ECHO & SEYMOUR LAKES WATERSHED ACTION PLAN

FINAL REPORT

Figure 1. Views of Elan Hill from Echo (left) and Seymour (right) lakeshores.

Prepared for:

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FIGURES
(attached to the end of this document)

CHARTS

ACRONYMS

AMP – Acceptable Management Practices

AOP – Aquatic Organism Passage

BIF – Batch Import File

BMP – Best Management Practice

CWIP – Clean Water Investment Program

CWSP – Clean Water Service Provider

DEC/VTDEC – Vermont Department of Environmental Conservation

ELPA – Echo Lake Protective Association

GPS – Global Positioning Systems

LWAP – Lake Watershed Action Plan

MWA – Memphremagog Watershed Association

OCNRCD – Orleans County Natural Resources Conservation District

RAP – Required Agricultural Practices

REI – Road Erosion Inventory

SGA – Stream Geomorphic Assessment

SLA – Seymour Lake Association

TBP – Tactical Basin Plan

TMDL – Total Maximum Daily Load

VFWD – Vermont Fish & Wildlife Department

Chapter 1 **INTRODUCTION**

1.1 Acknowledgements

This work was funded by an Echo-Seymour Lakes Watershed Action Plan (LWAP) contract awarded to the Orleans County Natural Resources Conservation District (OCNRCD) by VT Department of Environmental Conservation (VTDEC). Orleans County NRCD subcontracted the Memphremagog Watershed Association (MWA) to provide technical support on various aspects of the LWAP; this included data analysis, outreach, field assessments, project identification, project prioritization, development of 30% conceptual designs for water quality projects, and reporting. LWAP team members from OCNRCD and MWA extend their gratitude and appreciation to the dedicated leaders and membership of the Echo Lake Protective Association (ELPA) and Seymour Lake Association (SLA). Both organizations proved invaluable to the LWAP process by offering their institutional knowledge, endless cooperation and coordination, and deep community connections – all of which are critical to the stewardship and protection of both lakes. The LWAP Team would like to thank the Selectboard members, Road Foremen, and Town Clerks from Morgan, Holland, and Charleston for their assistance with numerous inquiries and their offering of support for implementing water quality and habitat restoration projects. Most importantly, we would like to thank all residents, businesses, and camp owners of the Echo-Seymour Lakes watershed, as without your enthusiasm for the health of the lakes and willingness to participate in the process and projects, none of this work would be possible.

1.2 Purpose & Process

This final report is the culmination of nearly two years' work evaluating, prioritizing, and developing water quality improvement projects to reduce phosphorus and sediment loading to Echo and Seymour lakes. **The purpose of this report is to summarize the results of desktop and field assessments, project prioritization efforts, and project development activities while providing an actionable plan for implementing meaningful water quality projects at both site-specific and watershed scales.** This report documents the methods used and results produced by MWA and OCNRCD following DEC's LWAP Technical Guidance (VTDEC, 2023a) and serves as a guide for the lake associations, municipalities, residents, and conservation project partners to continue to develop and implement projects now and into the future.

A total of four public stakeholder meetings were held during the LWAP process, with the goal of engaging as many community members as possible. The meetings were well attended by the various groups and stakeholders mentioned above, including a broad representation of Morgan and Charleston residents (permanent and seasonal, lakeshore and elsewhere) and property owners. During a virtual public kick-off meeting held on June 14, 2023, OCNRCD and MWA introduced the LWAP Team members, the process, and solicited input from approximately 25 members of the public. On July 13, 2023, the LWAP Team organized a public meeting at the Morgan Community House to present the watershed data library and web map, share figures of the proposed assessment areas, provide examples of LWAP deliverables from other watersheds, and discuss potential co-benefits for restoration projects. On August 8, 2024, MWA and OCNRCD hosted a public meeting to present the results of field assessments, project prioritization efforts, and recommendations for design projects. This meeting occurred shortly after a 1,000-year flood impacted the watershed, and as a result, was attended by over 50 members of the public. A final virtual public meeting was hosted on December 4, 2024 to showcase the four conceptual designs and broader recommendations that were developed by the LWAP Team. Approximately 40 stakeholders attended this virtual meeting. This meeting also provided the Team a chance to discuss next steps for implementing the LWAP's action items with the lake associations and community members.

1.3 Watershed Planning

Echo and Seymour lakes reside within the Lake Memphremagog watershed and as such are included in the Memphremagog Watershed Basin 17 Tactical Basin Plan (VTDEC, 2023b). The updated 2023 Tactical Basin Plan (TBP) provides an assessment of the health of the Lake Memphremagog basin through the lens of the phosphorus ("P") Total Maximum Daily Load (TMDL), and "provides a detailed description of current watershed conditions and identifies water quality focused strategies to protect and restore the Basin's surface waters" (VTDEC, 2017a). While the TBP "defines ongoing and future strategies to address high-priority surface water stressors", the LWAP offers a more refined and actionable plan that is tailored to a specific lake's catchment rather than the entire watershed (VT DEC, 2023a). In the TBP, Echo Lake is identified as a surface-water of 'good quality' but notes that it is subject to several stressors that threaten its status as a healthy, oligotrophic waterbody. These stressors include increasing nutrient trends, elevated mercury levels, and loss of shoreland habitat. Similarly, the TBP identifies Seymour Lake as surface-waters of good quality but also notes the lake is subject to stressors including increasing nutrient trends, high mercury, and poor shoreland habitat quality.

The TBP provides several strategies to address water quality stressors in Echo and Seymour Lakes. In the regulatory realm, reclassification of both lakes as A(1) excellent surface waters would protect the watersheds by prohibiting direct discharge of untreated wastes, development of new septic systems >1,000 gallons per day, and solid waste management facilities or application of biosolids or septage (Strategy #49). In 2021, the Echo Lake Protective Association submitted a petition to the State requesting reclassification to A(1) status. No such petition has been filed for Seymour Lake as of 2024. In addition to reclassification, both lakes are listed as ideal candidates for hosting Septic Socials to bring attention and awareness to the influence that hundreds of small-scale residential septic systems can have on lake water quality. Lastly, another strategy recommends Echo Lake continue to implement chemical monitoring of tributaries through the LaRosa program to better locate primary sources of increasing nutrient trends. While critically important, it is worth noting that the LWAP process was not designed to address regulatory initiatives or support chemical or biological monitoring programs.

Beyond monitoring and regulatory protections, the TBP recommends addressing water quality stressors in Echo and Seymour Lakes by assessing, identifying, and implementing water quality projects in several work sectors. Specifically, this includes implementing agricultural best management practices (BMPs) through the Agricultural Conservation Planning Framework and other initiatives (Strategies #2, 4, 6, 8, 9, 10, 11), performing private road erosion inventories (REIs)s and installing BMPs (Strategy #23), promoting septic system outreach and upgrades (Strategy #28), continuing Lake Wise assessments and implementation of shoreland restoration projects (Strategies #43, 44, 45, 46), upgrading stream crossings for enhanced AOP and geomorphic compatibility (Strategies #40, 41), and implementing riparian and process-based restoration projects on streams (Strategies #33, 34, 36). The LWAP process was designed to support the development and implementation of non-regulatory, voluntary water quality projects and is therefore an important step toward achieving those Strategies.

In addition to nutrients, other watershed health stressors include invasive species infestations and barriers to aquatic organism passage (AOP). Across both lakes, self-sustaining or stocked populations of brook trout, rainbow trout, landlocked Atlantic salmon, brown trout, rainbow smelt, and white sucker may benefit from AOP improvements. Both lake associations maintain robust Aquatic Invasive Species Greeter and Volunteer Invasive Patroller programs that are critical to preventing invasive species at public boat ramps and act as early detectors for populations that may establish in the lakes.

1.4 Goals & Objectives

Echo and Seymour lakes are renowned for their clear waters, low nutrient levels, superb cold-water fishing, and community-led protection & restoration efforts. It is because of these factors that the DEC Lakes and Ponds program selected it as a priority for development of a Lake Watershed Action Plan. By taking steps to identify water quality problem areas and remedies, the residents and towns of Charleston, Morgan, and Holland can work to protect and preserve the quality of water and habitat in the watershed. However, these cherished lakes are not unique in the sense that their pristine state is under constant threat from common water quality issues such as sedimentation, excess phosphorus loading, loss of natural lakeshore habitat, forest fragmentation, and degradation of tributary streams and wetlands. As such, the goals for the Echo-Seymour LWAP are to:

- Identify water quality stressors.
- Develop discrete water quality projects related to these stressors.
- Rank and evaluate the potential benefits of each project.
- Develop several projects that will reduce sediment and nutrient loading to the lake.

Specific objectives are outlined in the DEC LWAP Technical Guidance, but include individual project summary sheets, compiling an overall project prioritization table, and drafting 30% conceptual designs for multiple high-priority projects that will enable the Towns, Lake Associations, and other partners to seek grant funding for final design and implementation.

Chapter 2 **BACKGROUND INFORMATION**

2.1 Study Area

The Echo-Seymour Lakes Watershed is a subbasin of the Lake Memphremagog watershed located in Orleans County, Vermont and spans portions of the Towns of Morgan, Charleston, and Holland (Figure 1). From the outlet of Echo Lake, the contributing drainage area of the watershed (including lakes) is approximately 24.2 miles^2 (15,481 acres). Of this, approximately 20.6 miles^2 (13,224 acres) drains first to Lake Seymour, while the remaining 2,257 acres drains directly to Echo Lake (Figure 2). A substantial portion of the watershed is dominated by open water; Seymour Lake is a 1,777-acre glacial lake located entirely in the Town of Morgan, while Echo Lake is a 546-acre glacial lake located upstream of the village of East Charleston. Seymour Lake reaches a depth of 167 feet while Echo Lake reaches a depth of 129 feet. Both waterbodies are classified as B(2) waters by the State and characterized as having "good" water quality. Water levels on both lakes are regulated by hydroelectric dams at their respective outlets, owned and operated by Great Bay Hydro. Water flows out of Seymour Lake for approximately one-half of a mile before entering Echo Lake, which then drains into the Clyde River in the village of East Charleston. From there, the Clyde River flows approximately 25 miles to its terminus in Newport, VT where it discharges into Lake Memphremagog.

Analyses performed by VTDEC and reported in the Lake Land Cover Maps indicates 70% of the Echo-Seymour Lakes watershed is forested (Figure 3). Other dominant land cover types include grass/shrubs (~16%), open water (~13%), and impervious surfaces (1.4%). Of those impervious surfaces, bare soil accounts for 28 acres, buildings account for 35 acres, roads account for 111 acres, and parking lots and driveways account for 105 acres (VTDEC, 2022a).

When considering the Seymour Lake drainage area as a sub-catchment of the overall Echo-Seymour Lakes watershed, forested land cover increases to 80% and grass/shrub cover increases to ~18% (Figure 4; VTDEC, 2022b). Relatively unchanged at this scale is the proportion of impervious surface cover (1.6%). Of the impervious areas within the Lake Seymour sub-catchment, bare soil accounts for 27.3 acres, buildings account for 29.9 acres, roads account for 92.3 acres, and parking lots and driveways account for 87.7 acres.

Land cover data was not readily available from the State for lands that drain directly to Echo Lake without first passing through Seymour Lake. However, the relative area of each land cover class for this portion of the study area, referred to as Echo Lake direct drainages, can be inferred as the difference between the values from the entire watershed and the values for the Seymour Lake sub-catchment. Using this approach, MWA calculated the Echo Lake direct drainages watershed to be 37% forested, 11% grass/shrubs, 51% open water, and 1% impervious surface.

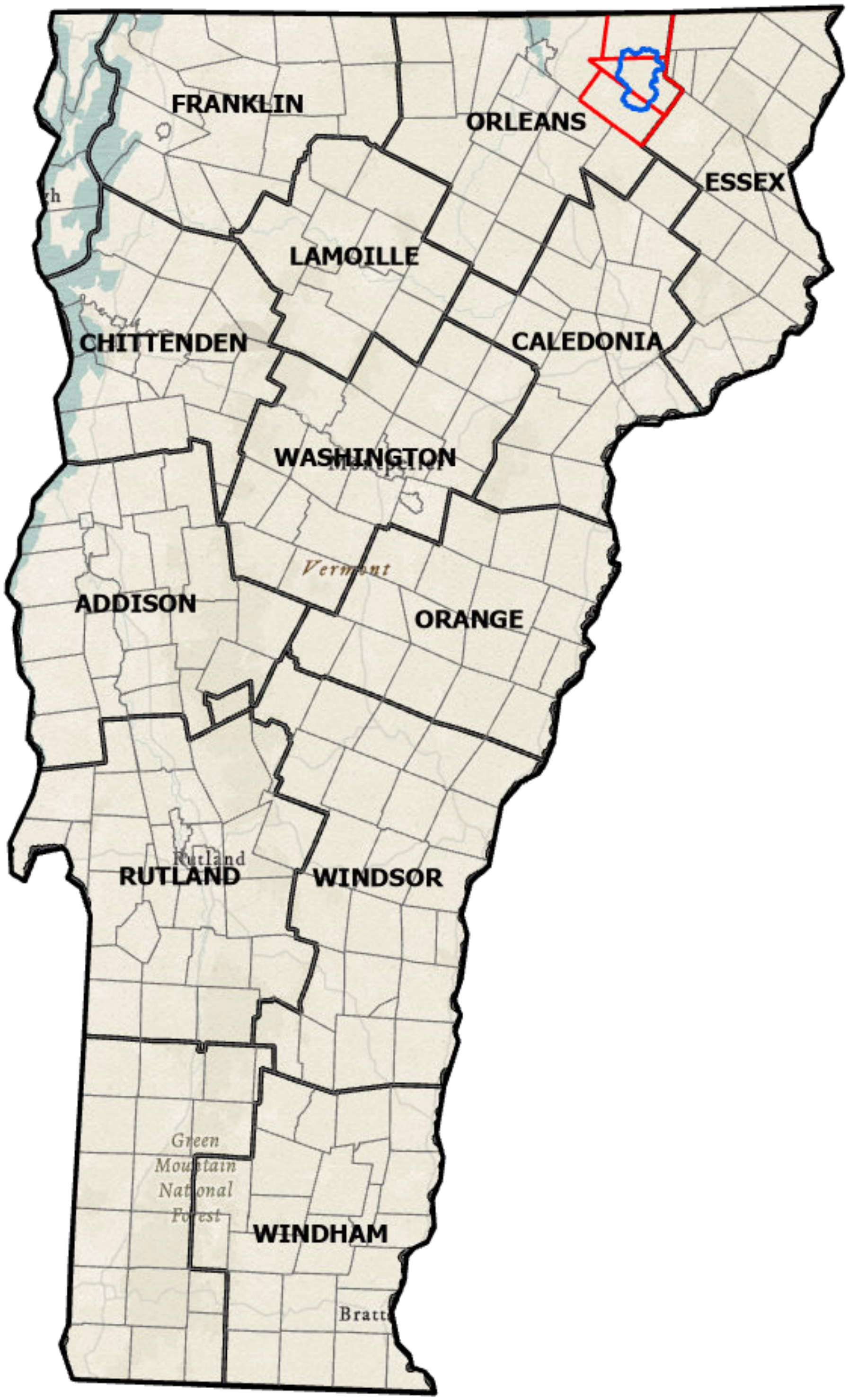
While impervious surfaces such as buildings, roads, paved areas, and bare soil collectively amount to less than 2% of the total land cover in the Echo-Seymour Lakes watershed, these land cover types are most concentrated along the periphery of the lakes. When considering only the 250-foot wide shoreland protection area around the periphery of the lakes, forest cover drops to 58% and 63% and impervious cover increases to 9% and 12% for Echo and Seymour Lakes, respectively (Figures 5-6). These changes represent an approximately 20% reduction in forest canopy and ten-fold increase in impervious surfaces in areas of the watershed where the lakes are most vulnerable to water quality stressors.

2.2 Watershed Data Library

The Echo-Seymour LWAP assessments began with a thorough desktop review of all information and documentation available from town, State, regional, and other sources. Relevant information ranges from water quality monitoring data and road erosion inventories (REI) to land use/land cover and stream crossing structures. In addition to the Watershed Data Library memo which outlines the findings from our research (**Appendix A**), MWA developed an online Echo-Seymour Lakes Watershed Web Map using the ArcGIS Online service. This web hosted tool is accessible for free to any person with the link; the public may also contact MWA or OCNRCD for access to the web map. Available data were thoroughly reviewed and utilized to plan for and propose key target assessment areas within the three core sectors of an LWAP: Lake Shorelands, Streams, & Roadways. These data were critical during the selection of the proposed target field assessment areas as well as an additional sector – large forested, agricultural, or developed lands – since they gave the most complete picture of the watershed to date. For instance, water quality data from the LaRosa Partnership Program were used to select target stream reaches for streamwalks, while Road Erosion Risk scores were used to identify which road segments required additional field screening. Sources utilized in the data library include:

- Lake Memphremagog TMDL
- Basin 17 Tactical Basin Plan
- International Joint Commission Report
- Hydrologically Connected Roads
- Road Erosion Inventory
- Land Cover Dataset
- Lake Scorecard
- Vermont Bridges & Culverts
- Fish & Wildlife Stream Crossings
- VT Hydrography Dataset
- Ephemeral Streams
- LiDAR DEM & 1-ft contours
- Potentially Erosive Features
- NRCS Soils & Erodibility
- Vermont Integrated Watershed Information System
- Volunteer Lay Water Quality Monitoring Database
- Stream Geomorphic Assessment Data Management System
- Aquatic Invasive Species Control Reports
- Significant Natural Communities
- Rare, Threatened, & Uncommon Species
- Stormwater & Wastewater Infrastructure
- Morgan & Charleston Town Bylaws
- Lake associations reports

FIGURE 1


FRANKLIN
ORLEANS
ESSEX
LAMOILLE
CHITTENDEN
CALEDONIA
WASHINGTON
Vermont
ADDISON
ORANGE
RUTLAND
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WINDSOR
Green
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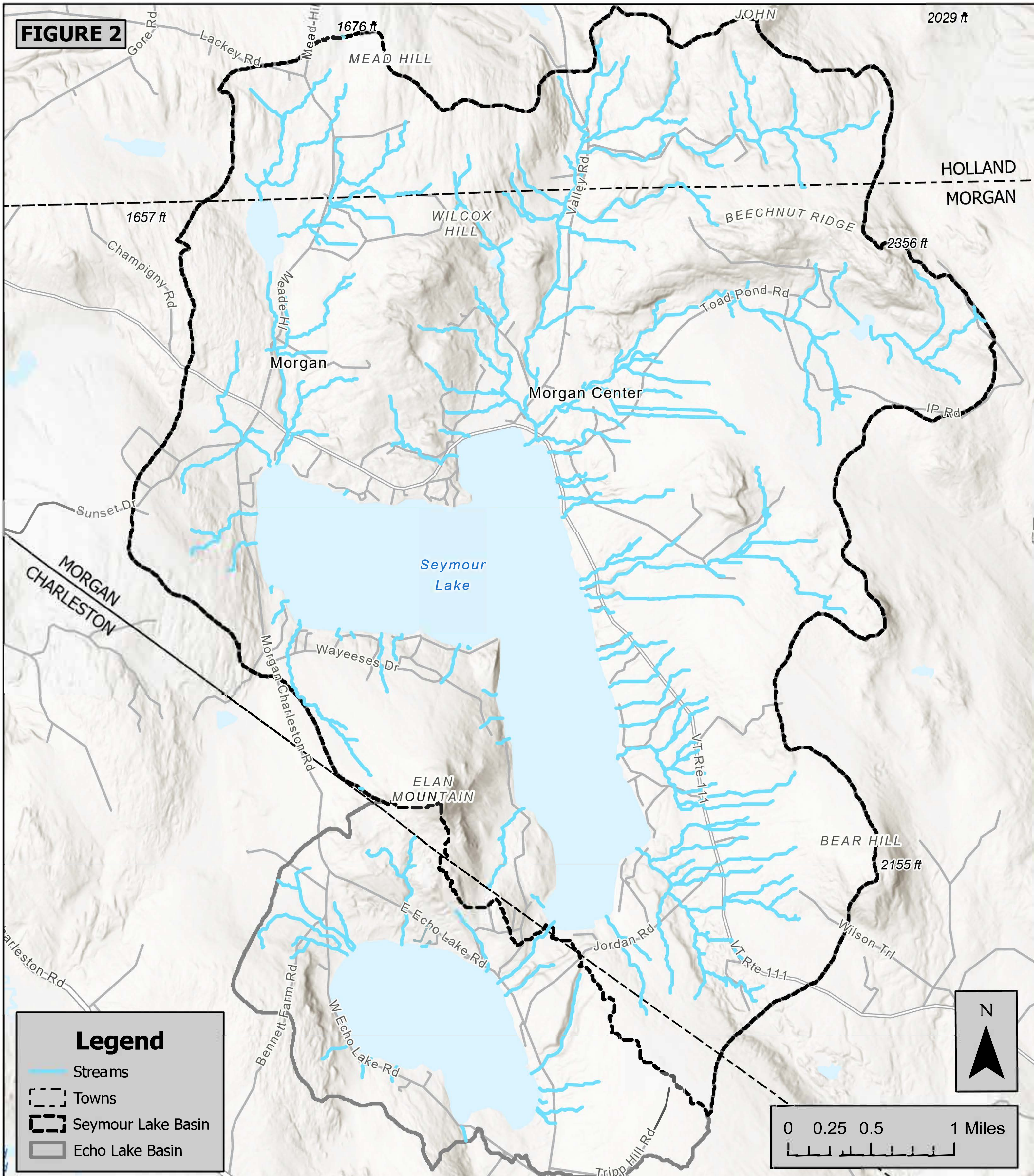


Notes: Map depicting the Echo and Seymour Lakes watershed in Morgan and Charleston, VT.

Drawn By: Patrick Hurley, MWA

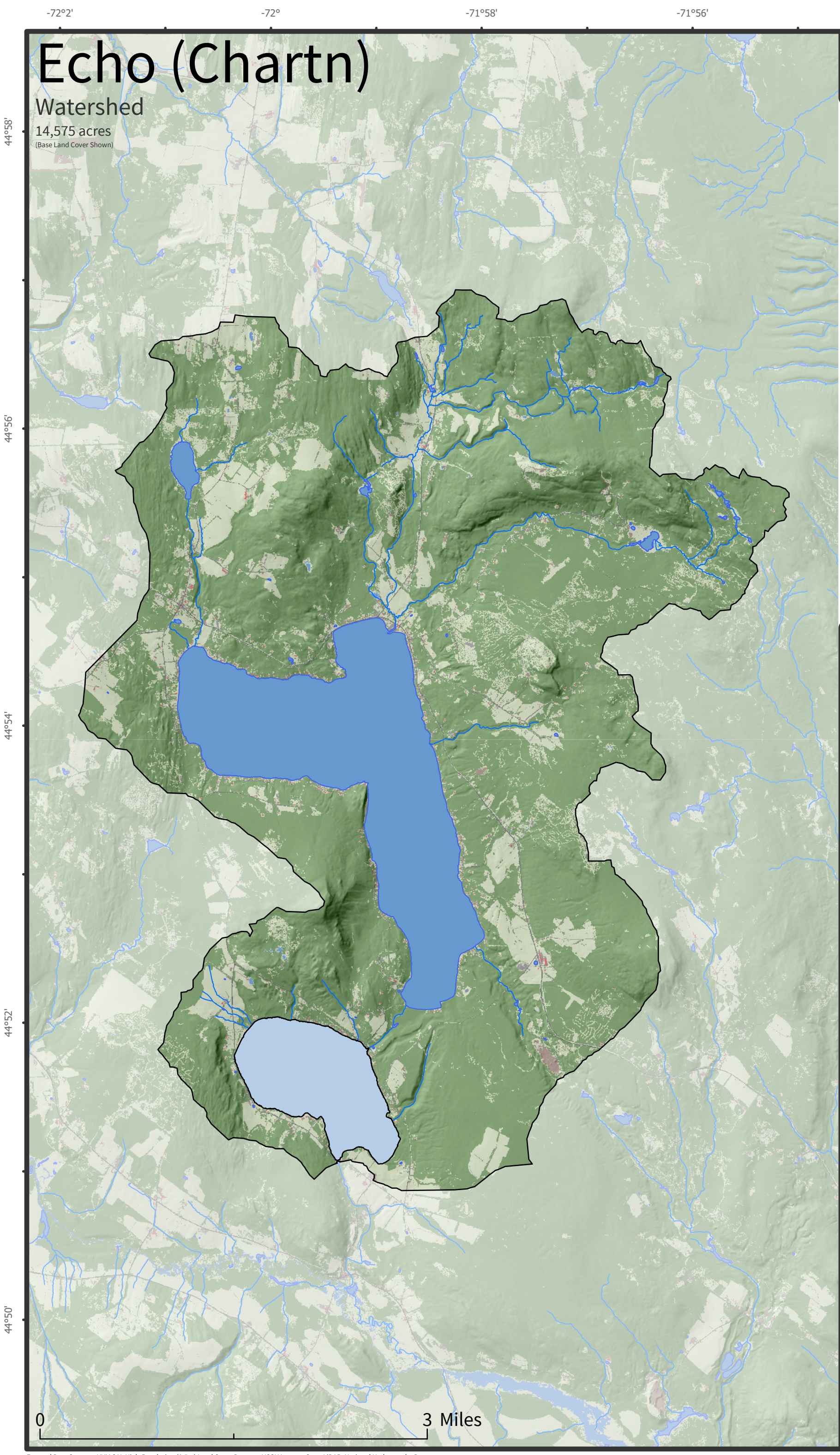
Date: June 25, 2023

Echo-Seymour Lakes Watershed

MWA MEMPHREMAGOG WATERSHED ASSOCIATION

Orleans County Natural Resources Conservation District

PO Box 513 | Newport, VT 05855 | 802.487.0160

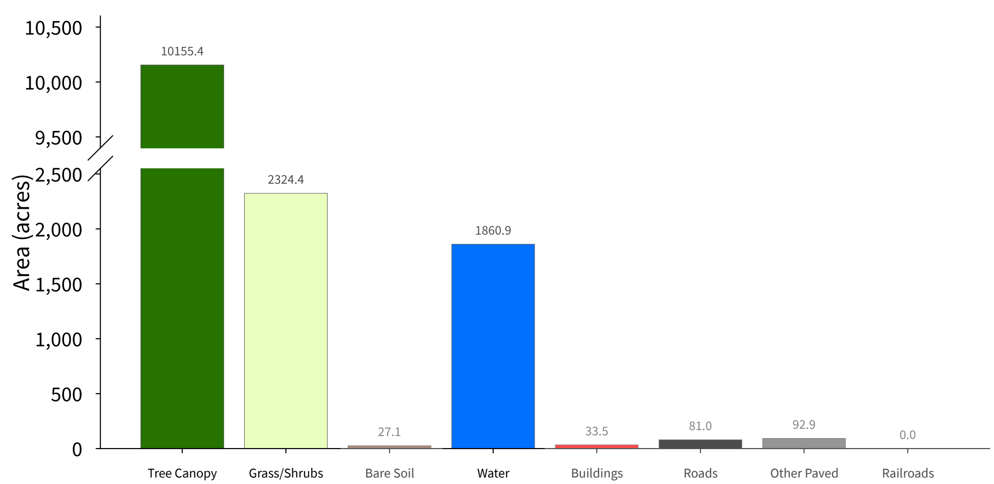


External Data Sources: UVM SAL High-Resolution (0.5m) Land Cover Dataset, VCGI Vermont State LiDAR, National Hydrography Dataset

High-Resolution Land Cover Summary

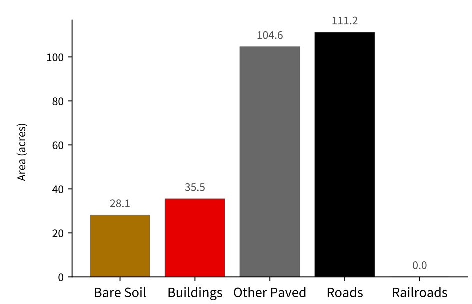
FIGURE 3

Base Land Cover (Top-Down*)

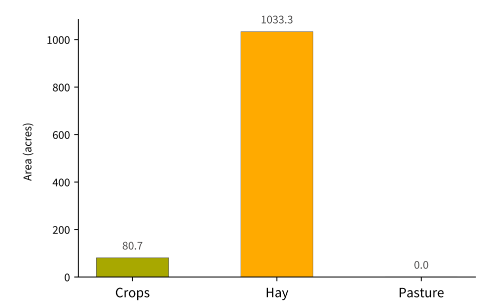


Supplemental Land Cover

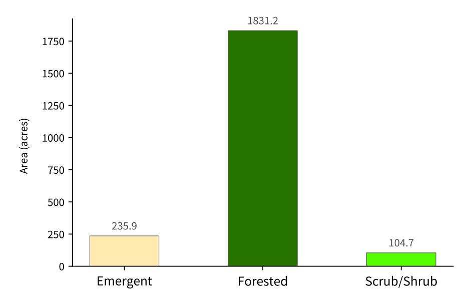
Impervious Surfaces (279.49 acres - 1.9 % of total) (Bottom-Up**)



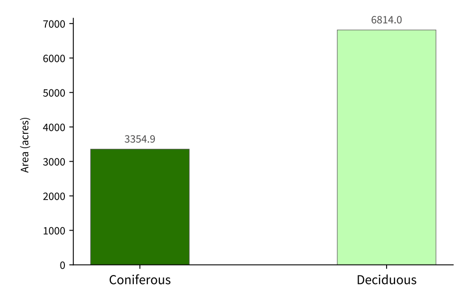
Agriculture (1,114.08 acres - 7.6 % of total)



Wetlands (2,171.8 acres - 14.9 % of total)



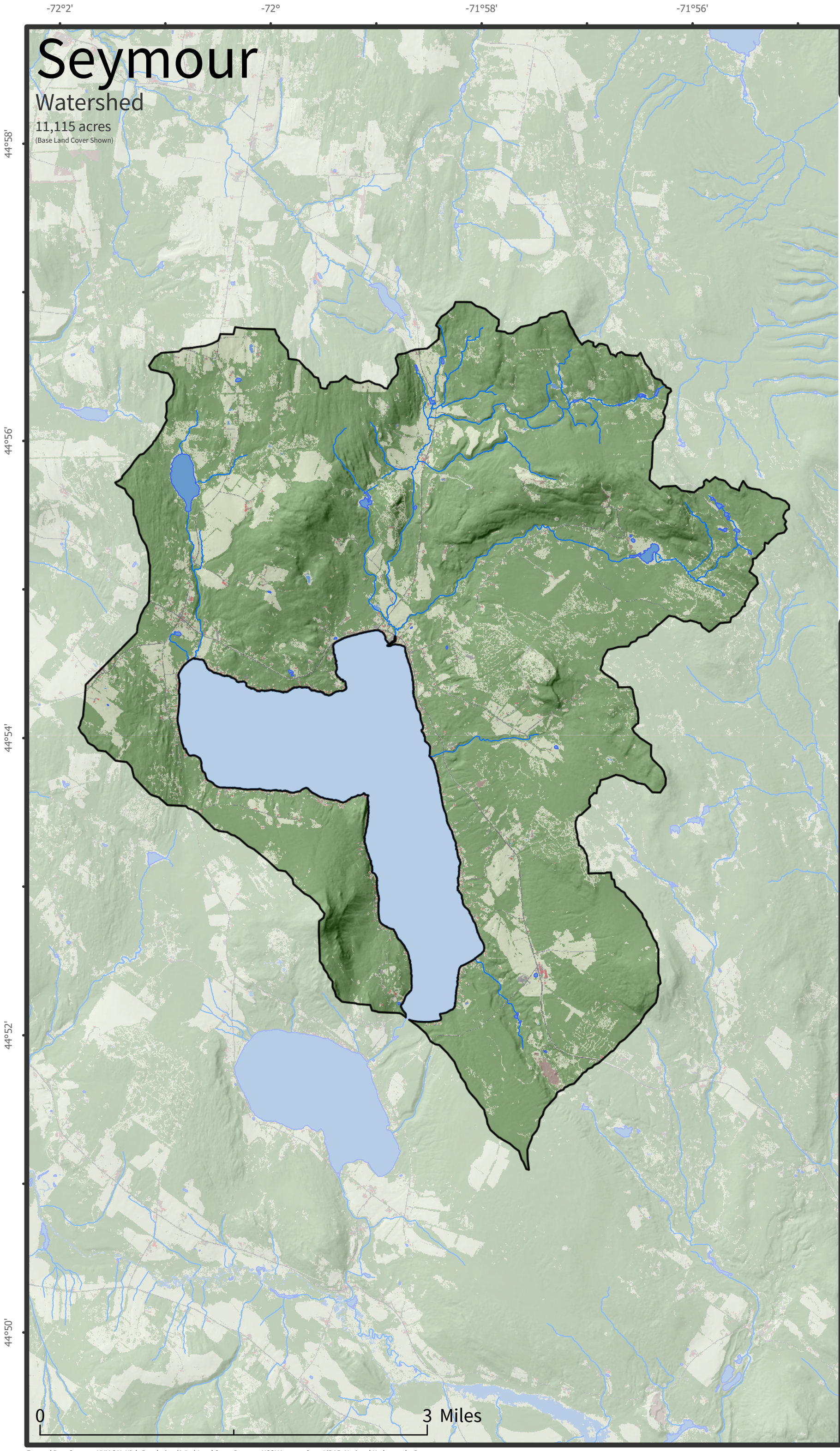
Tree Canopy (10,168.86 acres - 69.8 % of total)



*Top-Down: A traditional land cover mapping approach - land cover is mapped as the uppermost land cover class.
**Bottom-Up: A new land cover mapping approach - land cover is mapped as the lowermost land cover class. This approach results in improved mapping of features overlapped/obscured by other features.
See UVM SAL High-Resolution Land Cover 2016 Report for more detail.

High-Resolution Land Cover Summary

FIGURE 4



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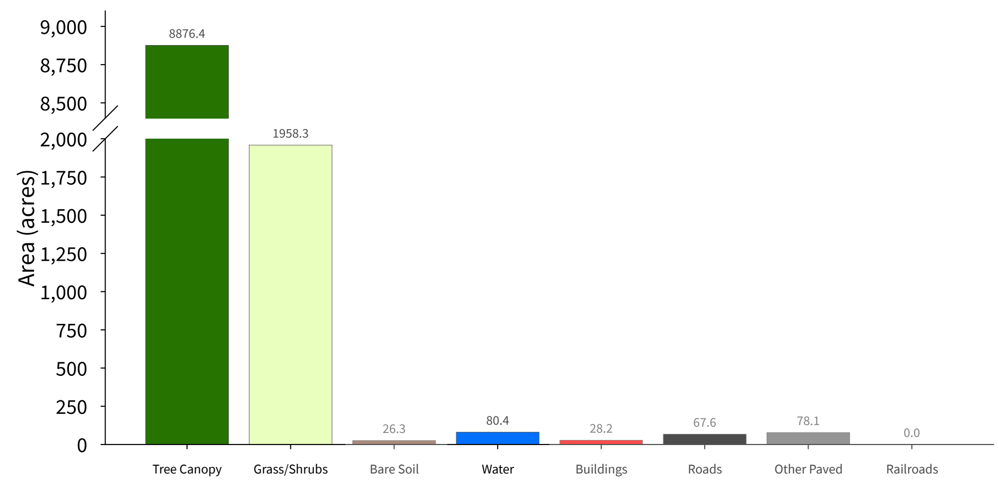
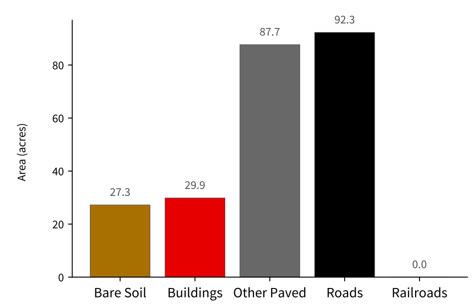
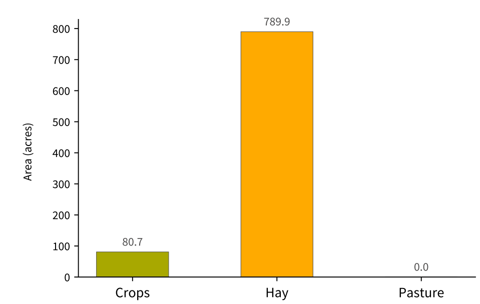


Supplemental Land Cover

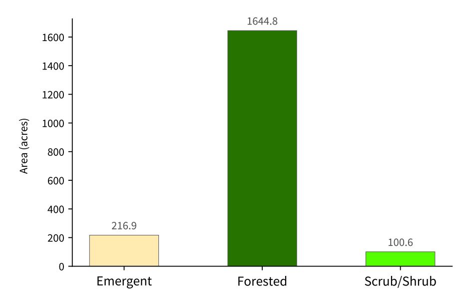
Impervious Surfaces (237.11 acres - 2.1 % of total) (Bottom-Up**)



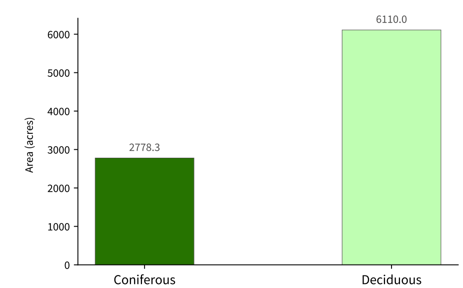
Agriculture (870.6 acres - 7.8 % of total)



Wetlands (1,962.27 acres - 17.7 % of total)



Tree Canopy (8,888.27 acres - 80 % of total)



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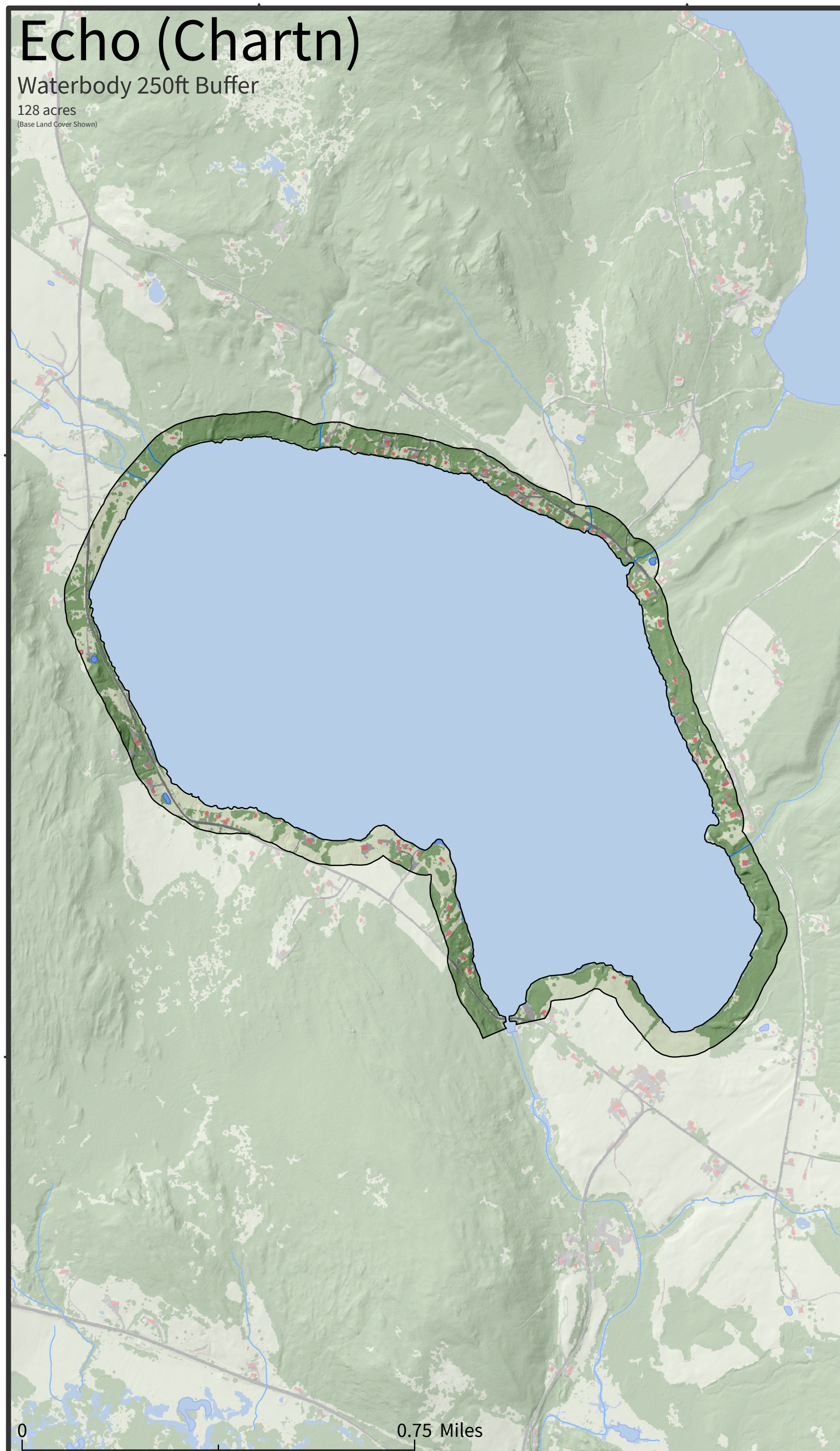
High-Resolution Land Cover Summary

FIGURE 5



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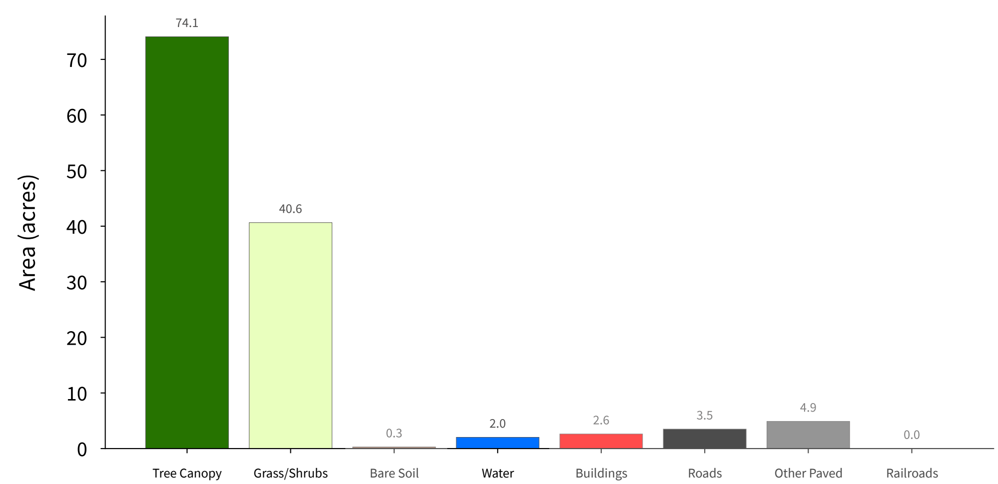
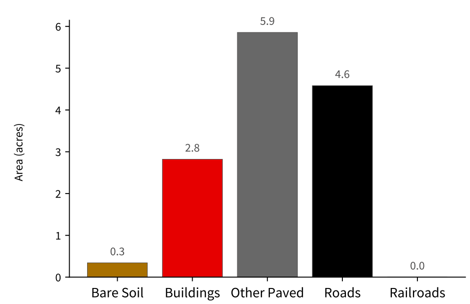
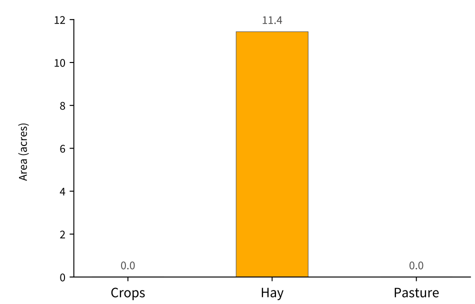


Supplemental Land Cover

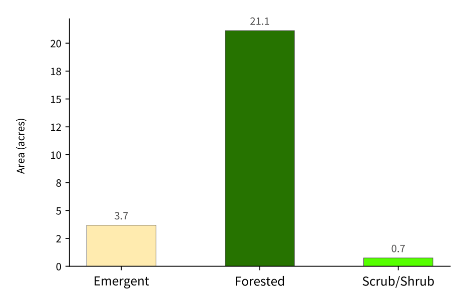
Impervious Surfaces (13.6 acres - 10.6 % of total) (Bottom-Up**)



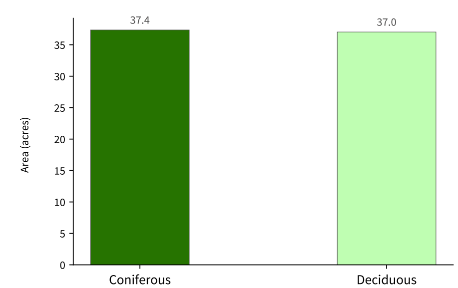
Agriculture (11.44 acres - 8.9 % of total)



Wetlands (25.55 acres - 20 % of total)



Tree Canopy (74.39 acres - 58.1 % of total)



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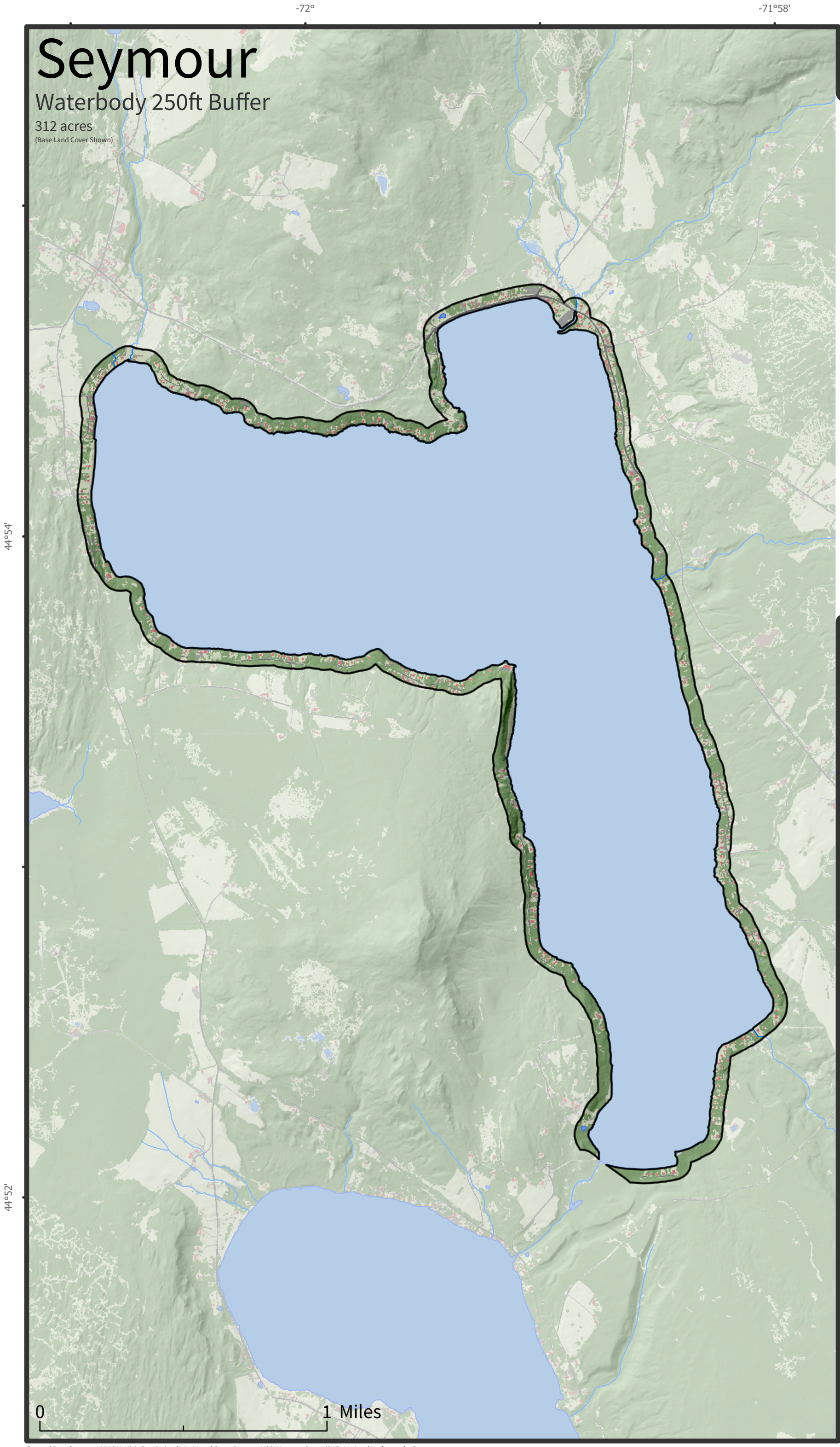

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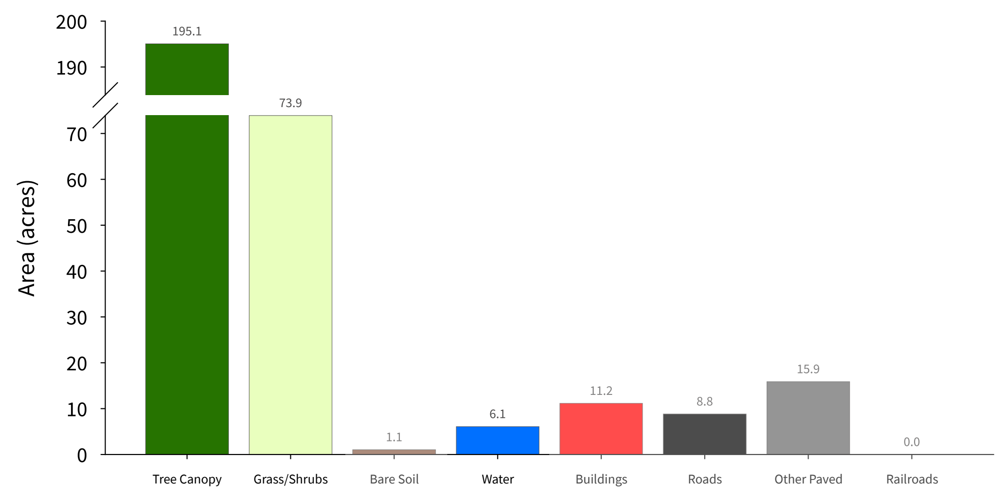
High-Resolution Land Cover Summary

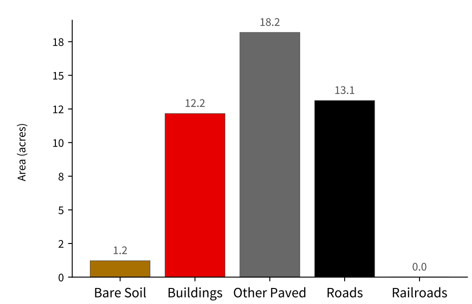
FIGURE 6

Base Land Cover (Top-Down*)

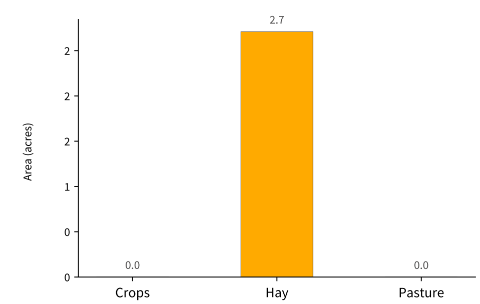


Supplemental Land Cover

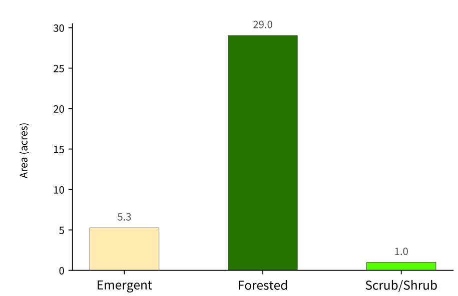
Impervious Surfaces (44.7 acres - 14.3 % of total) (Bottom-Up**)



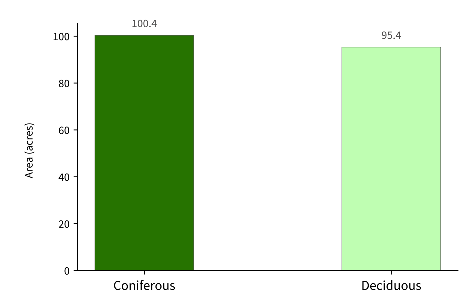
Agriculture (2.71 acres - 0.9 % of total)



Wetlands (35.28 acres - 11.3 % of total)



Tree Canopy (195.75 acres - 62.7 % of total)



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Chapter 3 **ASSESSMENTS & PROJECT IDENTIFICATION**

3.1 Water Quality Project Identification Methods

The identification of potential water quality improvement projects was a primary goal of the LWAP. Potential projects were identified by performing extensive stream, roadway, and lakeshore assessments throughout the watershed. As mentioned above, the selection of proposed target areas for field assessments was based on information gleaned during the development of the data library. In addition, MWA and OCNRCD solicited direct input from stakeholders throughout the study period for help with identifying chronic problem areas. This was done at the outset of the LWAP by providing blank maps of the watershed and instructing stakeholders to highlight and describe areas they are familiar with that may present water quality issues. MWA and OCNRCD also offered to perform site visits for landowners who suspected water quality issues on their properties. In total, MWA performed more than 24 requested site visits for project identification and development purposes. For more information about how the LWAP Team selected target field assessment areas, see the *Proposed Core Assessment Areas* memo (**Appendix B**). The following sections summarize project identification efforts undertaken for each of the core sectors.

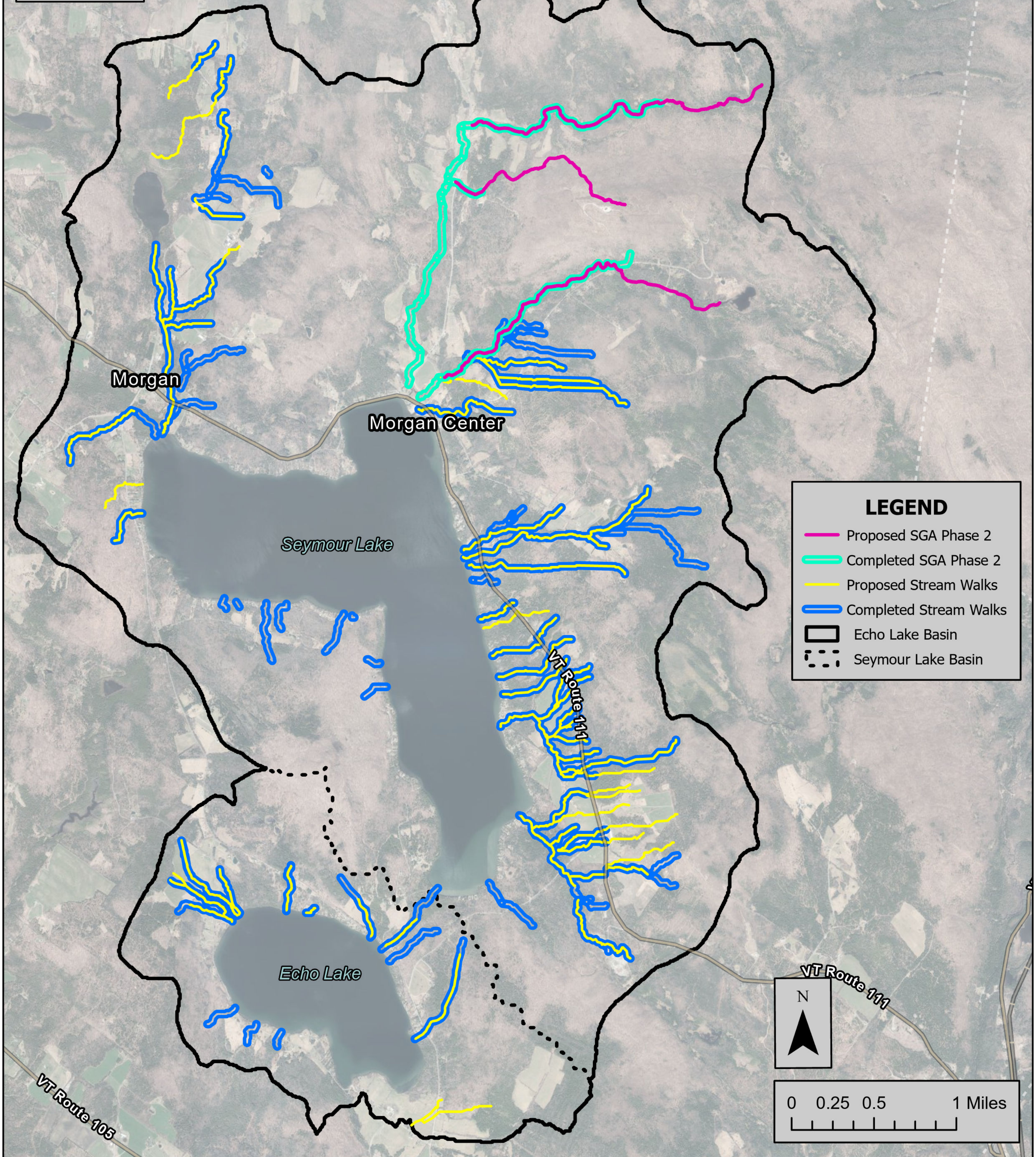
3.1.1 Stream Assessments

MWA opted to utilize a combination of assessment protocols for this effort. Phase 2 "lite" stream geomorphic assessments (SGA; VTDEC, 2009) were performed on multiple reaches of Valley Brook and Sucker Brook – the largest tributaries to the lakes and the focus of recent and ongoing restoration projects. Rapid assessments, referred to as "stream walks", were performed on tributaries smaller than 2 square miles. MWA's stream walks are based on a combination of SGA and the *Riparian Streambank Assessment* protocols. The latter approach was initially developed by the Riparian Lands Team within Vermont Fish & Wildlife Department's Fisheries Division for use on State-owned Streambank Management Areas. These rapid assessments also incorporated observations of features commonly evaluated during SGA Phase 2, including bank erosion, headcuts, gullies, log jams, beaver dams, stormwater inputs, bank erosion, and grade controls.

3.1.2 Stream Walks

MWA conducted stream walk assessments along 32.3 stream miles and across 213 individual properties (Figure 7). More than 500 field observations were collected during SGA and Stream Walk assessments. Assessments were performed on foot, typically from downstream to upstream, and extended laterally up contributing gullies, ephemeral drainages, or other areas where water quality issues were suspected. Observations were recorded in the field using an ESRI Field Map™ customized by MWA for the Echo-Seymour watershed. Each record included GPS location, observer name, date/time, description, notes, and photos (if applicable). Where discrete potential water quality or habitat improvement projects were identified, a Potential Project Summary Sheet was created in the field using an ESRI Survey123™ form generated by MWA. This digital field form included a project name & identifier, location and property information, description of the problem/opportunity, potential BMPs or other remedies, possible co-benefits, relevant measurements and metrics (e.g., length, width, & depth of a gully), photos, and other

FIGURE 7



Notes: Map depicting locations of proposed & completed StreamWalks & Phase 2 Stream Geomorphic Assessments.

Drawn By: Patrick Hurley, MWA

Date: November 26, 2024

Proposed & Completed Stream Assessments

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information that was pertinent to phosphorus reduction calculations, cost estimations, or project scoping and prioritization efforts.

3.1.3 Phase 2 Stream Geomorphic Assessments

Based on conversations with the DEC Rivers Program (S. Pomeroy & S. Pealer, *personal communication*), MWA elected to conduct SGA Phase 2 "lite" on reaches of Valley Brook and Sucker Brook (Figure 7). These are the two largest tributaries in the watershed, which converge on VFWD's Sucker Brook Streambank Management Area property on Valley Road before flowing into the lake at the Seymour Access Area off Route 111. These tributaries were selected due to their disproportionately large contributing drainage areas, recent flooding and fluvial erosion, and elevated phosphorus concentrations compared to smaller tributaries in the watershed. In addition, SGA had already been completed by MWA on several reaches of Valley Brook in Summer 2022 as part of Phase 1 restoration efforts at the Valley Brook Streambank Management Area owned by VFWD. As such, it was determined that SGA data from the remaining reaches of Sucker and Valley Brook would be useful for Phase 2 restoration efforts and ongoing monitoring of restoration project efficacy.

For this work, MWA followed protocols published by DEC Rivers Program (SGA Phase 2) and **performed geomorphic assessments across 5.4 miles of stream**. Valley Brook reaches T1.08 – T1.12 had already been assessed by MWA, thus reach T1.13 was evaluated by MWA and OCNRCD in May 2024. On Sucker Brook, MWA and OCNRCD completed SGA on T1S5.01 - T1S5.04, capturing geomorphic conditions and channel dimensions from downstream of Toad Pond to the confluence with Valley Brook near Seymour Lake. As part of this effort, MWA provided beta-testing of DEC Rivers Program's new SGA Survey123 application and provided technical feedback to the River Scientists and application developers.

3.1.4 Town & Private Road Erosion Assessments

MWA opted to perform roadway assessments using a combination of drive-by surveys and ground-based evaluations on foot. In general, roadway assessments consisted of 'windshield surveys' and/or on-the-ground rapid screening of non-compliant road segments, hydrologically connected road segments that intersect stream crossings, and priority private driveways. These qualitative assessments were based on the Road Erosion Inventory (REI) protocols and focused on identifying road segments and driveways that are prone to or undergoing erosion, gullying, or washouts (VTDEC, 2024). Roadway assessments focused on the travel lane surface, shoulder, stream crossings, and connected drainage infrastructure. MWA coordinated with DEC's Watershed Planner & Municipal Roads General Permit program to discuss assessment approaches, target areas, and data availability (B Copans & E Boardman, *personal communications).*

Roadway assessments were performed across multiple seasons between 2023 – 2024. Assessments started in July 2023 immediately following historic floods and fluvial erosion. Many road assessments were performed again following the July 11 and July 30, 2024, floods. Town road and highway segments were initially selected for screening based on their compliance status with Municipal Roads General Permit (MRGP) standards. Segments that were classified as either *Does Not Meet, Partially Meets, or Incomplete Data* were selected for field assessments. In some cases, road segments listed as not hydrologically connected were chosen for assessment due to observations of recent flood damage and/or fluvial erosion. VT Route 111, which passes through Morgan, was not selected for field assessments because of its status as a State Highway and required TS4 stormwater management regulations. Regardless of this status, MWA did perform rapid culvert assessments when crossing Route 111 during field work. While culvert crossings are a gray area, road erosion BMPs along Route 111 are not eligible for non-regulatory Clean Water Project funding and therefore are beyond the scope of this LWAP.

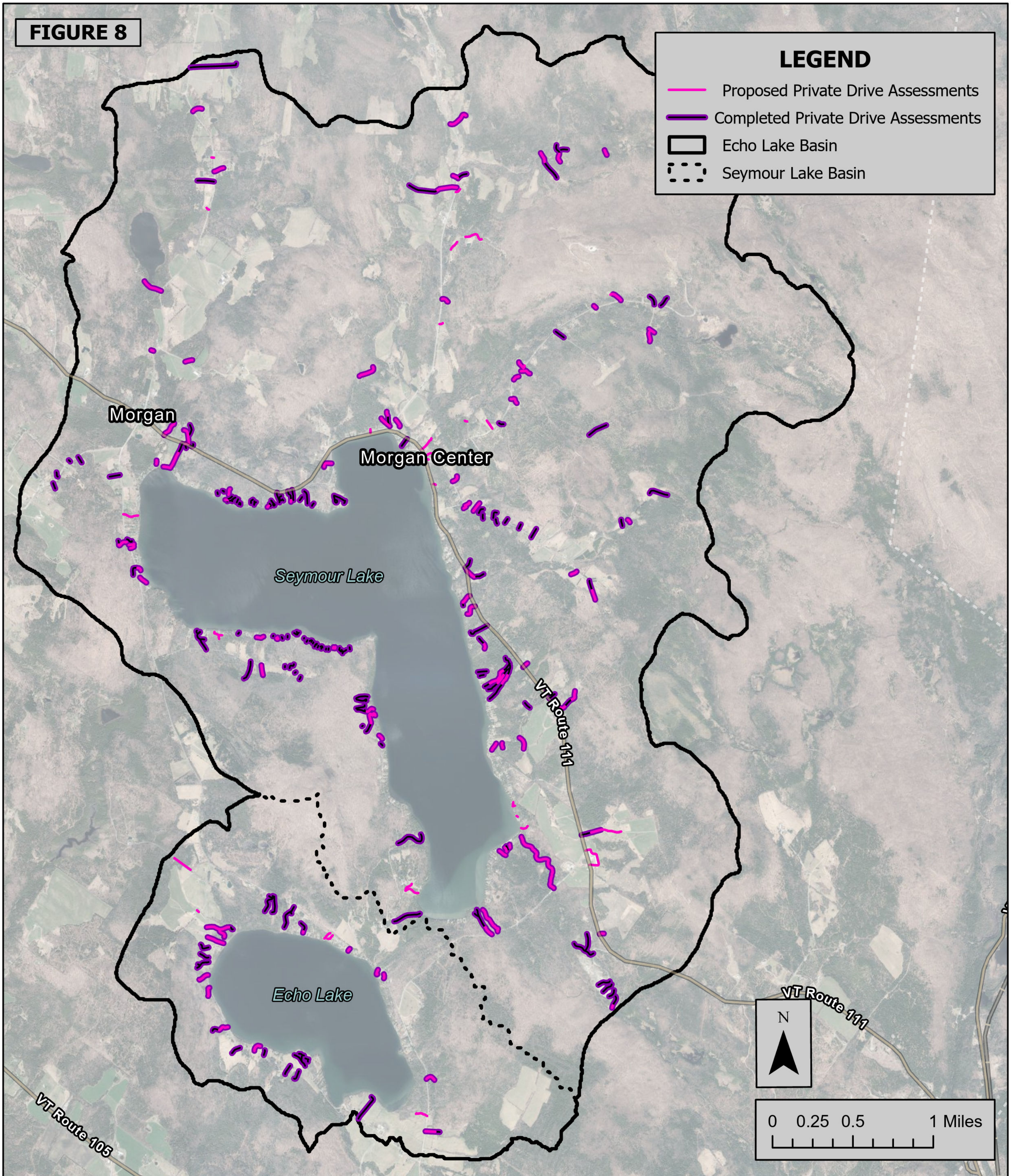
Private driveways were selected for screening by MWA using analytical approaches similar to those employed by DEC and the MRGP program. Private Road centerlines were split into 100m segments, and those segments within 100 feet of a stream, wetland, waterbody, or hydrologically connected road segment were reviewed for potential erosion risks.

MWA initially proposed to assess 7 miles of private roads and driveways (out of a total of 32 miles) and 3.4 miles of Town roads and highways (out of a total of 27.4 miles). **At the completion of the LWAP, MWA had assessed 13.3 miles of private roads and driveways and 22.7 miles of public roads and highways** (Figures 8 & 9). Of the public roadways, the majority of segments that were non-compliant with MRGP standards were located on West Echo Lake Road, East Echo Lake Road, Valley Road, Sunset Drive, Toad Pond Road, Williams Road, Hatton Heights, and Meade Hill Road.

3.1.5 Lake Shoreland & Lake Wise Assessments

Lake shoreland and Lake Wise assessments were used to evaluate the conditions of the lakeshore and identify projects that might not be visible from roadways or stream corridors. Shoreland assessments were a way to perform rapid screening of the entire shoreland by boat while circumnavigating the lake. This provided a complete picture of the lakeshore stability, riparian buffer quality, and development pressures for each lake. **MWA completed 15.1 miles of shoreland assessment boat tours during the months of August and September 2023** (Figure 10). The respective lake associations piloted the boat around the perimeter of each lake while MWA collected observations related to lakeshore erosion, habitat loss, shoreland buffer clearing, development patterns, and other potential water quality issues. On Seymour Lake, over 140 properties were screened and over 40 properties were prioritized for follow-up outreach or Lake Wise potential. On Echo Lake, over 70 properties were screened and nearly 30 properties were prioritized for follow-up outreach or Lake Wise potential.

From these priority property lists, staff from OCNRCD reached out to a couple dozen lakeshore property owners via letters, emails, and direct invitation from lake association members, offering to conduct free Lake Wise assessments. A Lake Wise assessment is a comprehensive evaluation of a lakeshore property to identify ways to improve stormwater management through Best Management Practices. While many offers were not taken, multiple landowners from the priority lists did agree to having Lake Wise assessments conducted. **In total, the LWAP Team performed 12 Lake Wise assessments between 2023 and 2024** (Figure 10). The assessments resulted in 4 awards and 1 certificate for Echo Lake and 4 awards and 3 certificates for Seymour Lake. MWA assisted OCNRCD and completed one Lake Wise assessment on Seymour Lake.



Notes: Map depicting locations of proposed & completed private road & driveway assessments.

Drawn By: Patrick Hurley, MWA

Date: November 26, 2024

Proposed & Completed Private Drive Assessments

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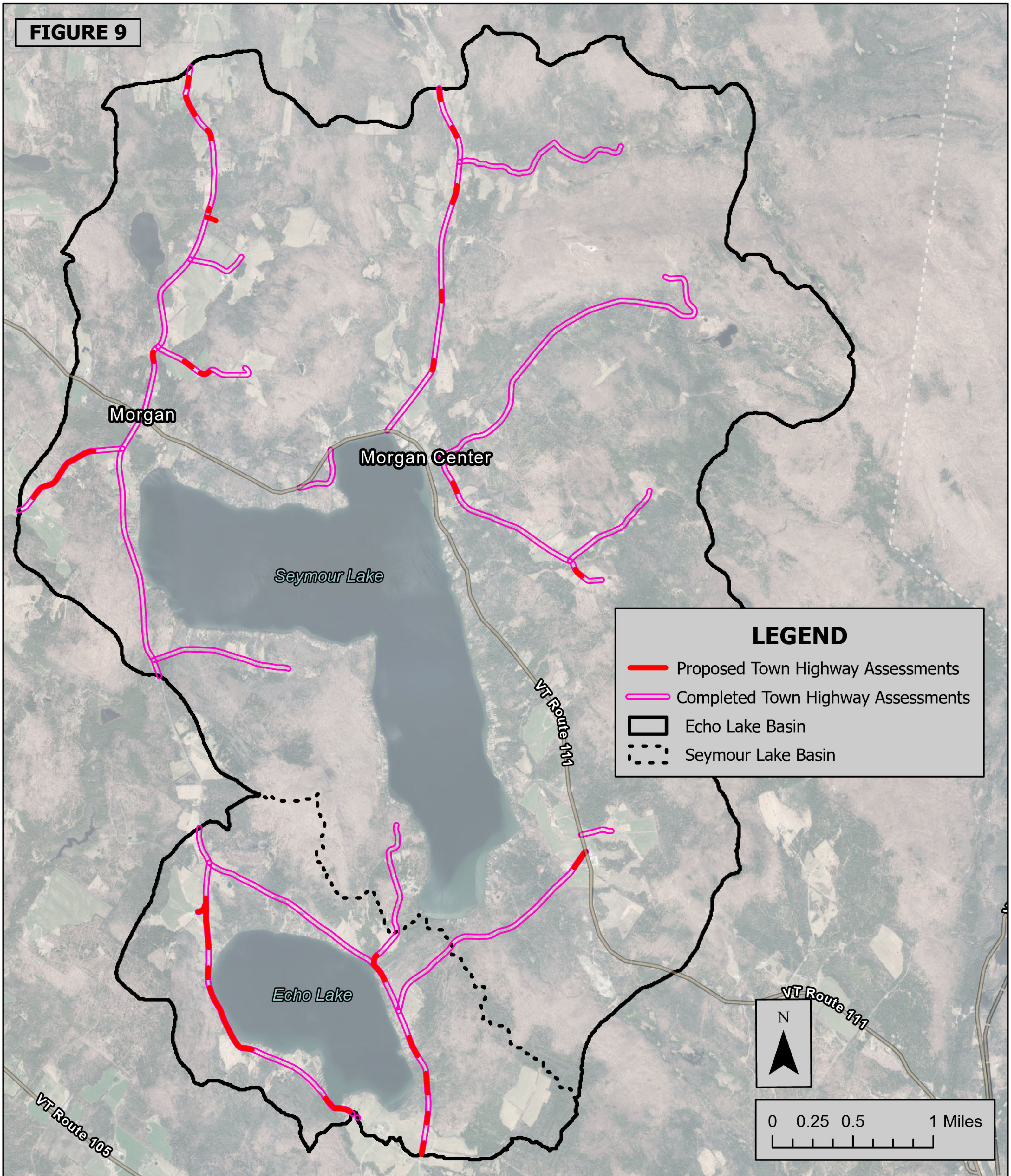

Notes: Map depicting locations of proposed & completed town road & highway assessments.

Drawn By: Patrick Hurley, MWA

Date: November 26, 2024

Proposed & Completed Town Road Assessments

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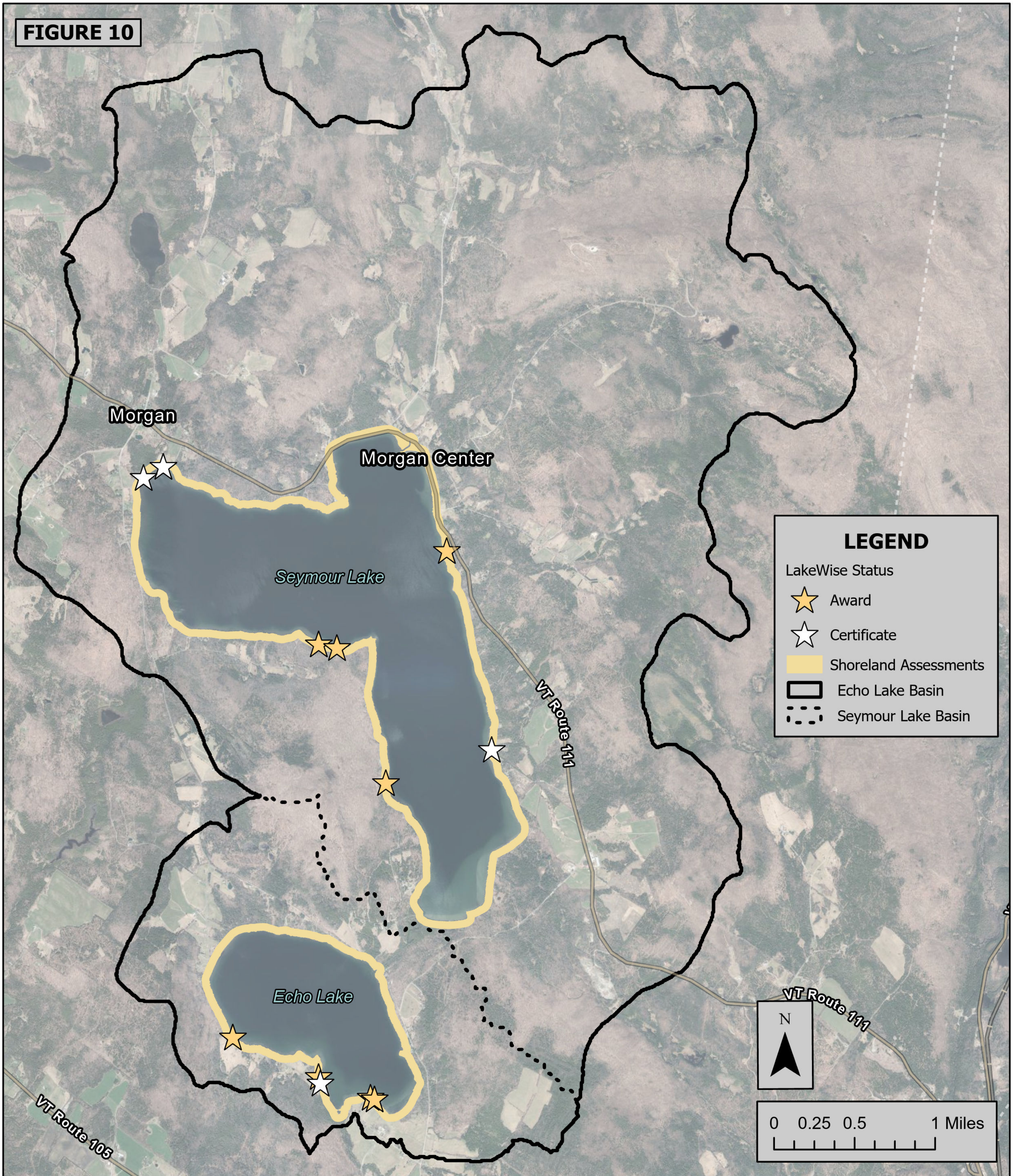

Notes: Map depicting locations of completed Lake Wise Assessments & Lake Shoreland Boat Tour assessments.

Drawn By: Patrick Hurley, MWA

Date: November 26, 2024

Lake Shoreland & LakeWise Assessments

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3.2 Project Identification Results

3.2.1 Riparian Buffers

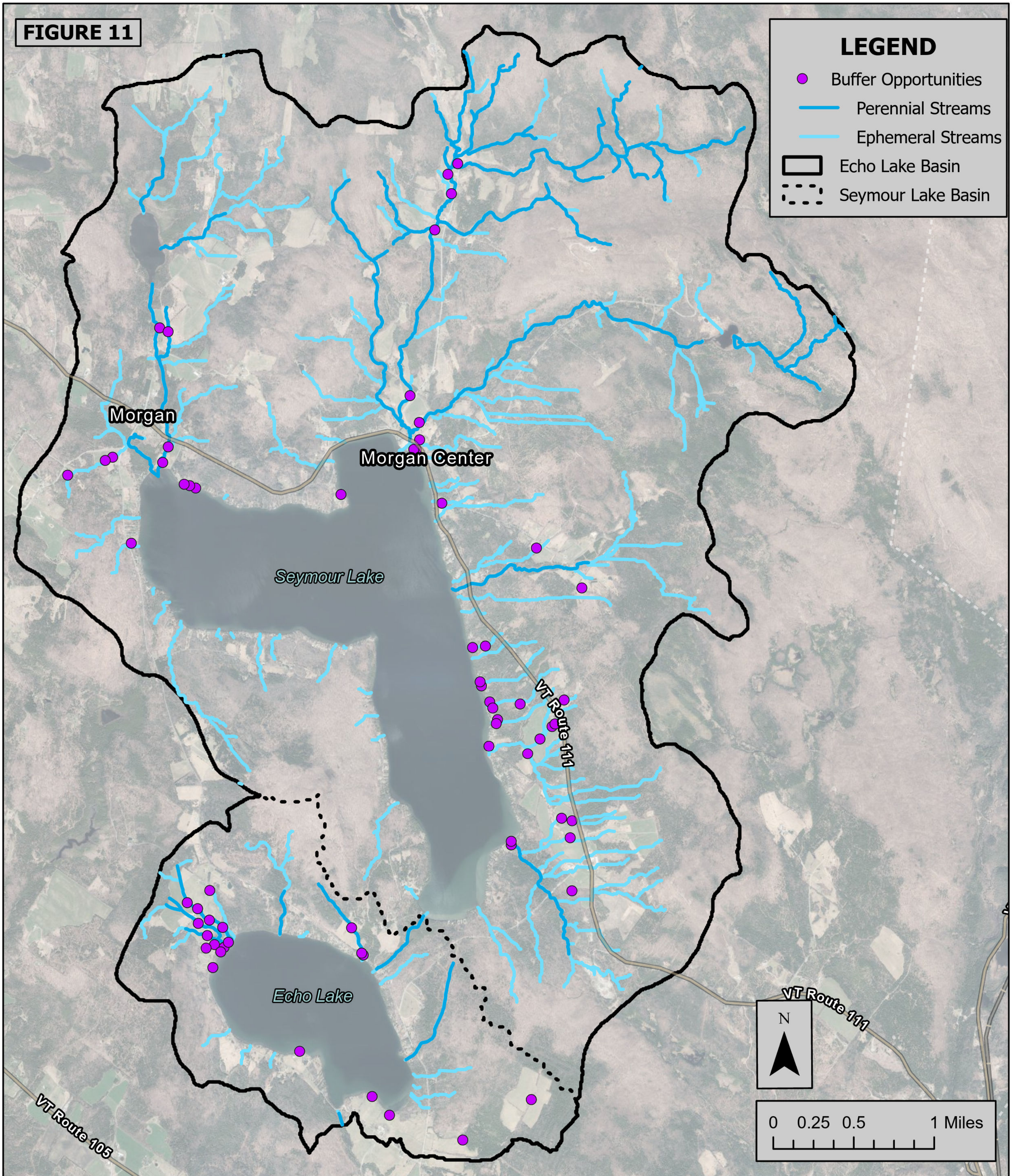
An important element to a healthy, stable river system is a properly functioning and adequately sized woody riparian buffer. Woody buffers work to slow, filter, and infiltrate runoff and absorb and mitigate floods. Over 70% of the Echo-Seymour Lakes watershed is forested and, as such, the streams tend to have mature riparian buffers. However, a large discrepancy exists between forested cover in the Lake Seymour sub-basin (80% forested) compared with the Echo Lake direct drainages (37% forested). The lack of woody riparian buffers and forested stream corridors may contribute to excessive erosion, sedimentation, and phosphorus loading to Echo Lake.

MWA identified 66 discrete areas that warranted stream buffer restoration or enhancement (Figure 11). However, many of these areas are not suitable for woody riparian buffer grants due to their small size. Only 16 opportunities were considered as potentially eligible water quality projects. Of these, only 4 projects were greater than 1 acre in size. The remaining were small buffer opportunities that are less competitive for grant funding and/or limited in size due to existing development or property boundaries. Opportunities for small buffer plantings were concentrated on tightly spaced lakeshore camp properties where both shoreland and streambank buffers are needed. The larger buffer planting opportunities are concentrated on agricultural and larger residential lands off Valley Road, West Echo Lake Road, Sunset Drive, and Cranberry Lane. These were typically greater than 300 feet in length and generally not confined by infrastructure, development, or property boundaries. **MWA created Project Summary Sheets for the 16 largest riparian buffer project opportunities under the Project Type *River – Planting*. These opportunities have been incorporated into the Batch Import File for future review and inclusion in the Watershed Project Database.**

3.2.2 Bank Erosion & Mass Wasting

MWA observed 90 disparate instances of accelerated stream bank and channel erosion in the watershed (Figure 12). These observations included features such as erosive gullies, head cuts, fords/crossings, lateral migration, and mass wasting. In general, bank erosion seems to be the result of channel adjustment processes acting in response to human development and increased frequency-intensity-magnitude of precipitation events, likely exacerbated by climate change. Bank erosion was concentrated along streams with minimal woody buffers but also frequently observed in steep, forested reaches where roads, stream crossings, or development activities encroach upon the stream corridor. These encroachments tend to modify natural channel energy slope, sediment loading, and hydrologic regimes, which can lead to a stream's departure from dynamic equilibrium and the initiation of dramatic erosion and deposition. Erosive features are particularly common along the ephemeral streams flowing through forested lands east of Seymour Lake along the Route 111 corridor. The development of ATV trails, agricultural development, land development, and undersized or improperly fitted crossing structures are examples of human developed features that encroach upon the stream corridor.

Mass wasting, considered in this report to be erosion that extends above average top of bank height and more characteristic of a localized landslide or sloughing, was rare in the Echo-Seymour Basin.



Notes: Map depicting locations of potential woody buffer enhancement or restoration opportunities.

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Date: November 26, 2024

Potential Woody Buffer Project Opportunities

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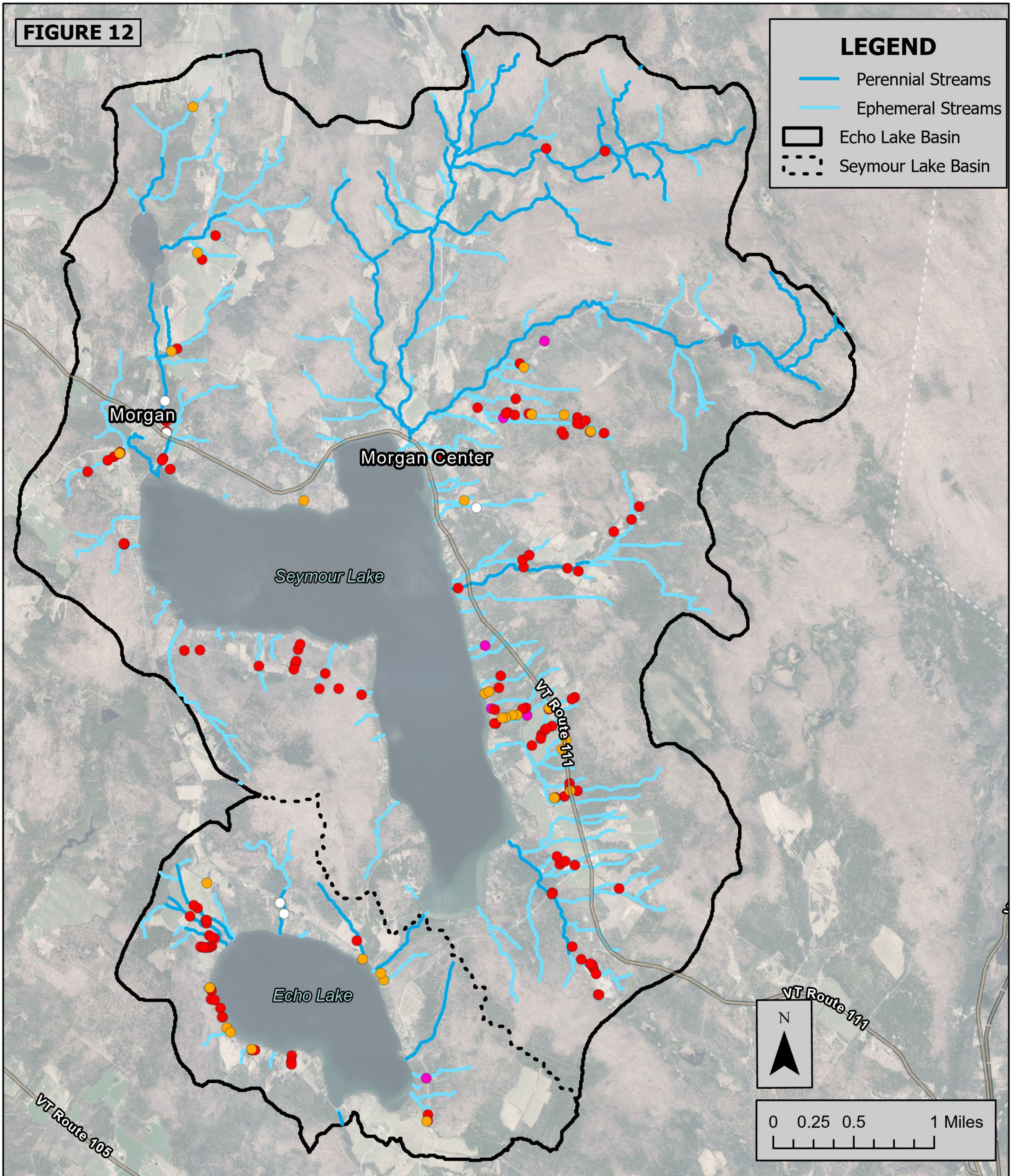

Notes: Map depicting locations of observed erosion, gullying, or mass wasting.

Drawn By: Patrick Hurley, MWA

Date: November 26, 2024

Streambank, Channel, Shoreland & Gully Erosion Observations

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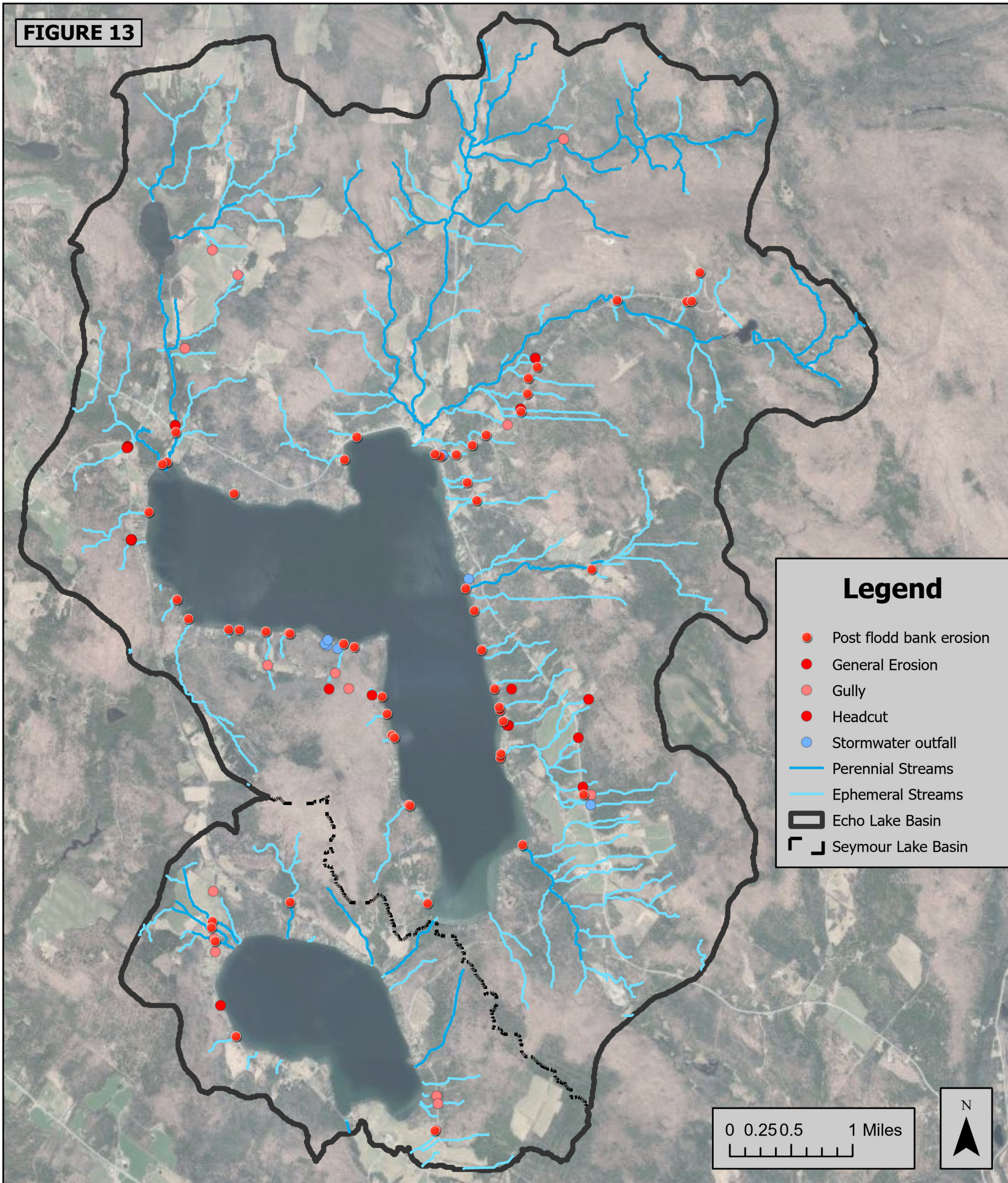
MWA recorded 3 instances of mass wasting – one downstream of the fish hatchery off Elliot Acres Road and two others on Dickey Brook downstream of East Echo Lake Rd. A potential future mass wasting was identified downstream of the Meade Hill Rd culvert on Cranberry Brook; here, a fissure runs parallel to the guardrail and road shoulder at the top of a 20-foot tall, ~60% slope.

Streambank stabilization is one method for slowing accelerated bank erosion and mass wasting processes, however, widespread streambank stabilization is not a common practice in Vermont as it does not always incorporate natural channel adjustment processes and may prevent rivers from reaching a state of dynamic equilibrium. However, many of the instances of accelerated bank erosion and mass wasting observed in the Echo-Seymour watershed are near development and pose a potential risk to infrastructure if allowed to progress unabated. For instance, MWA assisted a private landowner on West Echo Lake Road who required stabilization of an intermittent streambank to prevent accelerated erosion from destroying their drinking water well and septic system. **Due to the uncertainty of grant funding eligibility for bank stabilization practices within the Clean Water Initiative Program, these potential projects were not included in the DRAFT batch import file (BIF) or Potential Project Summaries unless they were a component of broader road erosion BMPs or floodplain restoration opportunities.**

3.2.3 Road & Developed Lands Stormwater Runoff

MWA identified 9 discrete point-source stormwater outfalls to the lakes and approximately 75 instances of road erosion or developed lands stormwater runoff issues (Figure 13). Point-source stormwater inputs to Seymour Lake from roadways and developed lands were concentrated along Wayeeses Shore Road, Toad Pond Rd, Meade Hill Rd, and Route 111. The stormwater outfalls along Wayeeses Shore Road (privately owned) consist of underground storm drain systems that discharge directly into Seymour Lake without treatment. Route 111 includes two unmapped stormwater systems, located at the intersection with Toad Pond Road and the intersection with Morgan-Charleston Road and Meade Hill Road. The Toad Pond Road/Route 111 storm drain system combines road runoff with flows from an intermittent stream; this system was severely overwhelmed and damaged during the July 2024 floods. At the base of Meade Hill Road, a storm drain system combines road runoff with flow from an intermittent stream, which enters the storm drain system through catch basins and discharges to an artificial wetland and swale before diffusely flowing through a vegetated area to the lake. No underground storm drain systems were identified in the Echo Lake sub-basin.

Many town road segments were identified as ideal candidates for additional best management practices to reduce erosion and manage stormwater runoff. Assessments identified some existing road erosion BMPs installed along many of these road segments including grass swales, stone lined ditches, and cross-drain culverts. However, many of these practices are inadequate for flood flows, poorly maintained, or undersized for the road segments they are intended to manage. In particular, Toad Pond Road, Hatton Heights, Sunset Drive, Williams Road, Jordan Road, and Elliot Acres Road could all benefit from upgrades and/or improvements to reduce sediment loading to Lake Seymour. On Echo Lake, additional road erosion BMPs are required for West Echo Lake Road, East Echo Lake Road, and publicly owned portions of Camp Winape Rd to be compliant with the MRGP. All these road segments were subject to significant erosion and even catastrophic gullying during the July 2024 floods. **It is recommended that all segments of these town roads be reassessed by the**



Notes: Map depicting locations of potential road erosion and developed lands stormwater runoff project opportunities.

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Date: November 26, 2024

Potential Road Erosion and Developed Lands Runoff Project Opportunities

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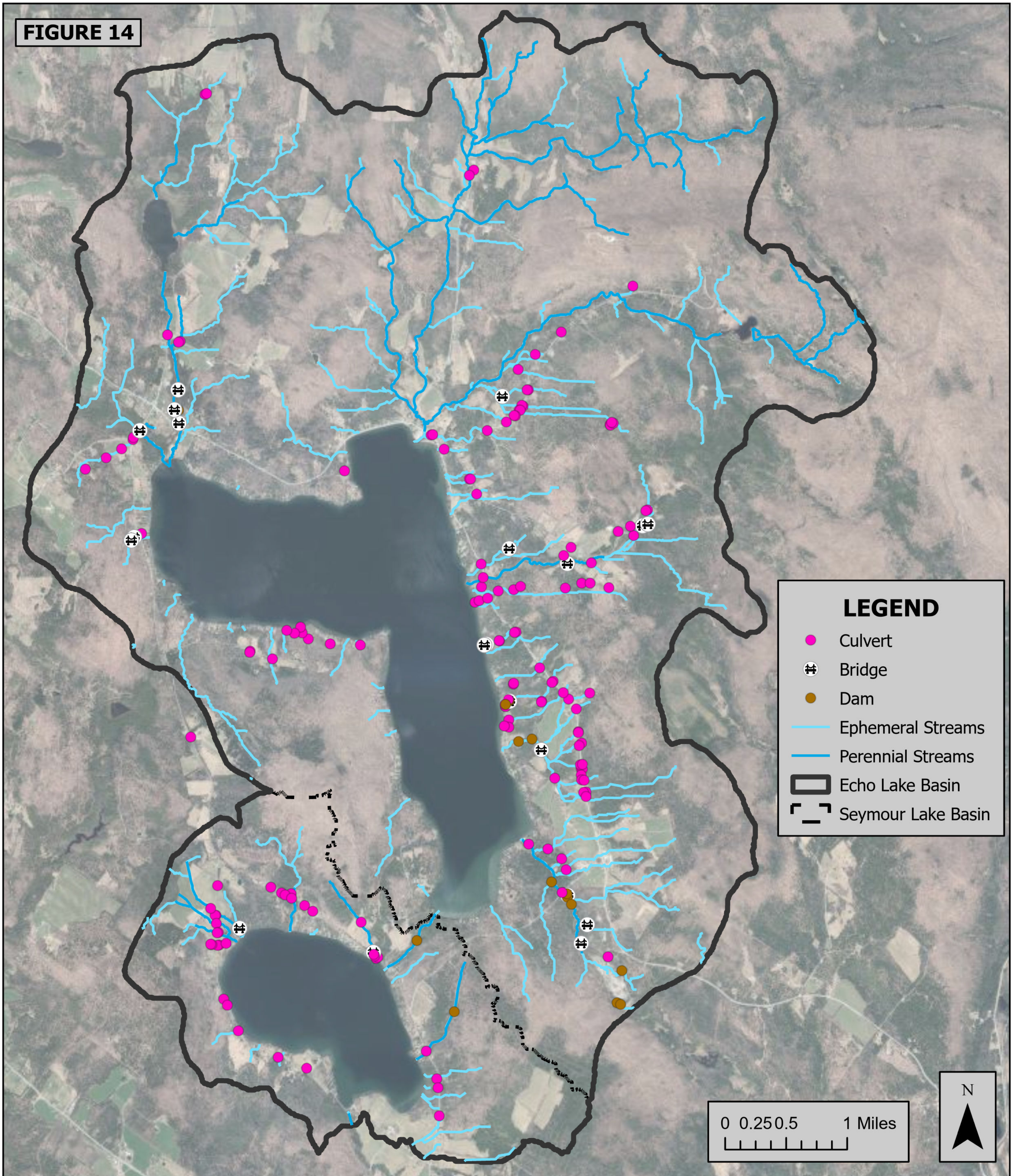
respective Highway Departments for opportunities to improve or install road erosion BMPs such as upsizing culverts, installing sediment forebays, adding stabilized outfalls at culvert crossings, removing grader berms along road shoulders, stone lining ditches, and increasing the frequency of turnouts. MWA identified and prioritized 21 potential Town Highway projects – all of which were transcribed into Project Summary Sheets and the BIF.

Private roads were also heavily screened during field assessments. On Echo Lake, the majority of private road issues were located on steep driveways that access lakeshore camps. On Lake Seymour, priority private roads included Curtis Road, Sugarbush Road, Buzzell Road West, Big Rock Road, Upland Acres Road, Hunting Camp Road, Wayeeses Shore Road, and many steep driveways. Driveways often look like insignificant sources of runoff and erosion but can quickly wash out during flood events. **As such, it is recommended that the respective lake associations work with private landowners to improve driveway practices so that runoff is managed and treated before being discharged to the lakes.** Improvements may include open-top culverts, road crowning and grading, shoulder berm removal, upsized driveway culverts, additional cross-drain culverts, sediment forebays and stabilized outlets, stone lined ditches, turnouts, and other disconnection practices. **MWA identified and prioritized 22 potential private road projects throughout the Echo-Seymour Lakes watershed.**

Stormwater runoff is not limited to roads and driveways. While the percent impervious land cover is relatively low in both the Seymour and Echo sub-basins, dense development along the shoreline emphasizes the importance of managing stormwater from roofs, driveways, and parking areas on-site. These tightly developed areas, however, are not conducive to centralized or engineered stormwater treatment practices as there is often 1) inadequate space for installing or maintaining practices, 2) poor soil infiltration capacity or shallow depth to bedrock, and 3) numerous land ownerships with expensive improvements that pose high risks and liabilities in the event of failure and damage to private property. As such, alternative stormwater management practices need to be considered and widely adopted. These can range from infiltration and disconnection practices to porous paver driveways and patios, to no-mow zones and buffer plantings, to driveway and parking area BMPs. For instance, MWA observed dozens of private driveways and lakeshore frontages that would benefit from minor changes in management activities or behaviors. These changes are not well-suited for grant funding but are excellent talking points for lake associations and private landowners that are able to implement these practices themselves. Promoting the Lake Wise program and lake-friendly practices is the most appropriate way to change social norms around lakeshore management and stormwater runoff where development patterns provide little opportunity for engineered stormwater treatment practices.

3.2.4 Stream Crossings & Floodplain/Stream Restoration

Over 180 stream crossings were screened and inspected during MWA's field assessments (Figure 14). In general, culverts in the Echo-Seymour basin are undersized and are often poorly aligned, perched, and/or impeding aquatic organism passage (AOP). This broad generalization is based on field observations of the crossing structure widths compared to stream channel bankfull widths and the multiple rain events during which culverts became overwhelmed following four notable floods. In general, many of the culverts in the watershed should be replaced with proper hydraulically



Notes: Map showing locations of potential culvert (orange), bridge (symbol), and dam (brown) project opportunities based on field observations.

Drawn By: Patrick Hurley, MWA

Date: November 26, 2024

Potential Culvert, Bridge, & Dam Improvements

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sized pipes, stabilized inlets and headers, and energy dissipating outlets. It is important that culverts are installed with a slope that is similar to the channel's energy slope so that sediment can pass through the pipe without clogging the inlet. This can also prevent outfalls from creating headcuts which undermine the culvert and road shoulder. MWA also made many observations about the poor condition of structure headers, wingwalls and signs of localized erosion and scour along Route 111 stream crossings south of Toad Pond Rd. Many culverts that were identified as being high-priority replacement projects are addressed in the 30% preliminary designs developed for Toad Pond Road, West Echo Lake Road, and Valley Road.

MWA recommends many stream crossing structure replacements be prioritized by the Towns and VTrans. The culverts draining branches of Cranberry Brook beneath Meade Hill Road and Hatton Heights were subject to multiple instances of plugging, erosion, and flood related damage that warrant replacement. Many of the cross-culverts and stream crossings on Toad Pond Road need to be properly sized and replaced to avoid a repeat of the July 30th flood catastrophe. West Echo Lake Road stream crossings and cross-culverts should also be individually sized and located to reduce the risk of repeat blow-outs. Several pour-in-place concrete box culverts beneath Route 111 need to be replaced or repaired due to hydraulic incompatibility and structural failure of the headers and wingwalls.

Undersized, perched, and AOP-incompatible stream crossings are widely distributed throughout the watershed. Stream crossings including culverts, bridges and dams should be replaced over time to promote free movement of aquatic organisms and reduce fluvial erosion risks. It is worth noting that potential natural passage barriers in the form of ledge outcrops and waterfalls are abundant in many of the small streams draining to the lakes. As such, replacement of structures that currently provide *Reduced AOP* or *No AOP* may not result in improved access to headwater habitat. Close inspection of AOP issues, fish habitat suitability, and selection of projects that will guarantee improved AOP to upper reaches of the streams is paramount to the prioritization effort.

While not as common as road-related projects, floodplain/stream restoration projects are a critical tool for protecting and improving water quality in Echo and Seymour lakes. However, large floodplains are not frequently encountered in the watershed as many of the streams are relatively small, steep, and confined. Therefore, floodplains are mostly concentrated at the outlets of the streams where they discharge to the lakes (e.g., Sucker-Valley Brook confluence, tributary draining Jordan Road) or in isolated pockets of beaver wetlands and upper-watershed valleys (e.g., upper Valley Brook, Toad Pond, Mud Pond). The upper watershed has been the subject of floodplain restoration projects since 2022, when MWA and VFWD initiated the Valley Brook Restoration Project. Phase 1 of this project restored up to 5 acres of wetlands and floodplains while also removing numerous problematic stream crossings and a section of erosive forest road. Additional opportunities for floodplain restoration exist at the confluence of Valley Brook and Sucker Brook near the Seymour Access Area as well as a breached dam removal on Cranberry Brook. Floodplain is exceedingly rare in the Echo Lake sub-basin; as such, no high-priority floodplain restoration projects were identified in this portion of the watershed. It is worth noting, however, that alluvial fans are common around both Echo and Seymour Lake. These are often areas where flood damage from debris flows is most apparent and dramatic – such as near Hunting Camp Road, Water Street, as well as numerous unnamed streams and ephemeral drainages that intersect roads near inflection points in the hillslope topography.

MWA created Project Summary Sheets for 14 floodplain/stream restoration opportunities, of which 9 were focused on stream crossing replacements. These projects were also included in the DRAFT BIF. Separation by Project Type was often based on the primary concerns or improvements that needed to be addressed; for instance, a single culvert crossing may constitute a *Floodplain/Stream Restoration Implementation* project, but multiple culverts and cross-drain issues are more characteristic of a *Roads Implementation* project. These Project Type determinations may be modified by the Watershed Planner prior to inclusion in the Watershed Project Database.

3.2.5 Agricultural, Forested & Developed Lands

Stream assessments led MWA to evaluate several larger parcels for opportunities to improve water quality (Figure 15). Four jurisdictional farms (1 each off Gonyaw Farm Road, West Echo Lake Road, East Echo Lake Road, & Route 111) are active within the watershed, as well as a gravel pit operation and numerous working forest lands. MWA identified discrete opportunities for gully and/or streambank stabilization, riparian or lakeshore buffers, stream crossing structure improvements, and farm road BMPs on each of the farms and the gravel pit property.

The Gonyaw Farm Road agricultural property is a 500-acre dairy farm with several small tributaries flowing through the property. There are several opportunities on the property to reduce barnyard and manure pit runoff, plant buffers along streams, improve ditches to stabilize soils and treat runoff, and remove trash from stream corridors.

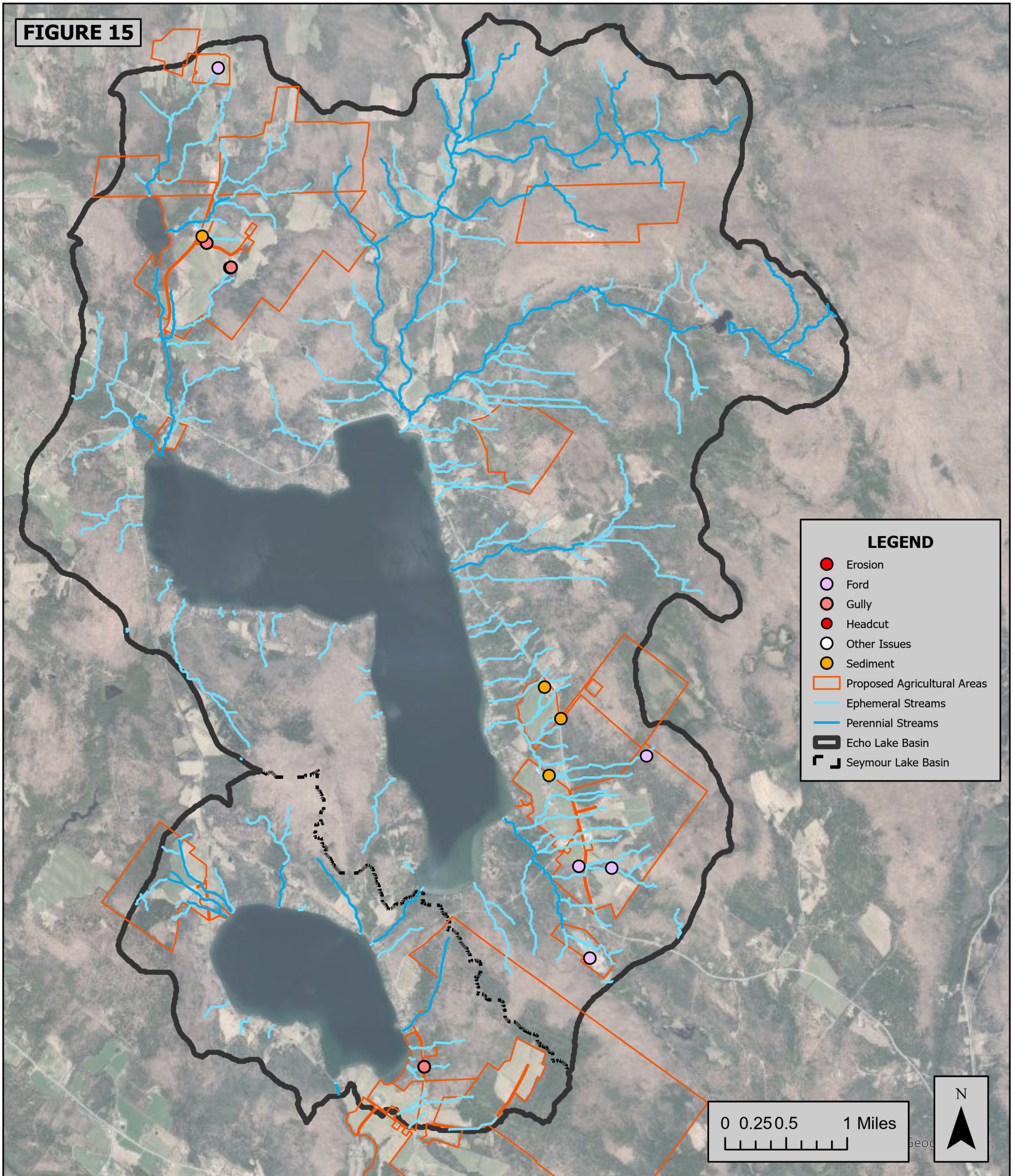
The farm off West Echo Lake Road is a 200-acre haying and sugarbush operation. Three perennial streams and several intermittent tributaries flow through the property and drain into Echo Lake. The stream corridors are all suitable for riparian buffer plantings and wider no-mow zones. Other opportunities include culvert improvements and farm road BMPs.

The farm off East Echo Lake Road is a 150-acre dairy farm that is located directly adjacent to Echo Lake. Opportunities to protect and improve water quality on this property include lakeshore buffer restoration, gully stabilization, riparian buffer enhancement, cattle fencing and watering system improvements, and stream crossing stabilization.

The farm off Route 111 is a 500-acre dairy farm with many hayfields. Numerous perennial and ephemeral streams flow through this property. Projects on this farm include gully stabilization along ditched ephemeral drainages, riparian buffer enhancement, and stream crossing upgrades.

The extraction operation located off Gravel Pit Road hosts several opportunities to protect and improve water quality. A perennial stream flowing through the property lacks a vegetative buffer, which has allowed for the development of several erosive gullies. Project opportunities include gully stabilization, riparian buffer restoration, and access road stormwater BMPs. Given the volume of loose materials on this property, attention should be focused on stabilizing the site and maintaining in-situ stormwater practices and settling ponds.

FIGURE 15



Notes: Map depicting potential erosion project opportunities on agricultural & forested lands.

Drawn By: Patrick Hurley, MWA

Date: November 26, 2024

Agricultural & Forestland BMP Opportunities

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Several forested parcels were identified as having opportunities for forest road and trail BMPs. In particular, forest roads and trails near Mossa Road and forested gullies near Wayeeses Road should be stabilized in conjunction with stormwater diversion practices. These projects may or may not be required under UVA Forest Management Plans.

MWA created 5 *Agricultural Pollution Prevention* and 2 *Forestry* Project Summary Sheets and included these in the BIF. These projects may need to be reviewed by respective agencies – either the VT Agency of Agriculture Food & Markets or VT Forest Parks & Recreation – prior to further project development as the identified projects may be compulsory under Required Agricultural Practices or Acceptable Management Practices. While these opportunities should be considered in the long-term strategies to protect the lakes, it is important to note that these are jurisdictional operations and are therefore subject to regulatory requirements. As such, many of the following project opportunities may not be eligible for Clean Water grant funding. Additional work is needed to determine their eligibility for non-regulatory funding opportunities and the appropriate pathways to address water quality issues.

3.2.6 Miscellaneous Observations & Projects

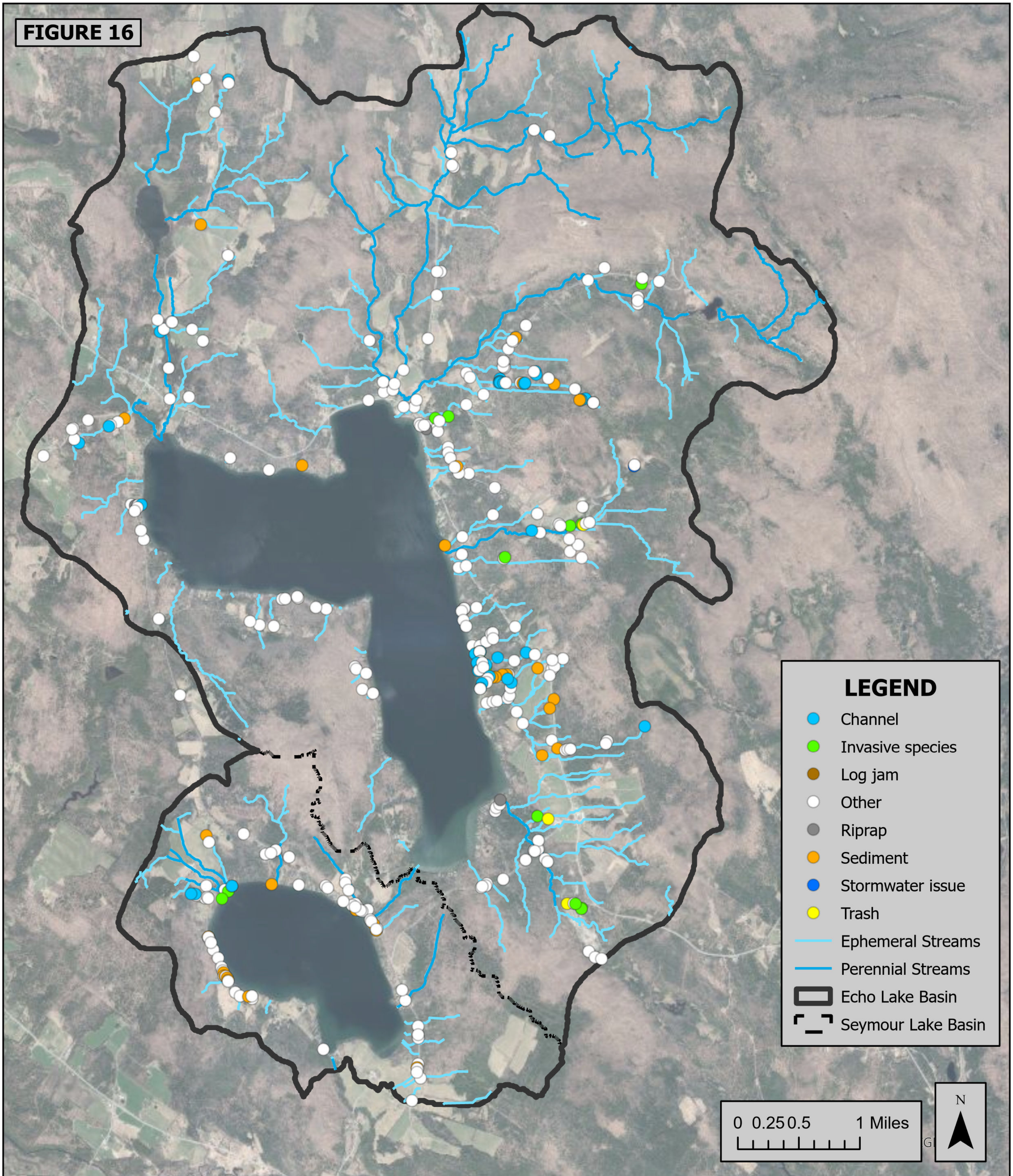
Several potential projects were identified that spanned various project types and may not be directly related to stream or roadway assessments. These include opportunities for shoreland stabilization, trash pollution, and wetland restoration. An opportunity for a shoreland restoration project on Seymour Lake near the outlet of Cranberry Brook was split into *Lakeshore*, *River – Planting*, and *Road* projects due to the multiple issues that can be addressed. Other project types include maintenance and stormwater improvements to the Echo Lake Access Area where runoff from the July 2024 floods connected a gully from West Echo Lake Road and a nearby driveway to the boat ramp area (Figure 16).

A potential wetland restoration site was identified along an unnamed tributary along West Echo Lake. Here, a wetland area has been heavily ditched and dredged contributing substantial amounts of sediment and phosphorus directly to the Echo Lake. Plugging ditches and restoring wetland hydrology would increase floodwater storage and reduce sediment inputs into the lake. This project is not likely eligible for CWIP grant funding as the impacts appear to be in violation of the Wetland Rules.

MWA identified 5 wetland restoration projects, 4 pollution prevention projects, and 8 lakeshore projects – each of which were crafted into a Project Summary Sheet and listed in the Draft BIF.

3.2.7 Invasive Species

MWA recorded the locations where significant infestations of invasive species were encountered during stream assessments (Figure 17). In total, MWA identified 14 invasions of Japanese knotweed, honeysuckle, and phragmites. Japanese knotweed is primarily confined to the eastern quadrant of the watershed along tributaries off Williams Road and Route 111. Honeysuckle was flagged in only three locations to the East of Seymour Lake but is likely ubiquitous throughout the watershed along field and road edges. Small patches of phragmites were distributed throughout the watershed, mainly along shoreline reaches and near stream corridors and roadsides. It is highly likely that these species occur with greater abundance than documented during these assessments, however, these infestations were in or near stream corridors and roadsides. Streams are efficient vectors of invasive plant seeds and materials and should be prioritized first to reduce the spread of existing infestations. **With recent debris flows and the creation of large, fresh deltas and gravel bars at the stream outlets, the lake associations should take care to inspect for and remove invasive species populations before they spread. Three invasive species control projects were transcribed into Project Summary Sheets and included in the BIF.**



Notes: Map depicting the distribution of miscellaneous observations or project opportunities throughout Echo-Seymour watershed.

Drawn By: Patrick Hurley, MWA

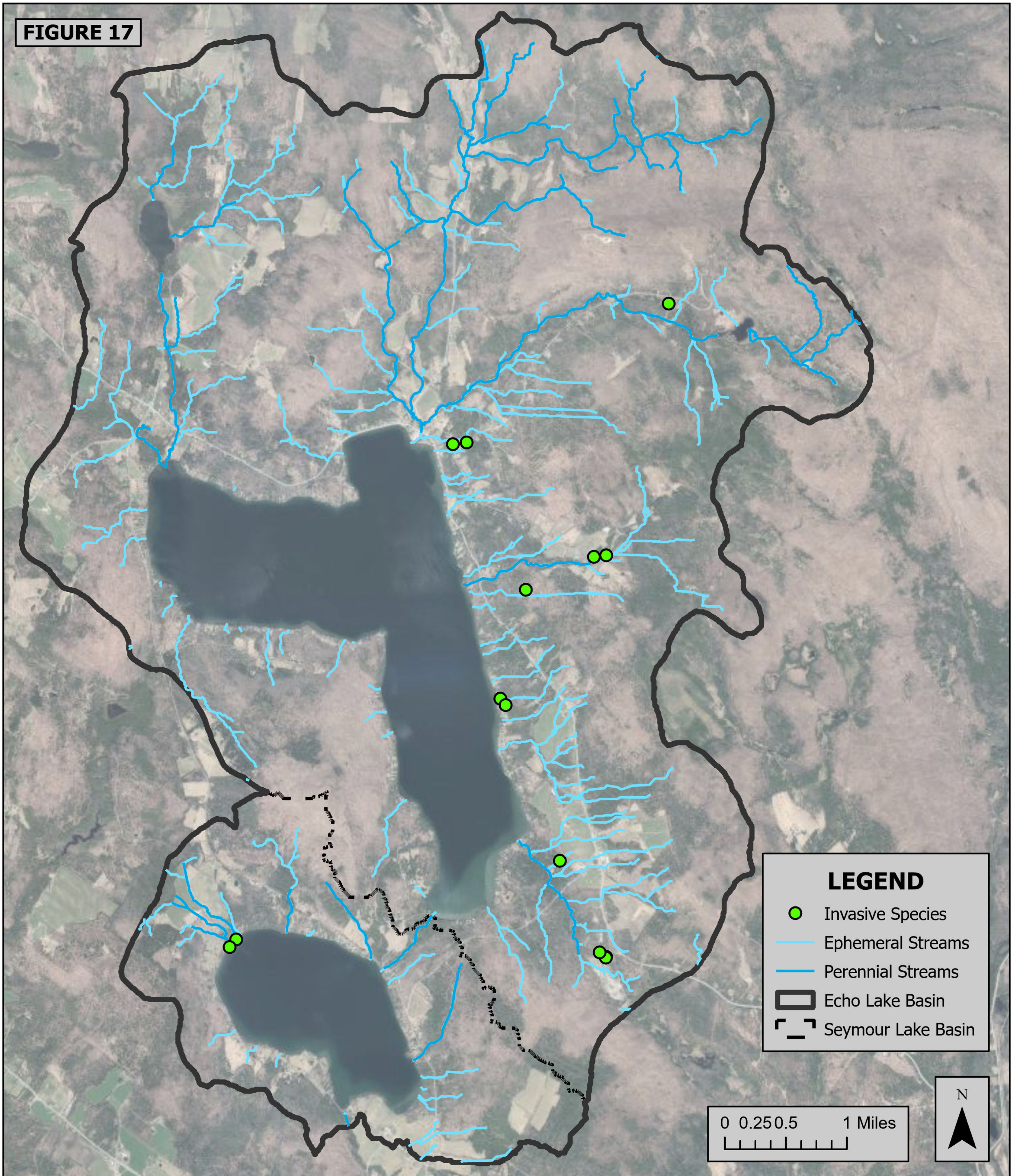
Date: November 25, 2024

Miscellaneous Observations

MWA
MEMPHREMAGOG WATERSHED ASSOCIATION

Orleans County Natural Resources Conservation District

PO Box 513 | Newport, VT 05855 | 802.487.0160



Notes: Map showing locations where invasive species including Phragmites, Knotweed, and Honeysuckle, have been identified.

Drawn By: Patrick Hurley, MWA

Date: November 26, 2024

Invasive Species Infestations

MWA Memphremagog Watershed Association

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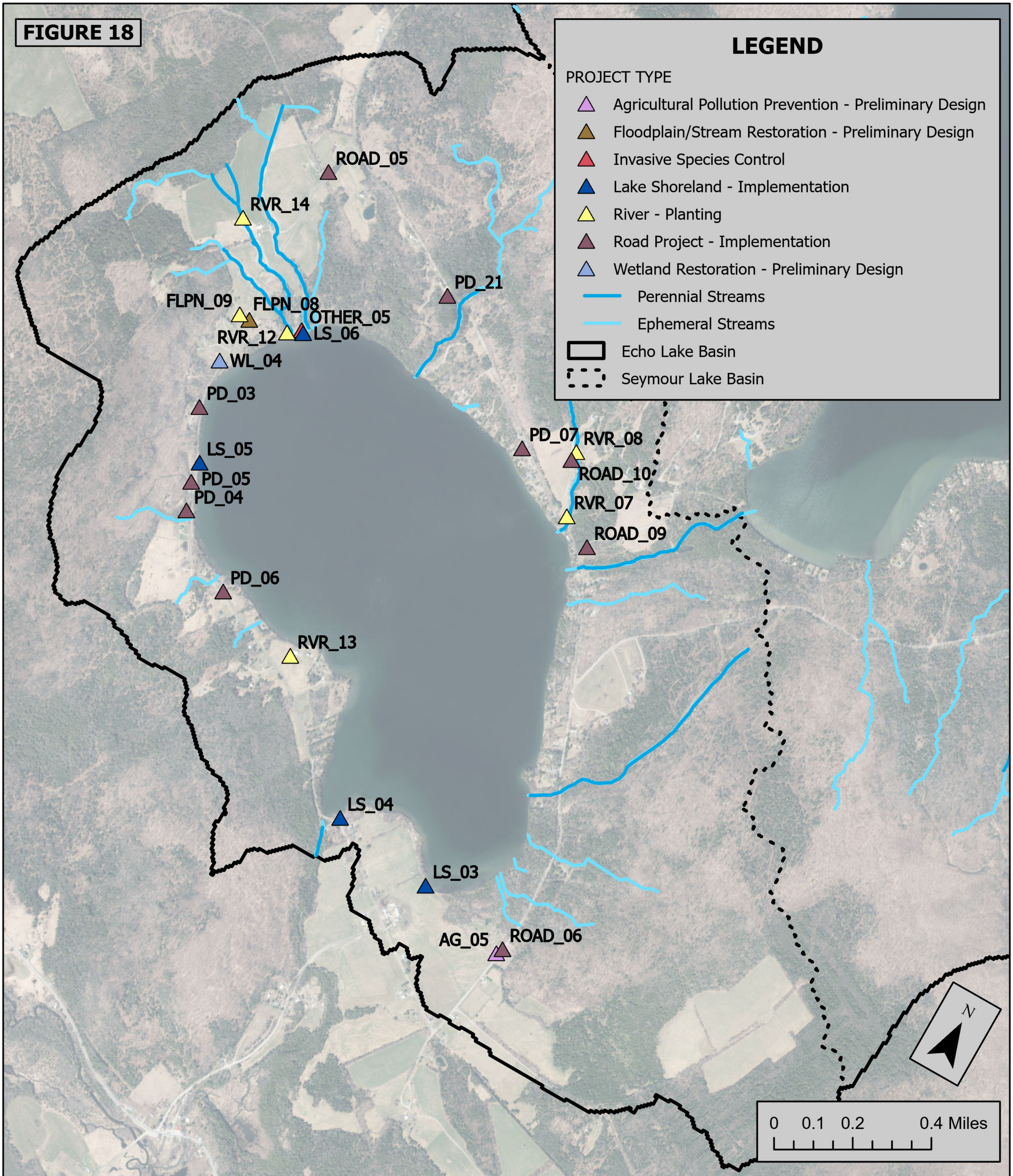
Chapter 4 **PROJECT EVALUATION & PRIORITIZATION**

4.1 Field & Desktop Analysis

Data collected in the field included key characteristics for each discrete problem area that was identified as a potential project opportunity. This may have included field measurements and estimations that would be critical for subsequent prioritization and phosphorus (P) reduction calculations. For instance, gully dimensions such as average length, width and depth were collected to inform P loading rate and reduction estimates. Key observations from the field were then coupled with geospatial datasets to further refine project scopes and potential water quality benefits. Geospatial datasets included:

- Elevation Data – 1ft contours and LiDAR DEMs collected in 2014 and 2023 were used to evaluate slope, flowpaths, and other landscape features.
- Contributing Drainage Area - Each discrete project's contributing drainage area was delineated using GIS tools such as USGS StreamStats, VT Atlas, or watershed tools in ArcGIS.
- Land Use/Land Cover - Where relevant, contributing drainage area polygons were uploaded to VT Atlas and utilized to classify land use/land cover for individual projects.
- Aerial Imagery - Each project area was thoroughly evaluated using contemporary aerial imagery (2016 – 2023); in certain cases, imagery dating as far back as 1962 and 1940 were reviewed to better characterize historic conditions and past disturbances.
- Stream Crossing Structures - Bridge and culvert data collected by the Northeastern Vermont Development Association and Vermont Fish & Wildlife were thoroughly reviewed to provide context related to geomorphic compatibility, structural condition, and potential barriers to aquatic organism passage.
- Soils - Used to review soil erodibility, hydric soil classification, hydrologic soil group classification, and prime farmland status.
- Potentially Erosive Features – Used to review upland and forested contributing drainage areas to inspect for remotely sensed gullies and other erosive features.
- Road Erosion Inventory – Used to identify known road segments that are not in compliance with MRGP standards.
- Parcel Data – Used to approximate parcel boundaries, road rights-of-way, and ownerships as they relate to a project area.

Geospatial data and field observations helped the LWAP Team to demarcate potential project areas, evaluate drainage patterns, estimate rainfall-runoff volumes, interpret underlying soils, calculate phosphorus reduction values, inform permit screening, develop cost opinions, and recommend certain best management practices over other alternatives. Ultimately, the LWAP Team identified 100 potential project opportunities across the landscape that varied from Agricultural and Road Erosion BMPs to Floodplain/Stream/Wetland and Lakeshore Restoration (Figures 18 & 19). These



Notes: Map depicting locations of potential projects with Project ID & colored symbols differentiating project types.

Drawn By: Patrick Hurley, MWA

Date: November 26, 2024

Echo Lake Potential Projects

MWA
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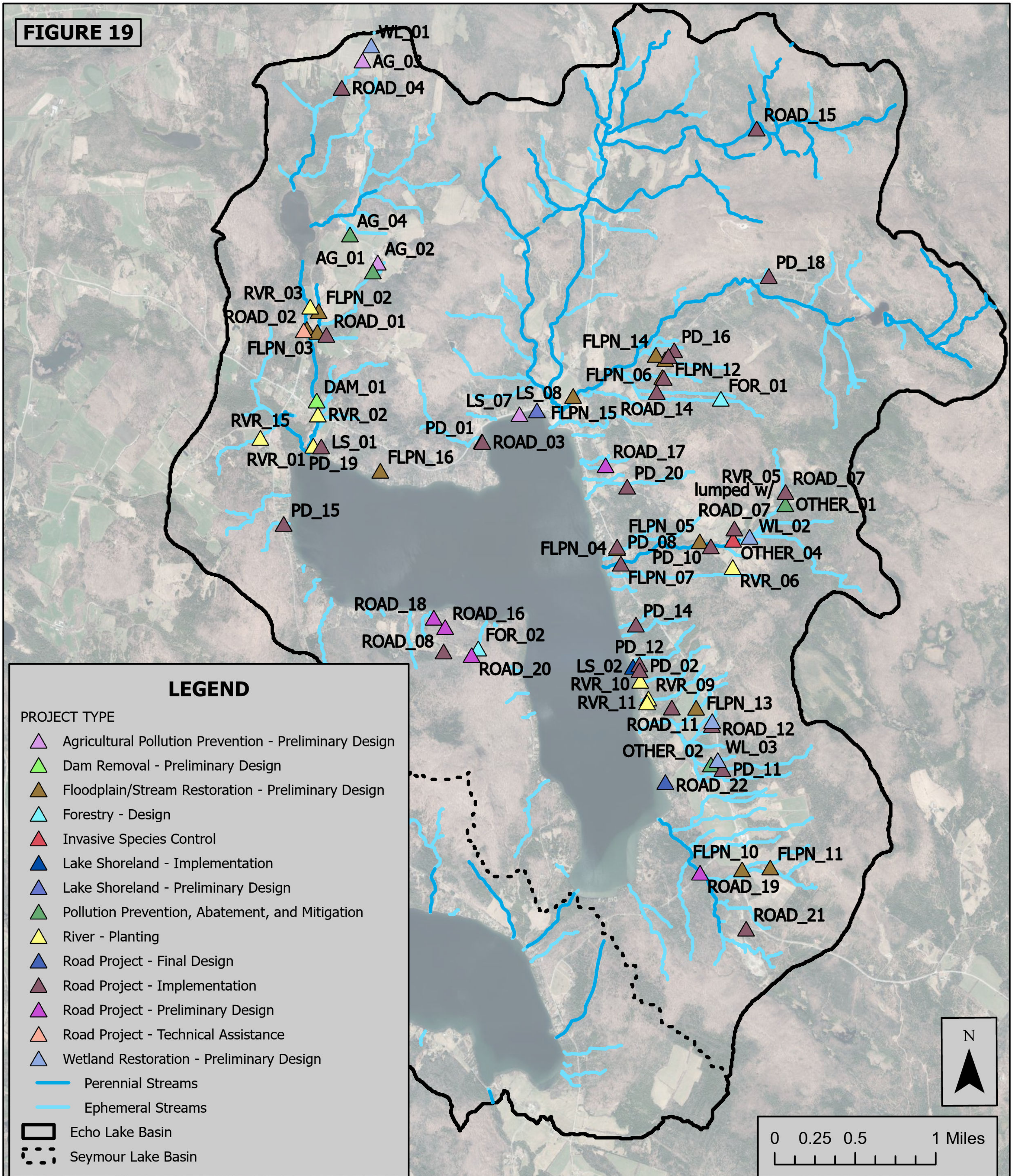

Notes: Map depicting locations of potential projects with Project ID & colored symbols differentiating project types.

Drawn By: Patrick Hurley, MWA

Date: November 26, 2024

Seymour Lake Potential Projects

MWA MEMPHREMAGOG WATERSHED ASSOCIATION

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potential projects were summarized in two separate Batch Import Files, one for Echo (**Appendix C**) and one for Seymour (**Appendix D**). These batch import files will be reviewed by DEC's Basin 17 Watershed Planner, and projects that are eligible for Clean Water funding will be uploaded to DEC's Watershed Projects Database for future project partners to develop, design, and implement.

4.2 Prioritization Criteria & Cost Estimating

The LWAP Team developed a prioritization methodology that effectively compared multiple project types amongst each other to aid in the selection of projects for 30% concept designs. The prioritization methodology was heavily influenced by the criteria developed during the completion of the Lake Elmore Watershed Action Plan (Fitzgerald Environmental Associates, 2020). The Echo-Seymour LWAP Team solicited input from the community and DEC at public meetings and incorporated this feedback into the Echo-Seymour Prioritization Criteria & Methodology (**Appendix E**). In general, the recommendations from the public focused on adding potential co-benefits to the point system. Each of the 100 potential projects were evaluated using the prioritization methods, and points were assigned to each criterion based on quantitative and qualitative measures, with a maximum possible score of 36 points. The Echo Project Prioritization Matrix (**Appendix F**) and the Seymour Project Prioritization Matrix (**Appendix G**) both summarize the inputs and outputs of this approach for projects within the respective lake drainage areas. Prioritization efforts ranked potential projects based on the following criteria:

- **Water Quality Benefits (16 points total)**
  - **Phosphorus (P) Load Reduction (5 points)** – Represents the magnitude of potential P load reduction achieved through project implementation, estimated in kg/yr. Values may be chosen to represent relative P loading rates, removal efficiency, and/or P removal capacity. P loading, reductions, and efficiencies will be quantified using the VTDEC "Interim Phosphorus Calculator Tool".
    - 0 points – No P source and/or no increased treatment (0 kg/yr)
    - 1 point – Minor P source and/or minor increase in treatment (0 – 1 kg/yr)
    - 2 points – Moderate P source with some increase in treatment (1 – 2 kg/yr)
    - 3 points – Moderate P source with significant increase in treatment (2 – 3 lbs/yr)
    - 4 points – Major P source with significant increase in treatment (3 – 5 kg/yr)
    - 5 points - Major P source with significant increase in treatment (> 5 lbs/yr)
  - **Sediment Retention (4 points)** – Represents the magnitude of potential sediment load reduction or retention achieved through project implementation. Values may be chosen to represent existing sediment loading rates, reductions through stabilization, and/or retention through treatment capacity. Sediment retention will be characterized using the following qualitative classes based on dominant contributing sources of runoff and sediment:
    - 0 points – No meaningful sediment source and/or no treatment (e.g., rooftop runoff infiltration)
    - 1 point – Minor sediment source and/or minor increase in treatment (e.g., lawns, grass swales)
    - 2 points – Moderate sediment source with some increase in treatment (e.g., parking areas, riparian buffers)

        - 3 points – Moderate sediment source with significant increase in treatment (e.g., unpaved road BMPs, bank stabilization)
        - 4 points – Major sediment source with significant increase in treatment (e.g., stabilize mass wasting, stormwater treatment practice)
    - **Drainage Area (1 point)** – Approximate drainage area to site is greater than 2 acres
    - **Percent Impervious and/or Agricultural in Drainage (3 points)** – Score based on percentage of impervious surfaces in the contributing drainage area. Percent impervious surface shall be estimated in GIS.
        - 0 points – Percent impervious surface or agricultural lands <25%
        - 1 point – Percent impervious surface or agricultural lands 25-50%
        - 2 points – Percent impervious surface or agricultural lands 50-75%
        - 3 points – Percent impervious surface or agricultural lands >75%
    - **Connectivity to Perennial, Ephemeral, & Intermittent Surface Waters (3 points)**
        - 0 points – All runoff infiltrates on site or is treated through natural or artificial means
        - 1 point – Moderate treatment of runoff before discharge to receiving waters (e.g., mature riparian buffer)
        - 2 points – Minor treatment of runoff via conveyance or drainage infrastructure prior to discharge to receiving waters (e.g., stone lined ditch, lawn)
        - 3 points – No treatment of runoff prior to discharge to receiving waters (e.g., storm drain outfall)
- **Level of Landowner Support (2 points)**
    - 0 points – Landowner support not obtained or expressed
    - 1 point – Landowner expressed initial support for the project
    - 2 points – Public land; landowner has expressed full support of the project
- **Cost and Feasibility (6 points) –** Cost and feasibility represents both the lifetime project cost and planning and design constraints that may influence implementation of the project. Lifetime project costs include planning, design, engineering, permitting, implementation, and operations and maintenance (O&M). Feasibility focuses on site constraints like utilities, land ownership, long-term treatment reliability, degree of required O&M, and public interest.
    - 1 point – >$100,000
    - 2 points – $50,000 – 100,000
    - 3 points – $25,000 – 50,000
    - 4 points – $15,000 – 25,000
    - 5 points – $2,500 – 15,000
    - 6 points – <$2,500
- **O&M and Project Longevity (2 points total) –** Projects with minimal and/or inexpensive operations & maintenance requirements should be prioritized over those that have expensive or intensive O&M requirements.
    - 0 points – expensive & intensive labor requirements
    - 1 point – moderate expense & labor requirements
    - 2 points – low expense & labor requirements
- **Co-Benefits (10 points total) –** Clean Water Projects often provide co-benefits beyond P reduction and sediment retention capacities. The following co-benefits were selected by the Echo-Seymour LWAP Team following stakeholder input during public meetings and reflect specific concerns of the watershed and the lake communities of Morgan and Charleston. Co-benefits eligible for points in this prioritization are as follows:
    - **(1) Chronic Problem Area** – The site requires frequent maintenance and/or is an ongoing problem affecting water quality.

- **(2) Reduces Flood Risk, Peak Flows, or Seasonal Flooding** – The site is affected by or contributes to seasonal flooding.
- **(3) Educational** – The site provides an opportunity to educate the public about natural resources or stormwater treatment practices.
- **(4) High Visibility or Potential to Influence Community** – The site is highly visible or frequently used by the public. The site will benefit aesthetically from a properly designed treatment practice or educate and raise awareness of stakeholders who influence the health of the watershed.
- **(5) Agricultural Land Use Compatibility** – The project supports functional, sustainable agricultural operations and augments other existing best management practices on the property
- **(6) Improves Existing BMPs** – The project will improve the performance of existing water quality BMPs and provide additive water quality improvements
- **(7) Enhances Lakeshore Natural Communities** – The project will promote a native vegetated lakeshore buffer and/or provide wildlife habitat along the lakeshore
- **(8) Fisheries Habitat Enhancement –** The project will improve aquatic organism passage and/or fish spawning and nursery habitat quality or quantity.
- **(9) Flood Resilient Infrastructure –** The project will upgrade drainage systems and stream crossing structures to promote geomorphic compatibility and reduce fluvial erosion and flood hazard risk.
- **(10) Invasive Species Control –** The project will address or control existing or potential invasive species infestations and restore native vegetation.

After compiling all potential projects into a BIF and Prioritization Matrix, MWA applied the prioritization criteria & methodology to evaluate and rank each of the projects. Since reduction of phosphorus (P) and sediment loads are the priority of the LWAP process, these two metrics comprised up to 25% of each potential project's total possible score. The P reduction rates were determined using the *Interim Phosphorus Reduction Calculator Tool_V1.0* or the *Stormwater Treatment Practice Calculator* (depending on most relevant project types), both developed by DEC. Estimated P removal rates were coupled with cost estimates to determine the approximate project efficiency score ($ / kg of P reduction).

Cost estimates for each project were generated through several approaches. For typical Clean Water Project types (e.g., riparian buffers, lakeshore stabilization, floodplain/stream restoration, road erosion BMPs, etc.), the LWAP Team applied average unit costs taken from DEC's *Water Quality Restoration Formula Grant Target and Fund Allocation Methodology* (VTDEC, 2022c). In these instances, proposed project scopes (e.g., linear feet of lakeshore restoration, acres of floodplain restoration, linear feet of road BMPs, acres of riparian buffer plantings) were multiplied by the average unit cost reported by DEC, plus a 20% contingency factor. On occasion, potential project constraints such as existing infrastructure or technical complexity were considered, and cost estimates were adjusted based on best professional judgment. Where average unit costs were not available or deemed inappropriate, the LWAP Team estimated project costs by collecting cost data from similar projects completed in the region within the last 5 years. This approach was particularly useful for stream crossing structures and stormwater infrastructure. The LWAP Team compared project cost estimates to the Vermont Agency of Transportation 2- and 5-year Averaged Price Lists from the 2018 specifications for relative accuracy and adjusted cost estimates to account for discrepancies as well as recent inflation.

Other metrics used during prioritization included drainage area size, connectivity to surface waters, percent agricultural or impervious, landowner support, cost & feasibility, operations-maintenance-longevity, and co-benefits. Some of these metrics required geospatial analyses – such as drainage area size, percent land cover, and connectivity to surface waters. Other metrics required community relations and landowner outreach or cost estimating research.

4.3 Project Summary Sheets

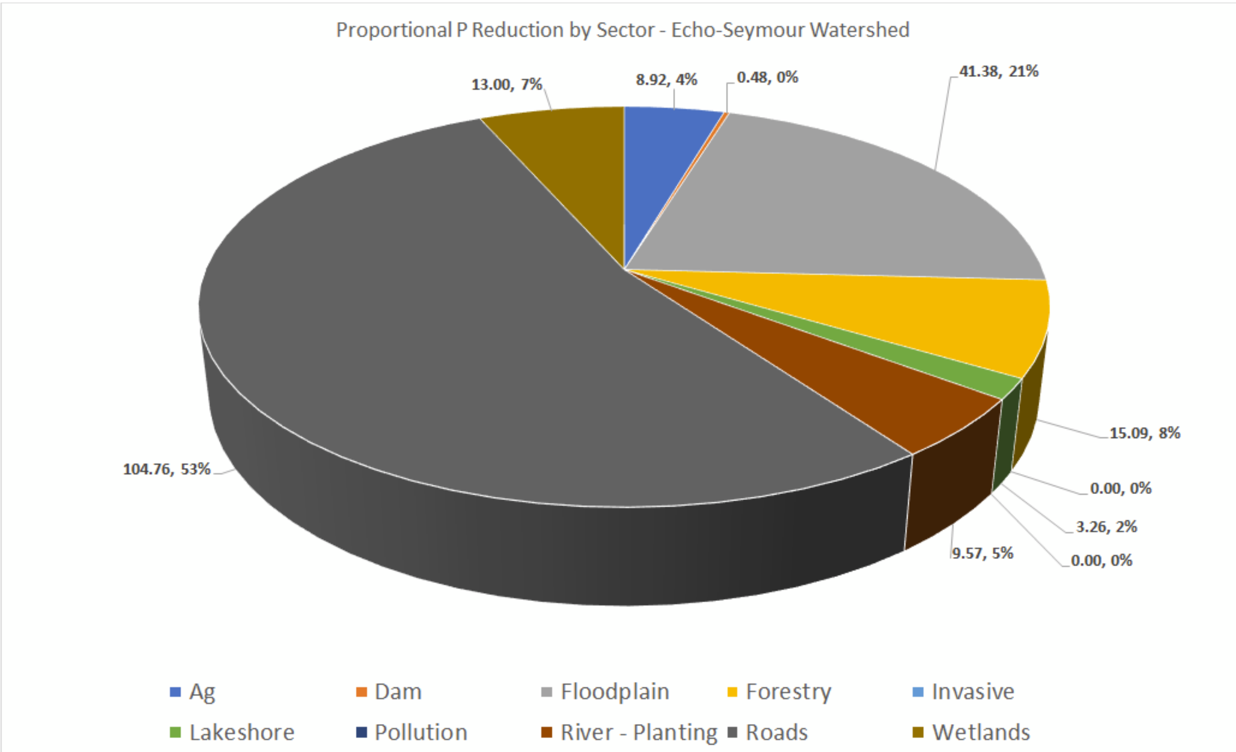
Each one of the 100 potential projects included in the BIF and Prioritization Matrix were transcribed into a Project Summary Sheet. The Project Summary Sheets are intended to serve as 1–2-page profiles for each potential water quality improvement project that was identified and prioritized. The Echo Project Summary Sheets (**Appendix H**) and the Seymour Project Summary Sheets (**Appendix I**) provide the respective towns and lake associations with a customized potential project archive. Project Summary sheets provide critical information for each priority project, including:

- Project Name, Identification Number & Clean Water Project Type
- Location (lat/long), Ownership, & Locator Map
- Description of Problem Area & Photo(s) of Water Quality Issues/Project Opportunities
- Description of proposed BMP & anticipated Co-Benefits
- Table of Prioritization Criteria Scores
- Notes/Comments relevant to landowner support, anticipated permitting, cost estimates, and potential constraints/technical complexities.

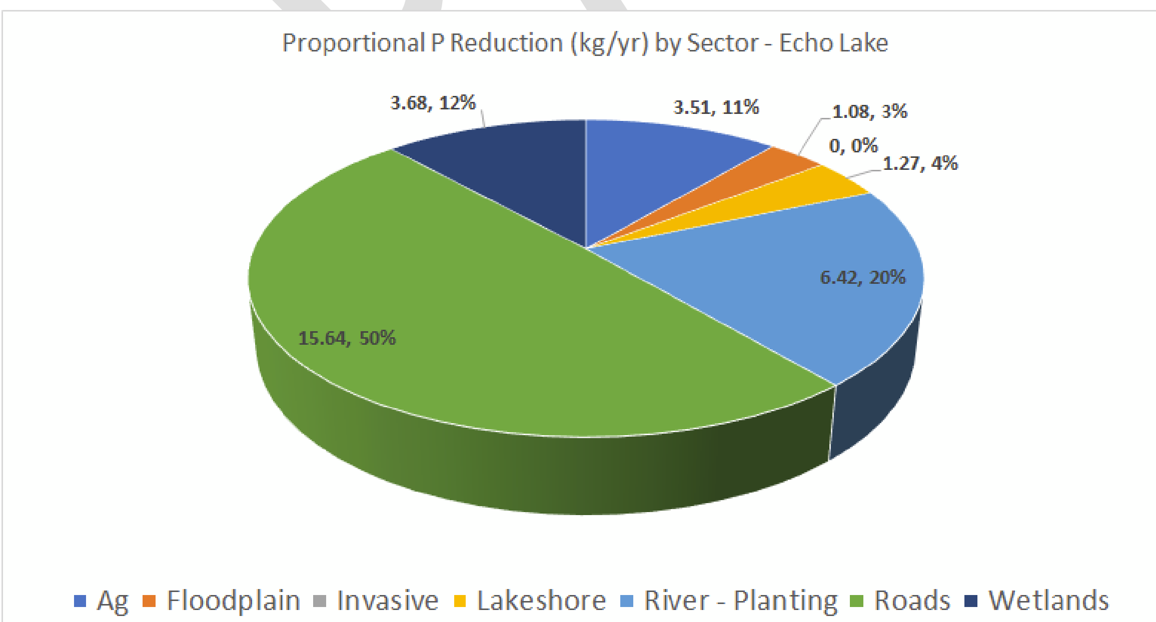
4.4 Water Quality Stressors by Sector

The LWAP Team utilized outputs from the P load reduction calculations to estimate the relative contribution of nutrients to the watershed, as well as each individual lake. P load reduction outputs for each of the 100 potential projects were taken from the Interim P or STP Calculator and grouped by their respective project type. This allowed MWA to characterize potential P reduction values of projects that address phosphorus runoff specific to agriculture, streams/wetlands, roads, shorelands, and stormwater runoff. MWA analyzed the proportional contribution of each sector to the watershed, as well as individually for Seymour Lake and Echo Lake.

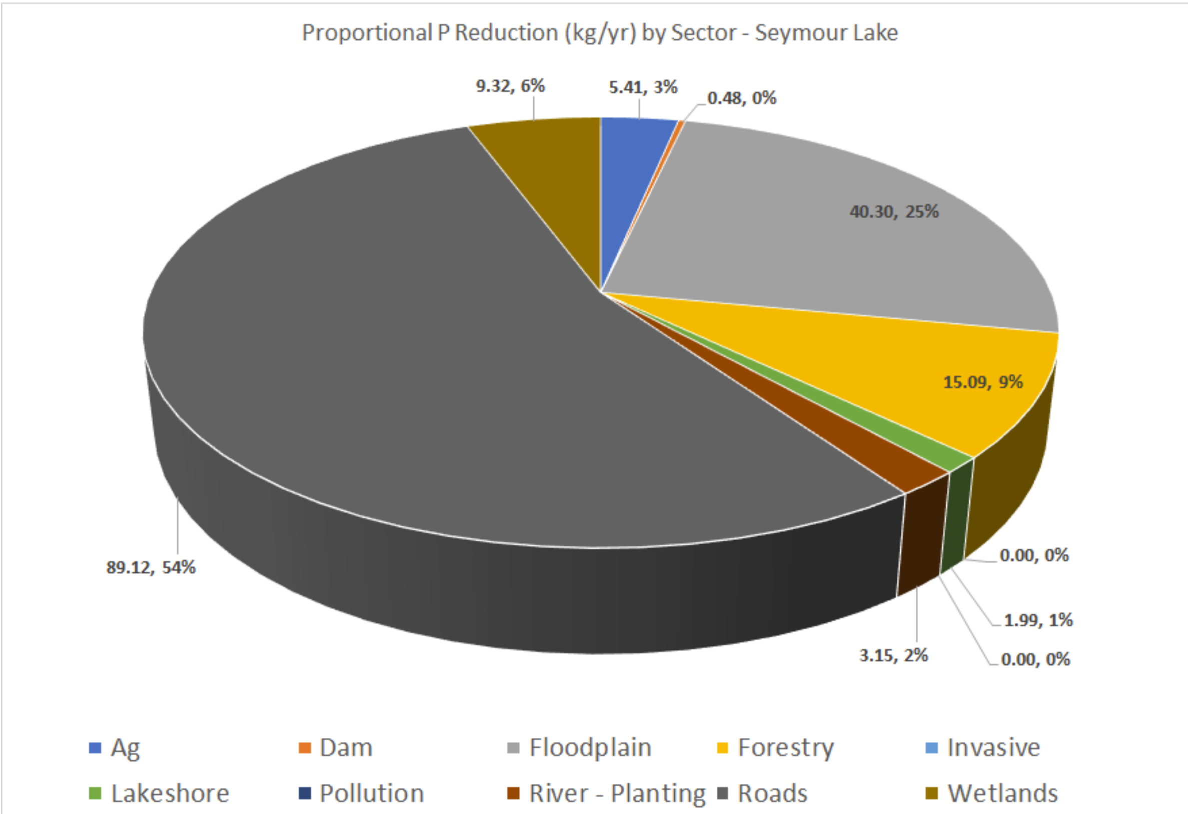
When using this approach and considering the watershed as a whole, public and private road projects have the potential to reduce P loading by 104.75 kg/yr or 53% of the total reduction potential identified across all project types in this LWAP. The stream/floodplain projects contribute approximately 21% of excess P loading (41.38 kg), followed by forestry projects (15.1 kg/yr; 8%) and wetlands projects (13 kg/yr; 7%). Agricultural projects (8.92 kg/yr) and river-planting projects (9.57 kg/yr) each contribute approximately 5% of excess P loads to the watershed. Minor contributions were also observed from the lakeshore projects (3.26 kg/yr; 3%). Invasive species control and pollution abatement projects did not receive any P reduction values and, as such, do not contribute excess P loads to the watershed.



In the Echo Lake direct drainage, public and private road projects again account for approximately half of the excess P loading (15.64 kg/yr; 49%). Around Echo Lake, river-planting projects contribute 20% (6.42 kg/yr) of excess loads, followed by wetland projects (3.68 kg/yr; 12%) and agricultural projects (3.51 kg/yr; 11%). Potential lakeshore projects (1.27 kg/yr; 4%) and floodplain/stream projects (1.1 kg/yr; 3%) contribute relatively minor excess P loads.



Similarly, public and private roads are the most significant sources of excess P loading to Seymour Lake. Here, road projects contribute 54% (89.1 kg/yr) of the excess P loads, followed by floodplain/stream projects (40.3 kg/yr; 24%), forestry projects (15.1 kg/yr; 9%), and wetland projects (9.3 kg/yr; 6%). Agricultural projects were found to be relatively small contributors of excess P loads (5.4 kg/yr; 3%), much like river-planting projects (3.2 kg/yr; 2%) and lakeshore projects (1.99 kg/yr; 1%).



The LWAP Team was not surprised by the small proportion of excess P loading that can be attributed to the lakeshore sector – which in the case of Echo-Seymour Lakes includes both shoreland erosion and stormwater runoff from developed lakeshores. First and foremost, shoreland erosion was not frequently observed or encountered. This is likely due, in part, to large sections of shoreline with natural stone armoring or artificial retaining walls that resist erosion from waves, ice, and foot traffic. If shoreland erosion is not observed, then minimal P inputs to the lakes can be attributed to the lakeshore sector. Second, property ownership along the shoreline tends to be very small. As a result, project identification and prioritization efforts tend to overlook very small opportunities to manage stormwater runoff. While stormwater runoff from many small, developed lakeshores can be a significant *cumulative* source of nutrient loading to a lake, the effects of runoff from a single small property is relatively insignificant compared to other project types like agriculture, stream/floodplain, and roads. For instance, lakeshore buffer plantings that amount to less than 10,000 square feet do not rank highly against other riparian buffer projects that can often be acres in size. Third, lakeshore projects can take many forms, ranging from shoreland stabilization and lakeshore buffer plantings to driveway upgrades and gutter downspout disconnection practices. In some cases, projects were identified along the lakeshore but classified as a *Private Roads* or *River – Planting* project type based on the predominant concerns or landscape features. Lastly, P-reduction calculation methods do not exist for many lakeshore-friendly practices like infiltration steps, gutter downspout disconnection, no-mow zones, and septic system upgrades. As such, some opportunities to improve lakeshore habitat or water quality cannot be quantified or compared against other project types. The result is a systematic underestimation of lakeshore P contributions.

Based on field assessments and visual indicators of erosion, scour, runoff, flood damages, farming, and forestry, the LWAP Team agrees with the relative contributions of excess P to the lakes by roadways, farm fields, forestry activities, and stream instability. Large deltas of recently deposited sediments were observed at the outlets of all major tributaries to the Lakes following flood events. These sediments are believed to be primarily originating from 1) road washouts, 2) streambank erosion, 3) drainage ditches, and 4) geomorphically incompatible culverts. Agricultural runoff was evident downgradient of farms where field assessments identified manure-laden drainage ditch outflows, filamentous algae, and 'froth' that resembles organic-rich pollution. Gravel roads throughout the watershed are typically steep, inadequately drained, have undersized culverts, and demonstrate a propensity to intercept & hijack stream flows which leads to substantial erosion and washouts.

The potential P reduction values derived from the LWAP analysis can be compared to the watershed loading rates to Lake Seymour taken from the TMDL (Table 1; *unfortunately, this cannot be done as easily for Echo Lake*). This comparison is helpful in determining whether or not the P reduction rates are realistic compared to modeled loading rates. Where sectors are directly comparable, the potential P reduction rates are within the same order of magnitude as the loading rates to Lake Seymour, indicating that reduction estimates are within reason. For instance, the LWAP determined that over 89 kg P/yr could be prevented from entering Lake Seymour by implementing road erosion BMPs whereas the TMDL estimated that roads contribute 200 kg P/yr. This indicates that BMP implementation may reduce over 44% of the road-related phosphorus loads. Similarly, the TMDL estimated that degraded streams and wetlands contribute 73 kg P/yr to Lake Seymour; if all the floodplain/stream/wetland projects from the LWAP were implemented, upwards of 50 kg P/yr could be reduced (68% reduction). If all potential LWAP projects in the Lake Seymour subcatchment were implemented, nearly 165 kg P/yr could be reduced from the overall loading rate. Based on the TMDL estimated loading rate of 1,381 kg P/yr, LWAP project implementation could achieve a 12% overall P load reduction. While these figures support the notion that P reduction rates are relatively accurate in relation to the overall P loading rates, both the TMDL model and P calculations are uniquely nuanced and include multiple assumptions that greatly influence the accuracy and precision.

Table 1. Modeled P loading rates to Lake Seymour, taken from the Memphremagog Total Maximum Daily Load (TMDL).

Load to Seymour	water/wetland	developed	roads	Ag	forest	septic	Total
total load (kg/yr)	73	154	200	459	306	189	1381
Percent	5.3%	11.2%	14.5%	33.2%	22.2%	13.7%	100.0%

Chapter 5 **PROJECT DESIGN, IMPLEMENTATION, & RECOMMENDATIONS**

5.1 Priority Project Selection

Of the 100 Project Summary Sheets and entries in the BIF, 30 HIGH- and MEDIUM-ranking projects were selected for consideration as potential 30% preliminary design projects. Ultimately, MWA chose ten projects to discuss with watershed stakeholders at a public meeting on August 7, 2024.

The ten highest ranking projects include:

1. Sucker Brook SMA floodplain restoration off Valley Rd in Morgan
2. Driveway, lakeshore, and riparian BMPs off Cranberry Brook in Morgan
3. Road erosion BMPs on West Echo Lake Road in Charleston
4. Road erosion BMPs on Toad Pond Road in Morgan
5. Riparian Buffer Plantings on unnamed streams off Bennett Farm Road in Charleston
6. Wayeeses & Sugarbush Road BMPs & Gully Stabilization in Morgan
7. Derelict dam removal on Cranberry Brook in Morgan
8. Lakeshore buffer planting off W Echo Lake Rd in Charleston
9. Stream restoration & buffer planting in unnamed stream off Sunset Dr in Morgan
10. Road erosion BMPs on Williams Road

Some of these recommended projects address multiple Project Summaries in the overall design scope. For instance, *Road Erosion BMPs on Toad Pond Rd in Morgan* includes at least five separate Project Summaries that are all located on different road segments, but intrinsically tied to one another through drainage networks or ownerships.

Of these ten recommendations, three were selected for preliminary designs. These three projects include the Sucker-Valley Brook confluence area, Toad Pond Rd, and West Echo Lake Road. These projects were chosen because of their significant P reduction values, numerous co-benefits, and documented landowner support. If implemented, they have among the highest P reduction values and would provide the greatest benefit to the public. At the time of the recommendation, the Sucker-Valley Brook confluence area was under conservation acquisition by the VT Fish & Wildlife Department. Toad Pond Rd and West Echo Lake Rd were chosen, in particular, because of the severe flood damage that occurred in July 2024 and the substantial sediment loading that resulted. MWA opted to develop preliminary designs for a fourth project – the Echo Lake Access Area – to ensure both lakes received the same number of designs and to address concerns of stormwater runoff from the highly visible boat ramp and parking lot.

5.2 30% Preliminary Designs

MWA developed 30% preliminary designs for four of the highest-priority projects that were identified and prioritized during the LWAP process. These projects were selected for their potential water quality benefits as well as strong landowner support and multiple co-benefits. MWA obtained support from VFWD to proceed with Sucker Brook & Echo Access Area designs. Permission and support were also obtained from the Morgan & Charleston Selectboards to develop designs for Toad Pond Road and West Echo Lake Road. The Echo Lake Preliminary Designs include proposed BMPs for the Echo Access Area and West Echo Lake Road (**Appendix J**). The Seymour Lake Preliminary Designs include proposed BMPs for Toad Pond Road and the Sucker-Valley Brook Streambank Management Area (**Appendix K**). Each of the four design packages include many of the following components:

- Existing Conditions Site Plan
- Parcel boundaries
- Mapped streams and wetlands
- LiDAR-derived 1-ft contour lines
- Proposed Best Management Practices and/or Treatment Areas
- Longitudinal profiles, cross-sections, and contributing drainage areas
- Stream geomorphic parameters (e.g., bankfull width, floodprone width, incision ratio, entrenchment ratio, etc.)
- Typical details for proposed practices
- Preliminary cost opinions & permit screening

Summaries of the four projects that were selected for 30% design development:

1. **Sucker-Valley Brook Confluence Floodplain Restoration** – The two largest tributaries to Lake Seymour converge on a property recently acquired and conserved by the VT Fish & Wildlife Department and MWA. Recent flood damages and historic agricultural activities have resulted in a decrease in the function and connectivity of the floodplains. The streambanks are undergoing significant erosion in places and sediment loading is very high in these shallow-sloped reaches. The designs call for reconnecting historic flood chutes, adding strategic wood additions to increase floodplain connectivity, and restoring riparian buffers along the river corridor.

2. **Road Erosion BMPs on W Echo Lake Rd** – West Echo Lake Road has been a chronic problem area in recent years due to intense flood events. On multiple occasions and in several locations during the LWAP period, stream crossings and culverts became overwhelmed and caused major road and driveway washouts. The road has several steep sections and a long stretch that directly abuts the lakeshore. The designs call for upsizing multiple stream crossing structures to hydraulically compatible sizes, installing additional cross-drain and driveway culverts where needed, armoring ditches, and creating turnouts where possible. Improvements also include proper road crowns and grader berm removal along the entire road length as well as wetland restoration and lakeshore enhancement in two discrete locations.

3. **Echo Lake Access Area Stormwater Improvements** – The boat ramp and access area at Echo Lake is owned by VT Fish & Wildlife Department. Concerns about stormwater runoff, lakeshore erosion, and sediment loading resulted in the LWAP Team developing multiple BMP designs for this small lakeshore property. The designs call for installing two rain gardens to manage runoff from an upgradient driveway and West Echo Lake Rd. Designs

also called for expanding and improving an existing stone lined ditch alongside the parking area, planting wider riparian buffers in three discrete lakeshore areas, constructing infiltration steps to provide stabilized access to the lake, and installing driftwood bank protection along the shoreline to prevent further erosion.

4. **Road Erosion BMPs on Toad Pond Rd in Morgan** – Toad Pond Road has been a chronic problem area in recent years due to intense flood events. Nearly the entire road washed out following the July 30 floods, sending thousands of cubic yards of road material and sediment into waterways, residential properties, and Seymour Lake. The road has several steep sections and a mile-long stretch that frequently intercepts streams and diverts runoff from hundreds of acres, which runs down the length of the road. The designs call for upsizing dozens of stream crossing structures to hydraulically compatible sizes, installing additional cross-drain and driveway culverts where needed, armoring ditches, and creating turnouts where possible. Improvements also include proper road crowns and grader berm removal along the entire road length as well as storm drain system improvements at the intersection with VT Route 111.

Due to the severity of flood damage to W Echo Lake & Toad Pond Rd, MWA performed detailed drainage analyses and rainfall-runoff modeling to size and locate culverts and stream crossings. This included surveying the roads with RTK GPS and coupling these data with newly available 2023 preliminary LiDAR data. A memo with supporting documentation was developed by MWA and submitted alongside the 30% preliminary designs to capture some of the methods and rationale behind the proposed designs.

5.3 Next Steps

The following sections highlight *Next Steps* that should be taken by conservation partners, municipalities, and residents of Morgan, Charleston, and Holland to continue with flood recovery while also implementing the projects identified during the LWAP process.

5.3.1 Flood Recovery

MWA responded to over two dozen requests for site visits or technical assistance for flood-related damage that occurred following the 2023 and 2024 floods. Following these visits, MWA provided recommendations to landowners and municipalities about drainage improvements, streambank stabilization, and flood clean-up. While flood repair efforts are important, these actions are often temporary fixes, emergency in nature, and are not necessarily long-term solutions. It is important to recognize that while flood damage may have been repaired quickly, they may not provide a meaningful improvement in *flood resilience* unless steps are taken to address the underlying reasons that damage occurred. For instance, rebuilding a road and its drainage infrastructure following a flood is critically important for emergency access and public safety. However, unless thoughtful actions are taken to address underlying issues – such as undersized culverts and inadequate ditch disconnection practices – flood resilience has not improved, and the likelihood of repeat flood damage remains high.

5.3.2 Landowners

Next Steps for implementing the LWAP can be split into different categories based on the entity that will implement water quality and habitat enhancement projects. First, individual landowners should review the Project Summaries to determine whether their property was flagged as hosting potential project opportunities. Many of these Project Summaries are limited to simple actions – such as driveway upgrades, no-mow zones, and small buffer plantings – that can be implemented at the individual level without need for much technical support or financial assistance. There are dozens of private driveways, private roads, or small-scale buffer projects that can be implemented immediately by residents within the watershed– without the need for engineering, permitting, designs, or grant assistance. Landowner-driven actions should be the first *Next Step* taken across the watershed.

To take the first step in making improvements to one's shoreland property, owners can seek the assistance of the Lake Wise program via VTDEC or OCNRCD staff. Or, landowners can start by educating themselves about Shoreland Best Management Practices (BMPs) at the VTDEC Lake Wise website. The website offers multiple fact sheets on the many shoreland BMPs that can be downloaded free of charge.

5.3.3 Lake Associations

Beyond individual efforts, the Lake Associations are the most important players in the Action Plan. The associations have the institutional knowledge and social capacity to reach out and work directly with their members or neighbors to implement projects that were identified during the LWAP process. Specifically, the associations are well suited for coordinating private road association improvements and small-scale river or lakeshore buffer plantings. These are efforts that can make important gains for the watershed when implemented at large scales around the entire lakeshore. The lake associations are also superbly well-suited for promoting the Lake Wise program and implementing lake-friendly practices on private properties. The Lake Wise program is free to all shoreland property owners and should be the first step in educating landowners about what lake-friendly practice they can adopt on their own properties to improve water quality and habitat. Lake Associations should work collectively and with individual landowners to promote Lake Wise practices and implement those small-scale driveway, private road, and buffer projects as their *Next Steps*.

5.3.4 Municipalities

At the municipal level, *Next Steps* should focus on reviewing the preliminary designs and Project Summaries that apply to Town Highways and municipal rights-of-way. Where Highway Department budgets and capacity allow, preliminary designs should be finalized and implemented on Toad Pond Rd and West Echo Lake Rd to improve flood resilience, water quality, and aquatic organism passage. Charleston and Morgan should explore the opportunity for the *Better Roads* grant program to fund some of this work. Incompatible culverts were the most common issues identified during the LWAP process; undersized, misaligned, or poorly installed culverts are often the root cause of streambank and channel erosion, road washouts, forest and farm field gullies, barriers to aquatic organism passage, and flood vulnerability. For this reason, the Highway Departments should make efforts to upgrade culverts to convey the 100-year flood (where possible) and add outfall stabilization practices to ensure stability in the long term. Towns should also review Class IV roads and legal trail statuses and determine whether some of these roads can be reclassified for improvements or decommissioned. Unmaintained roads and trails caused severe erosion issues during flood events, and it is unlikely that a single landowner is able to implement the upgrades needed to make a Class IV Road more flood resilient and compliant with MRGP standards. As such, municipalities should explore the potential for these roads and trails to be improved or decommissioned.

5.3.5 Local Conservation Partners

Conservation partners such as MWA, OCNRCD, and the NorthWoods Stewardship Center are excellent resources for the more technical projects identified during the LWAP process. These entities should be leveraged to help obtain and administer Clean Water grants, develop and design restoration projects, aid in permitting, subcontract engineering services, and lead or oversee implementation efforts. It is important that the towns, lake associations, and residents utilize these organizations in the most efficient and effective manner to maximize their capacity and impact. For instance, these organizations likely do not have the capacity to administer grants for dozens of small projects that are often in the $1,000-10,000 range. These entities are better suited for managing more complex projects that are less likely to be funded by municipalities or private individuals. The *Next Steps* for MWA should be to further develop, design, and implement projects in the stream/floodplain/wetland restoration sectors that were listed in the LWAP; this includes projects on Valley Brook, Sucker Brook, Cranberry Brook, and unnamed tributaries around Echo Lake. OCNRCD's *Next Steps* include onboarding a new Lake Watershed Program Specialist to coordinate the lake shoreland work sector, host BMP workshops, conduct Lake Wise assessments, serve as a program navigator to shepherd identified priority projects, develop and implement lakeshore restoration projects, and continue to work with agricultural producers to address identified water quality improvement opportunities. The *Next Steps* for NorthWoods Stewardship Center should be offering fee-for-service contracts to implement projects that manage runoff from driveways, private roads, and residential properties while also restoring lakeshore, stream, floodplain, and wetland habitats.

Local conservation partners are already hard at work developing and designing restoration projects in the watershed. In 2023, MWA completed Phase 1 of the Valley Brook Restoration Project, a project that will reduce phosphorus loading to the lakes by 28 kg/year. Phase 2 of this project is already underway using a Water Quality Formula Grant to re-engineer four problematic culverts and design floodplain restoration actions off Valley Road in Morgan and Holland. As part of this work, MWA is working with landowners on Hunting Camp Road and Valley Road to discuss FEMA flood buy-outs, road re-routing, stream crossing upgrades, and road stabilization BMPs. Phase 3 of the Valley Brook project will include the Sucker-Valley Brook confluence area, a top-priority project from the LWAP. Program and other incentive programs to improve stream conditions and water quality. MWA is working with VT Fish & Wildlife Department to acquire and conserve up to 34 acres along Sucker and Valley Brook in Morgan. In 2023, the Town of Charleston worked with MWA and the Municipal Roads program to design and implement road erosion BMPs on East Echo Lake Road, which fared well following historic flooding in 2024. Following the 2024 floods, MWA worked with several landowners to design, permit, and install streambank bioengineering practices to reduce sediment loading and protect important infrastructure; one such project was completed off W Echo Lake Rd in September 2024.

OCNRCD is currently working with farmers on Echo Lake to discuss enrolling in the Conservation Reserve Enhancement Program and other incentive programs that protect water quality and improve habitat.

5.3.6 Workshops

The Echo Lake Protective Association and Seymour Lake Association should work with partners at OCNRCD, MWA, and NorthWoods to host BMP workshops for the public to attend. The local conservation partners are well-suited to offer technical assistance and host workshops to empower and enable lake associations and residents to implement much of the small-scale projects on their own. These workshops will aim to teach participants how to evaluate and remedy common water quality issues as well as provide them with hands-on experience implementing small-scale projects across the watershed. For example, local conservation partners are eager to host a “live-staking” workshop with the lake associations to train the public how to harvest, prepare, install, and care for willow and red osier dogwood live-stakes. Live-stakes are an extremely cost-efficient and effective method for establishing native woody riparian vegetation that helps stabilize streams and lakeshores. These are excellent practices to be implemented at the landowner level with minimal instruction. Other potential BMP workshops ideas include buffer plantings, steep gravel driveways, drainage ditch maintenance & stabilization, culvert maintenance, driveway & open-top culvert upgrades, downspout disconnection, and infiltration steps & trenches.

5.3.7 Tracking Local Scale Efforts

Both SLA and ELPA should consider developing simple tools – such as a spreadsheet or working document – that can be used to track and evaluate projects, workshops, or initiatives that are implemented within each lake community and subcatchment. This type of tool is important for maintaining a steady course of action as each association works to implement the priorities and recommendations of the LWAP. A spreadsheet tool can be used to track which landowners receive Lake Wise assessments, certificates, or awards during and following the LWAP; it can be used to track individual efforts taken at the landowner level to upgrade driveways or enhance lakeshore buffers. It is also a useful marketing tool that can be referenced in grant applications for expanding a local program or initiative when requesting funds or technical support. In terms of tracking progress, a local tool such as this would be extremely helpful if future LWAP or Tactical Basin Plan updates are being drafted. Lastly, the historical record that it provides and sense of continuity across multiple terms of leadership within each lake association is a critical asset when implementing projects and initiatives that can span decades.

5.4 Broader Recommendations

The LWAP Team identified numerous opportunities to improve water quality, manage stormwater runoff, enhance aquatic organism passage, and reduce fluvial erosion and flood risk hazards in the Echo-Seymour Lakes watershed. In general, findings indicate the best opportunities for improving water quality and habitat lie in restoring riparian and lakeshore buffers, implementing road erosion BMPs, improving geomorphic stability in streams, and reducing runoff from developed and agricultural lands. The following are broader recommendations from the LWAP Team that can be adopted by the lake associations, municipalities, and residents within the watershed.

5.4.1 Lakeshores

Stated broadly, the best long-term strategy to protect water quality and habitat in Echo and Seymour Lakes is to prevent development which encroaches upon the lakeshore or removes native woody vegetation. Vermont is ranked highest in the country for lakeshore development. A general trend across Northeast Kingdom lake communities is a rapid transition from unimproved summer camps to four-season residences and commercial properties. Intrinsically, the health of the lakes and watershed is directly proportional to land conversion and development activities. State regulations like the Shoreland Protection Act and Lake Encroachment Permitting act to prevent unrestricted development in the lake and within 250-feet of the lakeshore. While these are well-intentioned policies for water quality and habitat protection, they are only effective when coupled with outreach, education, and enforcement. **Landowners, lake associations, businesses, and municipalities should take care to learn these regulations and work pro-actively with the State to ensure development around the lakes are properly designed, permitted, and implemented.**

Many properties along the periphery of Echo and Seymour Lakes have retaining walls, bulkhead walls, riprap, or revetments lining the shore. These practices are often installed to create level ground for lawns and recreation space or to shore-up lakeshore erosion that occurred after vegetation clearing and development activities. Unfortunately, these practices often provide little or no functional shoreland habitat and can fail over time, resulting in significant erosion and property loss when not maintained properly. **Lakeshore landowners with failing retaining walls or armored shorelines should consider removal and replacement with living shorelines using bioengineering practices and native vegetation.** Artificial shorelines should be replaced with bioengineering practices such as natural stone toes, fabric encapsulated soil lifts, slope re-grading, live cribs, and fascines. These approaches provide long term stabilization and functional habitat by using biodegradable erosion control materials and native woody plants. See the Vermont Bioengineering Manual for more information on these practices.

The lakeshore community should make a concerted effort to shift the status quo around landscaping and lakeshore management activities. For instance, a paradigm shift from mowed lawns to native woody buffers or perennial no-mow zones would greatly reduce erosion and stormwater runoff from developed lakeshores. **This shift should also extend to lakeshore woody vegetation management; landowners should allow leaning, overhanging, and downed trees to remain in place in their natural state (where safe) and not be cleared or removal simply for aesthetic reasons.** These shoreline trees are the first and greatest defense against lakeshore erosion. Alive and upright, they provide soil stability through their roots and habitat in their canopy and beneath overhanging banks. When they fall and become partially submerged, their branches provide an underwater labyrinth for macroinvertebrates and fish to hide, forage, and reproduce. Downed trees also act to protect the shoreline and root zone from wind, ice, and wave erosion. While a temporary hazard to boat traffic when trees are floating in the lake, driftwood is a critically important substrate for critters at the center of the food web. Therefore, woody materials should be allowed to rack up on the shore or sink to the bottom of the lake. Active removal of trees or woody materials from the lake is detrimental to the ecological health and stability of the lakeshore.

While more than half of the shorelands within 250 feet of Echo or Seymour Lake are forested, there are nonetheless numerous opportunities to improve natural lakeshore habitat that would also provide water quality benefits. Both lakes are subject to intense redevelopment as historically small camps are converted to larger, permanent residences. As this trend continues, it is even more important that the Town, Associations, landowners, and neighbors willingly adopt Best Management Practices for their lakeshores. **As such, the LWAP Team encourages the Lake Associations to continue to promote and pursue Lake Wise program participation from lakeshore property owners.** This can be achieved by requesting free Lake Wise assessments from DEC or by contracting professional outreach and technical services that will recruit greater adoption of this critical program.

The Town of Westmore requires landowners to obtain a *vegetative buffer disturbance permit*; this is a great local permitting model that can be adopted by other Towns to prevent further loss of lakeshore buffers. **The LWAP Team recommends that the Towns of Charleston & Morgan work to adopt vegetative buffer disturbance bylaws to protect the lakeshore and increase the awareness of the vegetative buffers.** The bylaws should establish rules and a permit to actively discourage the removal of shoreland or riparian vegetation unless absolutely necessary for public health and safety (e.g., hazard trees). The vegetative buffer disturbance permit should also clearly state that these restrictions are in addition to the Shoreland Protection Act, and that removal of woody vegetation within 250 feet of the shoreline also requires a VT Shoreland Permit. This may include mailings to all residents along with Town Meeting Day information or targeted mailings to new residents or homeowners when properties change hands. While the VT Shoreland Permit dictates how much vegetation can be removed from within 250 feet of the shoreline, Town Bylaws can go above and beyond the standards set by the State.

5.4.2 Streams & Stream Crossings

The majority of stream miles in the Echo-Seymour Lakes watershed are intermittent or ephemeral flowing and run through high-gradient, forested catchments. While forest canopies help to intercept and infiltrate precipitation and reduce runoff compared to impervious surfaces, many of these catchments are underlain by heavy soils that have poor infiltration capacities and high runoff coefficients. As such, small streams that drain to each lake tend to be very 'flashy' during rain events – particularly during summer thunderstorms and rain-on-snow. These watershed characteristics were very apparent during 2023 and 2024 floods, where waterways that usually flow at only a trickle (or even dry most of the time) became a torrent and caused severe fluvial erosion and damages. Climate change-driven shifts in precipitation patterns, expanding road networks, and increasing rates of land conversion/development strongly influence how small streams behave. These trends present major concerns for stream stability, flood risk, fluvial erosion, and water quality in the watershed. MWA re-evaluated many small streams after the 2024 floods and frequently observed major channel adjustment. These changes include widening, down-grading/incision, sedimentation, headcutting, and lateral migration – all of which significantly affect habitat and water quality as sediment is mobilized, floodplains become disconnected, and barriers to aquatic organism passage form. Stream corridors – whether they are for large rivers or small brooks – require a naturally vegetated buffer and minimal in-stream channel modifications to be resilient and ecologically healthy. Therefore, greater protections for natural, woody buffers and restrictions placed on in-stream channel modifications should be sought. **The LWAP Team recommends the Towns of Morgan, Charleston, & Holland adopt the River Corridor Bylaws to provide greater protection to riparian areas, reduce streambank encroachment, and properly plan development in flood hazard areas and river corridors.** An example of standard flood hazard bylaws is available from DEC for Towns to review and adopt. **The Towns should also consider adopting local protections for intermittent and ephemeral stream corridors to complement the State protections issued for perennial streams.**

Unless public safety or infrastructure is at risk, it is important to allow the stream system to "sort itself out" and be permitted to reach a state of dynamic equilibrium. This may necessitate intentional setbacks and forested buffers between streams and houses, lawns, roadways, and farm fields. It may necessitate allowing a former floodplain or alluvial fan that was converted to lawn to "re-wild" itself and become an area where sediment, woody materials, and floodwaters can deposit and disperse. It may necessitate allowing trees and other natural materials to fall into stream channels and form debris jams, which helps to slow down floodwaters, trap sediment, and aggrade incised channels. It may necessitate allowing beavers to perform their dam building activities without restriction so that flood and sediment storage capacities can increase. Of all the "things" that can be done to protect water quality and habitat in the watershed, letting nature take its course is one of the most important broad recommendations that can be provided to the community. Interference in a stream system can lead to unintended consequences and major downstream impacts. Infrastructure and public safety concerns overrule, but where possible, streams should be left to function and evolve without intervention. Where there is not enough space for a proper stream corridor due to existing development, properly designed and permitted river management activities can be taken to improve flood resilience, reduce flood risk, arrest stream channel & bank erosion, enhance aquatic organism passage, or restore floodplain function.

Some of the simplest flood resilience and stream restoration improvements that can be implemented in a wholesale fashion across the watershed are located outside of the streams – primarily drainage ditch and culvert upgrades. Ditches act to drain soils and rapidly shunt runoff away from roads, houses, and fields and discharge them into waterways. Drainage ditches often cause hydrologic "short-circuiting", increasing flood intensity and magnitude as runoff is collected and conveyed directly to stream channels rather than diffusing slowly across the landscape or infiltrating into the ground. Ditches are also a major source of sediment, as fast-flowing waters erode the channel and underlying soils, creating headcuts and gullies. Small drainage culverts or hydraulically incompatible stream crossings can also act as major sources of sediment when scoured during high flows. These knickpoints frequently create vertical barriers to aquatic organism passage. Where landowners are willing, culverts should be replaced with properly sized structures based on the contributing drainage area and ditches should be stabilized with stone lining, stone checks, or perennial vegetation. Best Management Practices state that roadside ditches should discharge to stable, vegetated areas and not directly to streams; this is critical to reduce flood intensity and magnitude. Similarly, culverts should be installed with stabilized headers, outfalls/splash aprons, at a similar slope to the channel slope, and have a diameter equal to the bankfull channel width.

There are countless examples throughout the watershed where a high-gradient stream transitions naturally to a low-gradient floodplain or alluvial fan, only to be constricted and encroached upon by a road, culvert, residence, or other infrastructure. The inflection points where the channel slope decreases are often where roads and stream crossings are constructed. Without a properly sized culvert or bridge, these crossings can easily become overwhelmed with sediment, floodwaters, and debris. There were numerous instances of blocked culverts and bridges that overtopped and washed out during the 2024 floods. A 0.1%-chance-flood (~1000-year) event, the July 2024 storms demonstrated exactly where stream crossings need to be upgraded to improve flood resilience, allow sediment to pass through culverts and under bridges, and convey flows to prevent fluvial erosion. Some examples of this are on West Echo Lake Road, Valley Road, Toad Pond Road, and along Route 111. Several concrete box culverts beneath Route 111 are old, in poor condition, and provide reduced or no aquatic organism passage (AOP). MWA also found these structures to be undersized and geomorphically incompatible with channel alignment and slope. While many culverts on these roads were upgraded following the 2024 floods, not all were improved to ideal design flow standards. **Unaddressed stream crossing structures on those roads should be the focus of long-term goals for Morgan, Charleston, Holland and VTrans, where applicable. These stream crossings should be replaced to improve flood resilience and promote free movement of fish (where populations can be supported).** It is worth noting that potential natural passage barriers in the form of ledge outcrops and waterfalls are abundant in many of the small streams draining to each lake. As such, replacement of structures that currently provide *Reduced AOP* or *No AOP* may not result in improved access to headwater habitat. Close inspection of AOP issues and selection of projects that will guarantee improved AOP to upper reaches of the streams is paramount to the prioritization effort.

Large scale bioengineered streambank stabilization is not a common practice in the Northeast Kingdom as it does not always incorporate natural channel adjustment processes and may prevent rivers from reaching a state of dynamic equilibrium. However, many of the instances of accelerated bank erosion and mass wasting observed in the Echo-Seymour Lakes watershed are being addressed by placing riprap stone along the bank. Where bank erosion is in close proximity to development and poses potential risks to infrastructure, this form of stabilization may be necessary. However, alternative stabilization methods that utilize bioengineering practices should be the preferred approach. An example of this was completed by MWA on an ephemeral stream off West Echo Lake Road, where a combination of riprap, grade controls, and encapsulated soil lifts were installed to restore bank erosion and protect a septic system and drinking water well. **Where existing development conflicts with stream processes and channel management is unavoidable, MWA recommends that bioengineering techniques be considered before installing or replacing traditional stabilization methods (e.g. riprap).** These practices work to absorb stream energy, reduce sediment and phosphorus loading from channel and bank erosion, and provide functional habitat and flood resilience.

5.4.3 Town Roads & Private Drives

Many Town Highways in the Echo-Seymour Lakes watershed are unpaved, steep, confined by hillsides or valley walls, and adjacent to waterways. The roads which present the greatest level of erosion risk and therefore opportunities to reduce sediment loading include Toad Pond Road, Sunset Drive, East Echo Lake Road, Meade Hill Road, Hatton Heights, publicly owned portions of

Camp Winape Road, Williams Road, and West Echo Lake Road. Some of these roads, such as East Echo Lake Road and Sunset Drive, were addressed and received BMP improvements in the last 2 years. Others had to be rebuilt following the 2024 floods. Regardless of rebuild or improvements, all of these roads require frequent maintenance to ensure the drainage network and road erosion BMPs function properly. **Therefore, the LWAP Team recommends the Towns continue working with OCNRCD and MWA to bring non-compliant segments of these roads up to MRGP standards and increase the frequency of maintenance for culverts, ditches, and shoulders to optimize stormwater management**.

Private roads and driveways are numerous in the Echo-Seymour Lakes watershed, amounting to 35% of the overall road mileage (18.5 miles). These are often steeper, less well-designed, have fewer road erosion BMPs than public roads. **As such, we recommend that private road associations and individual landowners work with their local Lake Association to design and implement Best Management Practices that manage runoff and reduce road erosion**. This may include regrading private road surfaces, lining ditches with stone, adding drainage culverts and stabilized outfalls, and other simple modifications. **The LWAP Team also recommends that private driveways be improved with practices such as water bars and open-top culverts that direct runoff to stable vegetated areas rather than piping this water directly to waterways or the lake.** The Echo Lake Protective Association and Seymour Lake Association are great advocates for this type of work on private property and could partner with OCNRCD, NorthWoods, or MWA to increase awareness and adoption of these strategies.

5.4.4 Agriculture & Forestry

Farming and forestry are important economic activities and cultural drivers in the watershed, and working collaboratively with farmers and forest landowners to implement BMPs should be a primary objective when implementing the LWAP and addressing broader water quality goals in the Memphremagog Watershed. Many agricultural BMPs are outside of the scope of the LWAP as some are mandatory under the Required Agricultural Practices (RAPs), a program overseen by VT Agency of Agriculture, Food, & Markets. There are four sizeable agricultural operations in the Echo-Seymour Lakes watershed, not including many leased fields where haying, manure spreading, or cattle grazing may occur. Three of these operations have agricultural easements through the Vermont Land Trust and are therefore partially protected from development or subdivision pressures. However, some of these easements do not have stream buffer, wetland, or water quality conservation protections. **In general, land trusts should work to add overlay protections to agricultural and/or conservation easement on large properties that possess Agriculturally Important Soils or sensitive natural resources. Agricultural operations and landowners interested in addressing possible agricultural impacts to water quality, like farm roads heavy use areas, lack of vegetative buffers or manure spreading setbacks should contact OCNRCD to request a site visit.** Efforts should be made to work with landowners to delineate sensitive wetlands, streams, or lakeshores and develop overlay easements to increase protection and landowner incentive.

Forestry activities can also impact water quality and habitat in episodic and lasting ways. Harvesting can result in sudden increases in erosion, sedimentation, and turbidity if skidders, tractors, feller-bunchers, or forwarders create gullies in soft or saturated soils. Similarly to agricultural operations, commercial logging jobs and private forestlands enrolled in the Use Value

Appraisal program are required to follow Acceptable Management Practices (AMPs) to protect water quality while harvesting timber. It is important that these practices be employed and enforced, which is a difficult task in the vast and remote upper watershed. Even with AMPs, erosion and sedimentation may still occur on historic logging roads and skid trails. Fortunately, Clean Water grant funding is available to work on private forest roads to reduce erosion risk. **Landowners interested in upgrading drainage practices or decommissioning historic forest roads should contact MWA to request a site visit and discuss the feasibility for dealing with these persistent, out-of-sight water quality issues.**

5.4.5 Wastewater Systems & Zoning

While the contributions of nutrient loads to the Lakes from septic systems is not part of the LWAP process, our Team strongly believes that aging septic systems play an important role in the phosphorus loading to both Echo and Seymour lakes. This is because 1) many of the septic systems in place are likely well past their initial design lifespan, 2) septic systems are subject to much greater usage as summer camps transition to permanent residences, and 3) many properties are seeing increases in the number of bedrooms and occupancy rates. "Septic Socials", or domestic wastewater workshops, are popular in other lake communities and are often hosted by Lake Associations or local conservation partners. Workshops are great opportunities for landowners to learn about septic system maintenance, problem identification, design options, upgrades, funding opportunities, and more. **The Echo Lake Protective Association and Seymour Lake Association should each launch an educational campaign to organize and invite all lakeshore landowners to attend Septic Socials to learn how they can manage wastewater to protect the Lake.** Lake associations should refer to the Homeowner's Guide to Wastewater Systems and the Guide to Failed Wastewater Systems for more information and resources on this topic.

In addition to lake association and landowner initiatives, **the Towns should consider reviewing the Town Zoning Bylaws to ensure proposed lakeshore redevelopment projects are required to replace or upgrade septic systems to maintain optimal treatment of wastewater.** As more and more lakeshore properties are redeveloped, the usage and wastewater load will increase. Therefore, care should be taken to ensure the wastewater system can support redevelopment and usage increases.

APPENDICES:

A. WATERSHED DATA LIBRARY MEMO
B. PROPOSED CORE ASSESSMENT AREAS MEMO
C. ECHO LAKE BATCH IMPORT FILE
D. SEYMOUR LAKE BATCH IMPORT FILE
E. PRIORITIZATION CRITERIA & METHODS
F. ECHO LAKE PROJECT PRIORITIZATION MATRIX
G. SEYMOUR LAKE PROJECT PRIORITIZATION MATRIX
H. ECHO LAKE PROJECT SUMMARY SHEETS
I. SEYMOUR LAKE PROJECT SUMMARY SHEETS
J. ECHO LAKE 30% PRELIMINARY BMP DESIGNS
K. SEYMOUR LAKE 30% PRELIMINARY DESIGNS

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