a concentration, and a 0.3 m (3 foot) increase in Secchi depth.

Section 5. Implementation Scenario

The implementation scenarios translate study findings into actionable, decision-support tools that help guide future water quality improvements. Using results from the lakeshed assessment, shoreline survey, septic review, and lake modeling, the implementation scenarios evaluate how different management actions could reduce phosphorus loading and improve lake water quality over time.

Each scenario represents a realistic combination of potential projects, such as shoreline restoration, watershed best management practices, reductions in runoff, septic system improvements, or other phosphorus reduction strategies. By modeling these actions individually and in combination, the scenarios estimate the expected water quality response and relative effectiveness of different approaches.

The implementation scenarios help stakeholders understand where investments are likely to provide the greatest benefit and evaluate tradeoffs between cost, feasibility, and water quality improvement. They also support prioritization of projects by identifying actions that address the most significant phosphorus sources identified in the study.

In addition, the scenarios provide a defensible technical basis for future grant applications, implementation planning, and coordination among partners. By linking recommended projects to measurable water quality outcomes, the implementation scenarios help transition the study from analysis to action and support strategic, cost-effective lake management moving forward.

Agricultural BMPs

The location and load reductions for implementing agricultural best management practices such as cover crops, no till, filter strips, and water and sediment control basins were developed using PTMApp. PTMApp is a Geographic Information Systems (GIS) tool that is publicly available (https://ptmapp.bwsr.state.mn.us).

PTMApp estimates existing phosphorus, sediment, and nitrogen loads and water quality benefits for a wide range of practices. Practices for this plan that are identified by PTMApp align with voluntary local implementation trends, have the highest cost-benefit ratios, and best phosphorus reduction as measured at the edge of the lake.

North Lida has six different areas targeted for agricultural practices with a total potential phosphorus reduction of 203.6 lbs/year. South Lida has seven different areas targeted for agricultural practices with a total potential phosphorus reduction of 82.6 lbs/year.

Local agricultural producers can work with the West Otter Tail Soil and Water Conservation District for technical and financial assistance in implementing these practices (https://www.wotswcd.org).

Protection

Minnesota's state agencies that manage surface water, drinking water, and habitat (DNR, MDH, MPCA, BWSR, MLBO) agree that forest and vegetative cover benefits clean surface water, drinking water, and habitat. More specifically, DNR Fisheries research has shown that once a minor watershed is over 25% disturbed (urban, agriculture, mining), the water quality is negatively affected. Protected land uses are defined as surface water, public land, private wetlands, conservation easements, Forest Stewardship Plans, and Sustainable Forest Incentive Act lands.

To qualify for Forest Stewardship Plans or the Sustainable Forest Incentive Act, parcels must be over 20 acres in size and forested. There are already a lot of protected lands around Lake Lida. Parcels that have the potential for these programs are highlighted in light green in Figure 17 and Figure 19. Parcels less than 20 acres in size are highlighted in orange in Figure 17 and Figure 19. Those parcels do not qualify for the programs above, but the lake's water quality would still would benefit from tree planting and keeping those lands natural.

The Riparian, Adjacency, Quality (RAQ) targeting method prioritizes areas for land protection. Protecting forests that are adjacent to the lake or other protected parcels are priorities (Figure 18 and Figure 20). Landowners can work with the West Otter Tail Soil and Water Conservation District on how to enroll in protection programs (https://www.wotswcd.org).

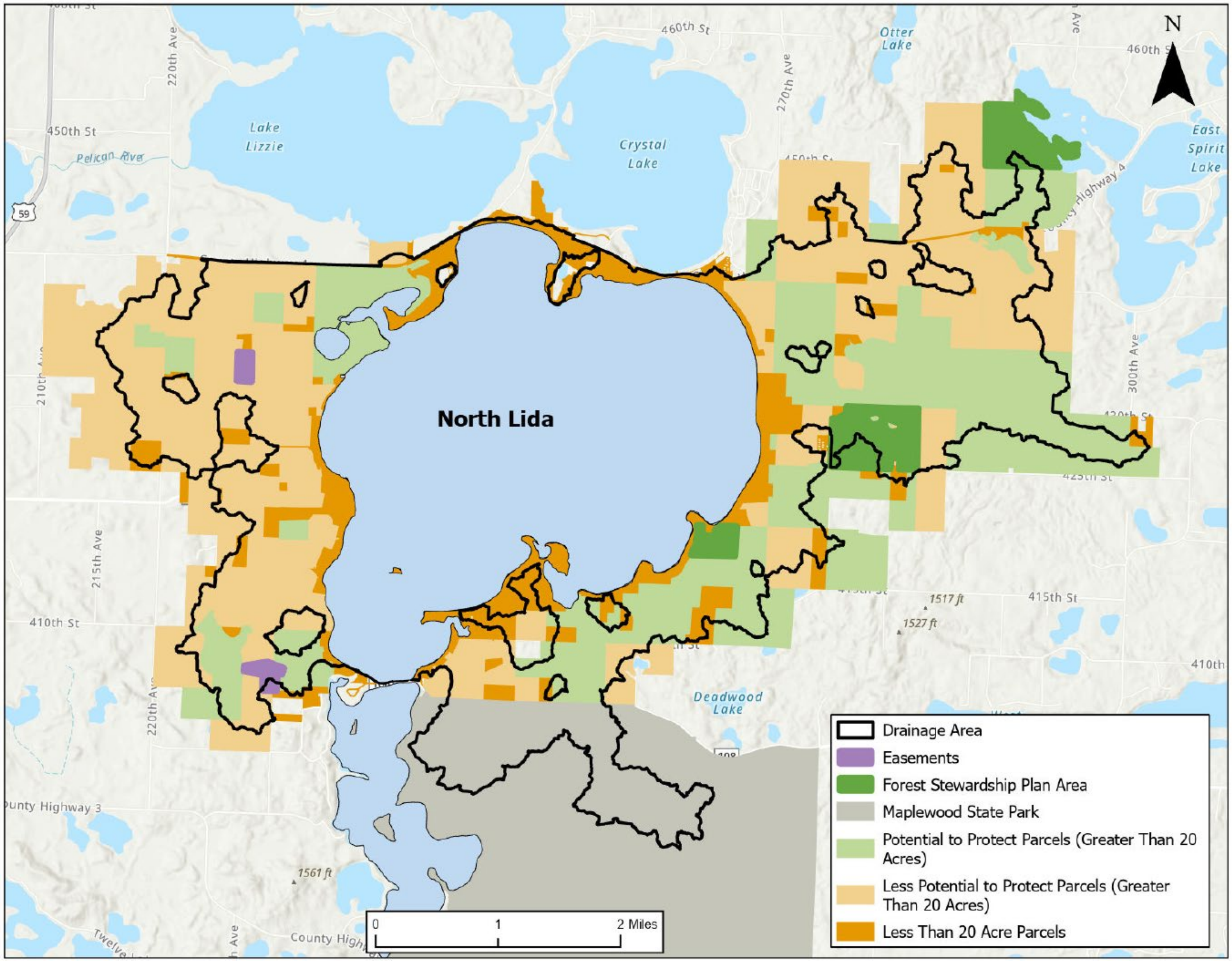


Figure 17. North Lida land protection status.

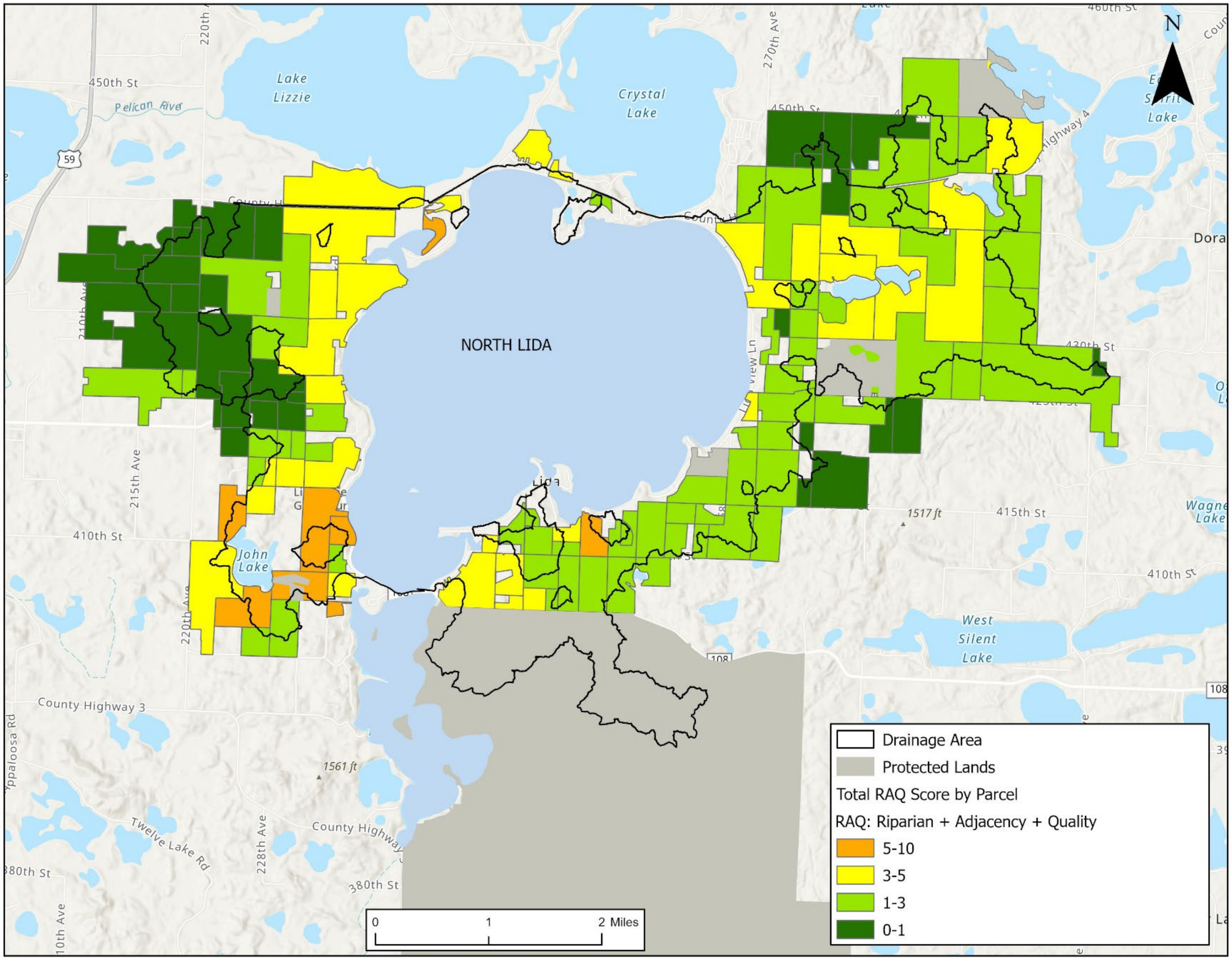


Figure 18. North Lida land protection priorities.

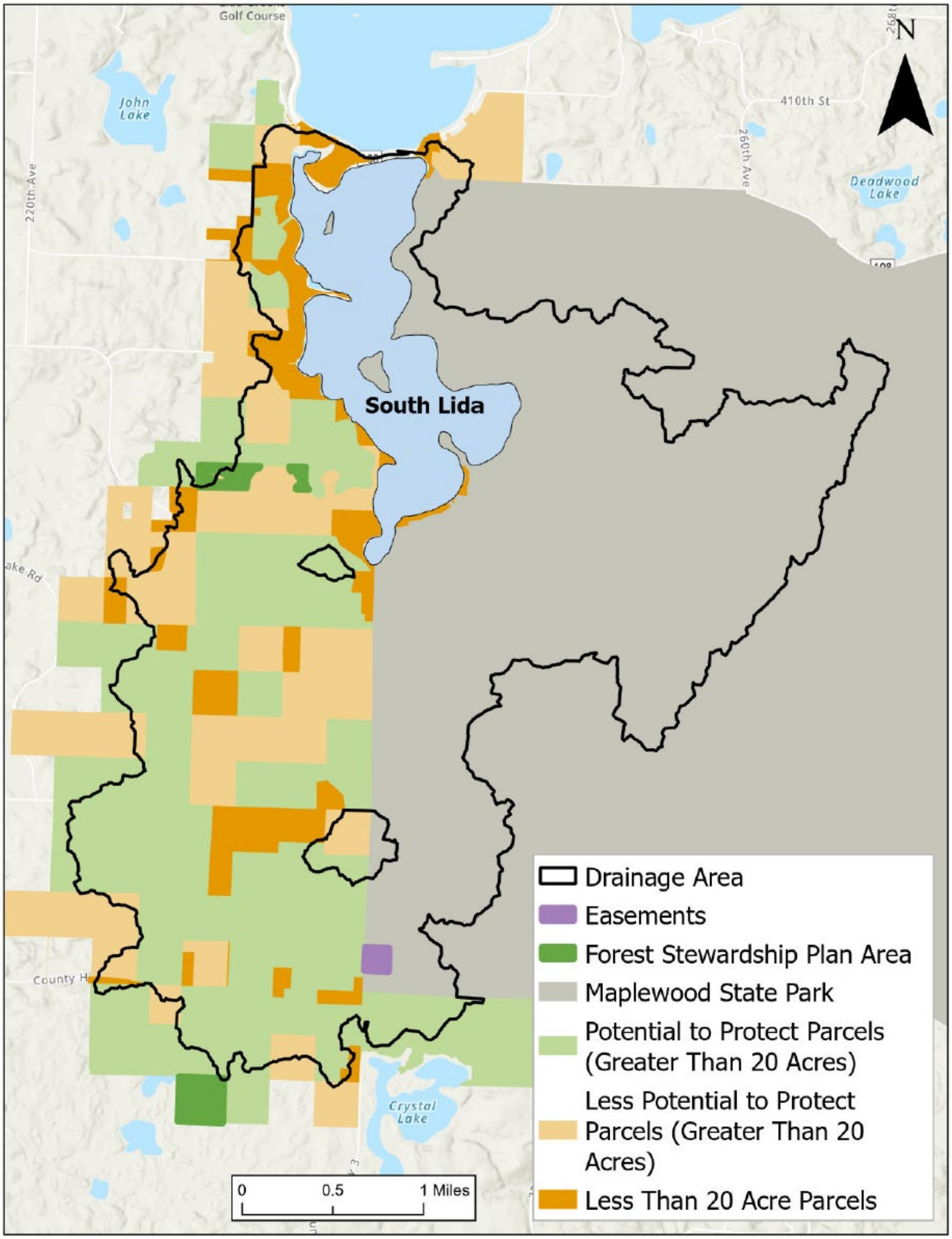


Figure 19. South Lida land protection status.

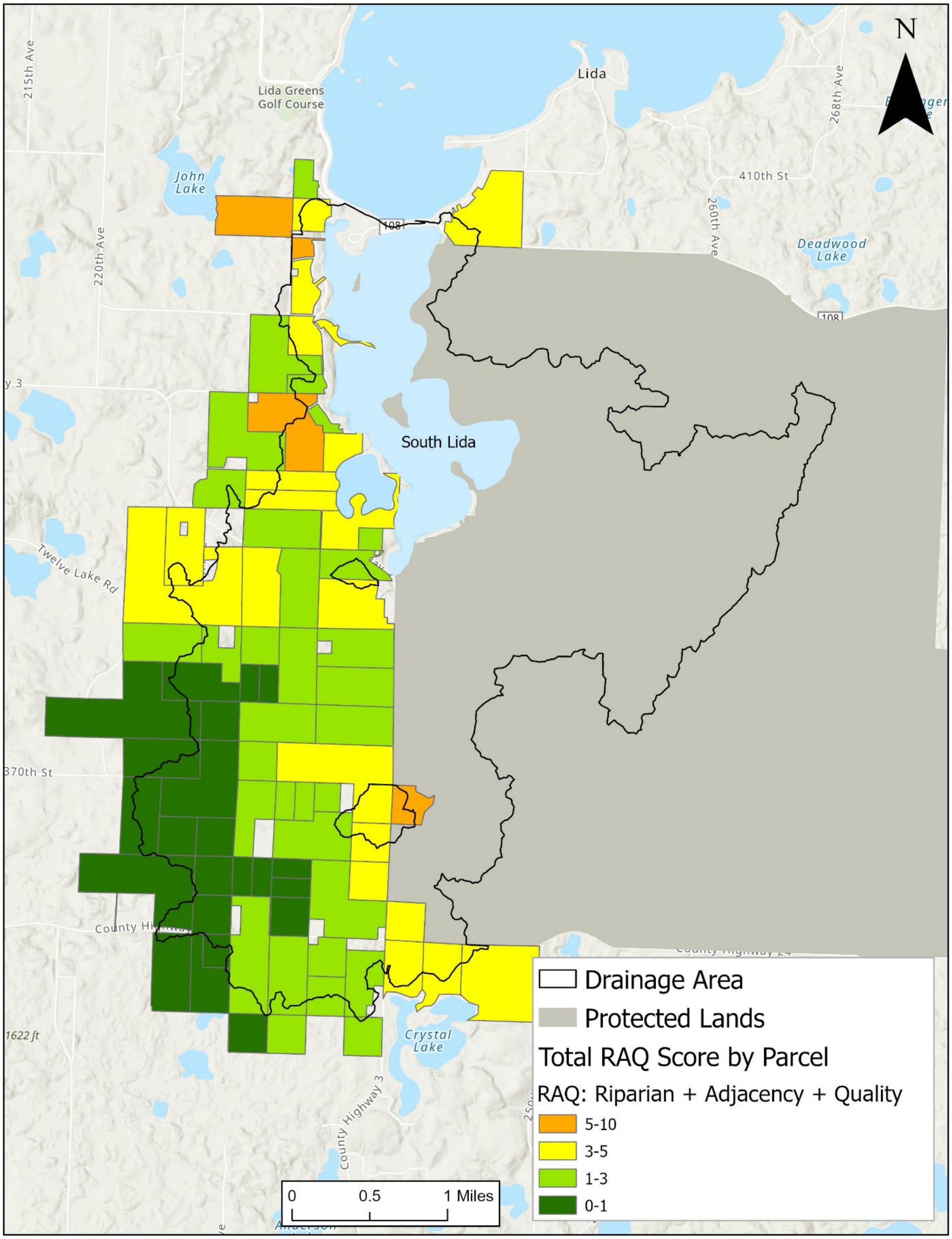


Figure 20. South Lida land protection priorities.

Shoreline

Targeting maps for shoreline will not be shown in this report in order to protect landowner privacy, but they will be shared with the West Otter Tail Soil and Water Conservation District for outreach to do projects. Parcels that are priorities for shoreline enhancement projects are those that had low and very low vegetation ratings, and those that are on steep slopes. Technical and financial assistance is available through West Otter Tail Soil and Water Conservation District to implement these projects with landowners.

Septic Systems

Targeting maps for septic systems will not be shown in this report in order to protect landowner privacy, but they will be shared with the Otter Tail County Land and Resource Department for outreach to do projects. This department does have cost share funding for landowners for septic system replacements.

Conclusions and Next Steps

This study has produced a list of priority projects and priority areas for targeting these projects. The short-term goals (10 Years: 2027 -2032) for the lake are shown below.

The LLID's role is in outreach and connecting landowners with the SWCD and County to implement projects. All practices are voluntary.

Table 6. Phosphorus loading and goals.

Lake	Total Phosphorus Load	10-Year Phosphorus Reduction Goal
North Lida	4,819	240 (5%)
South Lida	1,173	57 (5)

Appendix A – BATHTUB mass balance output

Scenario 1

Overall Water & Nutrient Balances

Overall Water Balance | **Averaging Period = 1.00 years**

Trb	Type	Seg	Name	Area km^2	Flow hm^3/yr	Variance (hm3/yr)^2	CV -	Runoff m/yr
1	2	2	NorthLidaOverlandCrops	52.2	1.1	0.00E+00	0.00	0.02
2	2	2	NorthLidaOverlandOther	52.2	8.4	0.00E+00	0.00	0.16
3	3	2	NorthLidaSeptic	52.2	0.1	0.00E+00	0.00	0.00
4	3	2	NorthLidaShoreline	52.2	0.1	0.00E+00	0.00	0.00
5	2	1	SouthLidaOverlandCrops	34.1	0.3	0.00E+00	0.00	0.01
6	2	1	SouthLidaOverlandOther	34.1	5.6	0.00E+00	0.00	0.16
7	3	1	SouthLidaSeptic	34.1	0.0	0.00E+00	0.00	0.00
8	3	1	SouthLidaShoreline	34.1	0.0	0.00E+00	0.00	0.00
PRECIPITATION				25.5	17.6	0.00E+00	0.00	0.69
NONPOINT INFLOW				172.7	15.4	0.00E+00	0.00	0.09
POINT-SOURCE INFLOW				172.7	0.2	0.00E+00	0.00	0.00
***TOTAL INFLOW				370.9	33.2	0.00E+00	0.00	0.09
ADVECTIVE OUTFLOW				370.9	8.5	0.00E+00	0.00	0.02
***TOTAL OUTFLOW				370.9	8.5	0.00E+00	0.00	0.02
***EVAPORATION					24.7	0.00E+00	0.00	

Overall Mass Balance Based Upon | **Predicted** | **Outflow & Reservoir Concentrations**

Component: | **TOTAL P**

Trb	Type	Seg	Name	Load kg/yr	%Total	Load Variance (kg/yr)^2	%Total	CV	Conc mg/m^3	Export kg/km^2/yr
1	2	2	NorthLidaOverlandCrops	266.6	12.3%	0.00E+00		0.00	245.4	5.1
2	2	2	NorthLidaOverlandOther	584.8	27.1%	0.00E+00		0.00	69.6	11.2
3	3	2	NorthLidaSeptic	152.1	7.0%	0.00E+00		0.00	1521.4	2.9
4	3	2	NorthLidaShoreline	45.2	2.1%	0.00E+00		0.00	451.9	0.9
5	2	1	SouthLidaOverlandCrops	71.5	3.3%	0.00E+00		0.00	236.2	2.1
6	2	1	SouthLidaOverlandOther	335.2	15.5%	0.00E+00		0.00	59.8	9.8
7	3	1	SouthLidaSeptic	29.2	1.4%	0.00E+00		0.00	1621.6	0.9
8	3	1	SouthLidaShoreline	9.9	0.5%	0.00E+00		0.00	495.7	0.3
PRECIPITATION				665.4	30.8%	0.00E+00		0.00	37.8	26.1
NONPOINT INFLOW				1258.1	58.2%	0.00E+00		0.00	81.7	7.3
POINT-SOURCE INFLOW				236.4	10.9%	0.00E+00		0.00	993.4	1.4
***TOTAL INFLOW				2159.9	100.0%	0.00E+00		0.00	65.0	5.8
ADVECTIVE OUTFLOW				177.2	8.2%	5.32E+03		0.41	20.8	0.5
***TOTAL OUTFLOW				177.2	8.2%	5.32E+03		0.41	20.8	0.5
***RETENTION				1982.7	91.8%	5.32E+03		0.04		

Overflow Rate (m/yr)	0.3	Nutrient Resid. Time (yrs)	1.4075
Hydraulic Resid. Time (yrs)	16.7845	Turnover Ratio	0.7
Reservoir Conc (mg/m3)	21	Retention Coef.	0.918

Scenario 2a

Overall Water & Nutrient Balances

Overall Water Balance — **Averaging Period = 1.00 years**

Trb	Type	Seg	Name	Area km²	Flow hm³/yr	Variance (hm3/yr)²	CV -	Runoff m/yr
1	2	2	NorthLidaOverlandCrops	52.2	1.1	0.00E+00	0.00	0.02
2	2	2	NorthLidaOverlandOther	52.2	8.4	0.00E+00	0.00	0.16
3	3	2	NorthLidaSeptic	52.2	0.1	0.00E+00	0.00	0.00
4	3	2	NorthLidaShoreline	52.2	0.1	0.00E+00	0.00	0.00
5	2	1	SouthLidaOverlandCrops	34.1	0.3	0.00E+00	0.00	0.01
6	2	1	SouthLidaOverlandOther	34.1	5.6	0.00E+00	0.00	0.16
7	3	1	SouthLidaSeptic	34.1	0.0	0.00E+00	0.00	0.00
8	3	1	SouthLidaShoreline	34.1	0.0	0.00E+00	0.00	0.00
PRECIPITATION				25.5	17.6	0.00E+00	0.00	0.69
NONPOINT INFLOW				172.7	15.4	0.00E+00	0.00	0.09
POINT-SOURCE INFLOW				172.7	0.2	0.00E+00	0.00	0.00
***TOTAL INFLOW				370.9	33.2	0.00E+00	0.00	0.09
ADVECTIVE OUTFLOW				370.9	8.5	0.00E+00	0.00	0.02
***TOTAL OUTFLOW				370.9	8.5	0.00E+00	0.00	0.02
***EVAPORATION					24.7	0.00E+00	0.00	

Overall Mass Balance Based Upon **Predicted** **Outflow & Reservoir Concentrations**
Component: **TOTAL P**

Trb	Type	Seg	Name	Load kg/yr	%Total	Load Variance (kg/yr)²	%Total	CV	Conc mg/m³	Export kg/km²/yr
1	2	2	NorthLidaOverlandCrops	153.5	7.5%	0.00E+00		0.00	141.3	2.9
2	2	2	NorthLidaOverlandOther	584.8	28.6%	0.00E+00		0.00	69.6	11.2
3	3	2	NorthLidaSeptic	152.1	7.4%	0.00E+00		0.00	1521.4	2.9
4	3	2	NorthLidaShoreline	45.2	2.2%	0.00E+00		0.00	451.9	0.9
5	2	1	SouthLidaOverlandCrops	71.5	3.5%	0.00E+00		0.00	236.2	2.1
6	2	1	SouthLidaOverlandOther	335.2	16.4%	0.00E+00		0.00	59.8	9.8
7	3	1	SouthLidaSeptic	29.2	1.4%	0.00E+00		0.00	1621.6	0.9
8	3	1	SouthLidaShoreline	9.9	0.5%	0.00E+00		0.00	495.7	0.3
PRECIPITATION				665.4	32.5%	0.00E+00		0.00	37.8	26.1
NONPOINT INFLOW				1145.0	55.9%	0.00E+00		0.00	74.3	6.6
POINT-SOURCE INFLOW				236.4	11.6%	0.00E+00		0.00	993.4	1.4
***TOTAL INFLOW				2046.8	100.0%	0.00E+00		0.00	61.6	5.5
ADVECTIVE OUTFLOW				171.4	8.4%	4.98E+03		0.41	20.2	0.5
***TOTAL OUTFLOW				171.4	8.4%	4.98E+03		0.41	20.2	0.5
***RETENTION				1875.5	91.6%	4.98E+03		0.04		

Overflow Rate (m/yr)	0.3	Nutrient Resid. Time (yrs)	1.4402
Hydraulic Resid. Time (yrs)	16.7845	Turnover Ratio	0.7
Reservoir Conc (mg/m3)	21	Retention Coef.	0.916

Scenario 2b

Overall Water & Nutrient Balances

Overall Water Balance — **Averaging Period = 1.00 years**

Trb	Type	Seg	Name	Area km²	Flow hm³/yr	Variance (hm3/yr)²	CV -	Runoff m/yr
1	2	2	NorthLidaOverlandCrops	52.2	1.1	0.00E+00	0.00	0.02
2	2	2	NorthLidaOverlandOther	52.2	8.4	0.00E+00	0.00	0.16
3	3	2	NorthLidaSeptic	52.2	0.1	0.00E+00	0.00	0.00
4	3	2	NorthLidaShoreline	52.2	0.1	0.00E+00	0.00	0.00
5	2	1	SouthLidaOverlandCrops	34.1	0.3	0.00E+00	0.00	0.01
6	2	1	SouthLidaOverlandOther	34.1	5.6	0.00E+00	0.00	0.16
7	3	1	SouthLidaSeptic	34.1	0.0	0.00E+00	0.00	0.00
8	3	1	SouthLidaShoreline	34.1	0.0	0.00E+00	0.00	0.00
PRECIPITATION				25.5	17.6	0.00E+00	0.00	0.69
NONPOINT INFLOW				172.7	15.4	0.00E+00	0.00	0.09
POINT-SOURCE INFLOW				172.7	0.2	0.00E+00	0.00	0.00
***TOTAL INFLOW				370.9	33.2	0.00E+00	0.00	0.09
ADVECTIVE OUTFLOW				370.9	8.5	0.00E+00	0.00	0.02
***TOTAL OUTFLOW				370.9	8.5	0.00E+00	0.00	0.02
***EVAPORATION					24.7	0.00E+00	0.00	

Overall Mass Balance Based Upon Predicted Outflow & Reservoir Concentrations

Component: TOTAL P

Trb	Type	Seg	Name	Load kg/yr	%Total	Load Variance (kg/yr)²	%Total	CV	Conc mg/m³	Export kg/km²/yr
2	2	2	NorthLidaOverlandOther	516.2	29.4%	0.00E+00		0.00	61.4	9.9
3	3	2	NorthLidaSeptic	152.1	8.7%	0.00E+00		0.00	1521.4	2.9
4	3	2	NorthLidaShoreline	45.2	2.6%	0.00E+00		0.00	451.9	0.9
6	2	1	SouthLidaOverlandOther	335.2	19.1%	0.00E+00		0.00	59.8	9.8
7	3	1	SouthLidaSeptic	29.2	1.7%	0.00E+00		0.00	1621.6	0.9
8	3	1	SouthLidaShoreline	9.9	0.6%	0.00E+00		0.00	495.7	0.3
PRECIPITATION				665.4	38.0%	0.00E+00		0.00	37.8	26.1
NONPOINT INFLOW				851.4	48.6%	0.00E+00		0.00	55.3	4.9
POINT-SOURCE INFLOW				236.4	13.5%	0.00E+00		0.00	993.4	1.4
***TOTAL INFLOW				1753.3	100.0%	0.00E+00		0.00	52.8	4.7
ADVECTIVE OUTFLOW				156.8	8.9%	4.11E+03		0.41	18.4	0.4
***TOTAL OUTFLOW				156.8	8.9%	4.11E+03		0.41	18.4	0.4
***RETENTION				1596.5	91.1%	4.11E+03		0.04		

Overflow Rate (m/yr)	0.3	Nutrient Resid. Time (yrs)	1.5363
Hydraulic Resid. Time (yrs)	16.7845	Turnover Ratio	0.7
Reservoir Conc (mg/m3)	19	Retention Coef.	0.911

Scenario 3

Overall Water & Nutrient Balances

Overall Water Balance — Averaging Period = 1.00 years

Trb	Type	Seg	Name	Area km^2	Flow hm^3/yr	Variance $(hm3/yr)^2$	CV -	Runoff m/yr
1	2	2	NorthLidaOverlandCrops	52.2	1.1	0.00E+00	0.00	0.02
2	2	2	NorthLidaOverlandOther	52.2	8.4	0.00E+00	0.00	0.16
3	3	2	NorthLidaSeptic	52.2	0.1	0.00E+00	0.00	0.00
4	3	2	NorthLidaShoreline	52.2	0.1	0.00E+00	0.00	0.00
5	2	1	SouthLidaOverlandCrops	34.1	0.3	0.00E+00	0.00	0.01
6	2	1	SouthLidaOverlandOther	34.1	5.6	0.00E+00	0.00	0.16
7	3	1	SouthLidaSeptic	34.1	0.0	0.00E+00	0.00	0.00
8	3	1	SouthLidaShoreline	34.1	0.0	0.00E+00	0.00	0.00
PRECIPITATION				25.5	17.6	0.00E+00	0.00	0.69
NONPOINT INFLOW				172.7	15.4	0.00E+00	0.00	0.09
POINT-SOURCE INFLOW				172.7	0.2	0.00E+00	0.00	0.00
***TOTAL INFLOW				370.9	33.2	0.00E+00	0.00	0.09
ADVECTIVE OUTFLOW				370.9	8.5	0.00E+00	0.00	0.02
***TOTAL OUTFLOW				370.9	8.5	0.00E+00	0.00	0.02
***EVAPORATION					24.7	0.00E+00	0.00	

Overall Mass Balance Based Upon Predicted Outflow & Reservoir Concentrations
Component: TOTAL P

Trb	Type	Seg	Name	Load kg/yr	%Total	Load Variance $(kg/yr)^2$	%Total	CV	Conc mg/m^3	Export $kg/km^2/yr$
1	2	2	NorthLidaOverlandCrops	266.6	12.7%	0.00E+00		0.00	245.4	5.1
2	2	2	NorthLidaOverlandOther	584.8	27.8%	0.00E+00		0.00	69.6	11.2
3	3	2	NorthLidaSeptic	152.1	7.2%	0.00E+00		0.00	1521.4	2.9
5	2	1	SouthLidaOverlandCrops	71.5	3.4%	0.00E+00		0.00	236.2	2.1
6	2	1	SouthLidaOverlandOther	335.2	15.9%	0.00E+00		0.00	59.8	9.8
7	3	1	SouthLidaSeptic	29.2	1.4%	0.00E+00		0.00	1621.6	0.9
PRECIPITATION				665.4	31.6%	0.00E+00		0.00	37.8	26.1
NONPOINT INFLOW				1258.1	59.8%	0.00E+00		0.00	81.7	7.3
POINT-SOURCE INFLOW				181.3	8.6%	0.00E+00		0.00	761.9	1.1
***TOTAL INFLOW				2104.8	100.0%	0.00E+00		0.00	63.3	5.7
ADVECTIVE OUTFLOW				174.6	8.3%	5.15E+03		0.41	20.5	0.5
***TOTAL OUTFLOW				174.6	8.3%	5.15E+03		0.41	20.5	0.5
***RETENTION				1930.3	91.7%	5.15E+03		0.04		

Overflow Rate (m/yr)	0.3	Nutrient Resid. Time (yrs)	1.4229
Hydraulic Resid. Time (yrs)	16.7845	Turnover Ratio	0.7
Reservoir Conc (mg/m3)	21	Retention Coef.	0.917

Scenario 4

Overall Water & Nutrient Balances

Overall Water Balance — **Averaging Period = 1.00 years**

Trb	Type	Seg	Name	Area km^2	Flow hm^3/yr	Variance $(hm3/yr)^2$	CV -	Runoff m/yr
1	2	2	NorthLidaOverlandCrops	52.2	1.1	0.00E+00	0.00	0.02
2	2	2	NorthLidaOverlandOther	52.2	8.4	0.00E+00	0.00	0.16
3	3	2	NorthLidaSeptic	52.2	0.1	0.00E+00	0.00	0.00
4	3	2	NorthLidaShoreline	52.2	0.1	0.00E+00	0.00	0.00
5	2	1	SouthLidaOverlandCrops	34.1	0.3	0.00E+00	0.00	0.01
6	2	1	SouthLidaOverlandOther	34.1	5.6	0.00E+00	0.00	0.16
7	3	1	SouthLidaSeptic	34.1	0.0	0.00E+00	0.00	0.00
8	3	1	SouthLidaShoreline	34.1	0.0	0.00E+00	0.00	0.00
PRECIPITATION				25.5	17.6	0.00E+00	0.00	0.69
NONPOINT INFLOW				172.7	15.4	0.00E+00	0.00	0.09
POINT-SOURCE INFLOW				172.7	0.2	0.00E+00	0.00	0.00
***TOTAL INFLOW				370.9	33.2	0.00E+00	0.00	0.09
ADVECTIVE OUTFLOW				370.9	8.5	0.00E+00	0.00	0.02
***TOTAL OUTFLOW				370.9	8.5	0.00E+00	0.00	0.02
***EVAPORATION					24.7	0.00E+00	0.00	

Overall Mass Balance Based Upon Predicted Outflow & Reservoir Concentrations

Component: TOTAL P

Trb	Type	Seg	Name	Load kg/yr	%Total	Load Variance $(kg/yr)^2$	%Total	CV	Conc mg/m^3	Export $kg/km^2/yr$
1	2	2	NorthLidaOverlandCrops	266.6	13.5%	0.00E+00		0.00	245.4	5.1
2	2	2	NorthLidaOverlandOther	584.8	29.6%	0.00E+00		0.00	69.6	11.2
4	3	2	NorthLidaShoreline	45.2	2.3%	0.00E+00		0.00	451.9	0.9
5	2	1	SouthLidaOverlandCrops	71.5	3.6%	0.00E+00		0.00	236.2	2.1
6	2	1	SouthLidaOverlandOther	335.2	16.9%	0.00E+00		0.00	59.8	9.8
8	3	1	SouthLidaShoreline	9.9	0.5%	0.00E+00		0.00	495.7	0.3
PRECIPITATION				665.4	33.6%	0.00E+00		0.00	37.8	26.1
NONPOINT INFLOW				1258.1	63.6%	0.00E+00		0.00	81.7	7.3
POINT-SOURCE INFLOW				55.1	2.8%	0.00E+00		0.00	231.5	0.3
***TOTAL INFLOW				1978.6	100.0%	0.00E+00		0.00	59.5	5.3
ADVECTIVE OUTFLOW				168.3	8.5%	4.77E+03		0.41	19.8	0.5
***TOTAL OUTFLOW				168.3	8.5%	4.77E+03		0.41	19.8	0.5
***RETENTION				1810.3	91.5%	4.77E+03		0.04		

Overflow Rate (m/yr)	0.3	Nutrient Resid. Time (yrs)	1.4604
Hydraulic Resid. Time (yrs)	16.7845	Turnover Ratio	0.7
Reservoir Conc (mg/m3)	20	Retention Coef.	0.915

Scenario 5d

Overall Water & Nutrient Balances

Overall Water Balance — **Averaging Period = 1.00 years**

Trb	Type	Seg	Name	Area km^2	Flow hm^3/yr	Variance (hm3/yr)^2	CV -	Runoff m/yr
1	2	2	NorthLidaOverlandCrops	52.2	1.1	0.00E+00	0.00	0.02
2	2	2	NorthLidaOverlandOther	52.2	8.4	0.00E+00	0.00	0.16
3	3	2	NorthLidaSeptic	52.2	0.1	0.00E+00	0.00	0.00
4	3	2	NorthLidaShoreline	52.2	0.1	0.00E+00	0.00	0.00
5	2	1	SouthLidaOverlandCrops	34.1	0.3	0.00E+00	0.00	0.01
6	2	1	SouthLidaOverlandOther	34.1	5.6	0.00E+00	0.00	0.16
7	3	1	SouthLidaSeptic	34.1	0.0	0.00E+00	0.00	0.00
8	3	1	SouthLidaShoreline	34.1	0.0	0.00E+00	0.00	0.00
PRECIPITATION				25.5	17.6	0.00E+00	0.00	0.69
NONPOINT INFLOW				172.7	15.4	0.00E+00	0.00	0.09
POINT-SOURCE INFLOW				172.7	0.2	0.00E+00	0.00	0.00
***TOTAL INFLOW				370.9	33.2	0.00E+00	0.00	0.09
ADVECTIVE OUTFLOW				370.9	8.5	0.00E+00	0.00	0.02
***TOTAL OUTFLOW				370.9	8.5	0.00E+00	0.00	0.02
***EVAPORATION					24.7	0.00E+00	0.00	

Overall Mass Balance Based Upon — **Predicted** — **Outflow & Reservoir Concentrations**
Component: — **TOTAL P**

Trb	Type	Seg	Name	Load kg/yr	%Total	Load Variance (kg/yr)^2	%Total	CV	Conc mg/m^3	Export kg/km^2/yr
1	2	2	NorthLidaOverlandCrops	153.5	8.0%	0.00E+00		0.00	141.3	2.9
2	2	2	NorthLidaOverlandOther	584.8	30.3%	0.00E+00		0.00	69.6	11.2
3	3	2	NorthLidaSeptic	76.1	3.9%	0.00E+00		0.00	760.7	1.5
4	3	2	NorthLidaShoreline	22.6	1.2%	0.00E+00		0.00	226.0	0.4
5	2	1	SouthLidaOverlandCrops	71.5	3.7%	0.00E+00		0.00	236.2	2.1
6	2	1	SouthLidaOverlandOther	335.2	17.4%	0.00E+00		0.00	59.8	9.8
7	3	1	SouthLidaSeptic	14.6	0.8%	0.00E+00		0.00	810.8	0.4
8	3	1	SouthLidaShoreline	5.0	0.3%	0.00E+00		0.00	247.9	0.1
PRECIPITATION				665.4	34.5%	0.00E+00		0.00	37.8	26.1
NONPOINT INFLOW				1145.0	59.4%	0.00E+00		0.00	74.3	6.6
POINT-SOURCE INFLOW				118.2	6.1%	0.00E+00		0.00	496.7	0.7
***TOTAL INFLOW				1928.6	100.0%	0.00E+00		0.00	58.0	5.2
ADVECTIVE OUTFLOW				165.5	8.6%	4.62E+03		0.41	19.5	0.4
***TOTAL OUTFLOW				165.5	8.6%	4.62E+03		0.41	19.5	0.4
***RETENTION				1763.2	91.4%	4.62E+03		0.04		

Overflow Rate (m/yr)	0.3	Nutrient Resid. Time (yrs)	1.4767
Hydraulic Resid. Time (yrs)	16.7845	Turnover Ratio	0.7
Reservoir Conc (mg/m3)	20	Retention Coef.	0.914