Aquatic Nuisance Control Permitting Approved 2025.06.26 11:39:12 -04'00'

RECEIVED 3/12/2025
DEPARTMENT OF ENVIRONMENTAL CONSERVATION
WATERSHED MANAGEMENT DIVISION

Pesticides

October 2022

Application for use of Pesticides under an Aquatic Nuisance Control Permit Per 10 V.S.A. Chapter 50, § 1455

VERMONT DEPARTMENT OF ENVIRONMENTAL CONSERVATION
WATERSHED MANAGEMENT DIVISION
LAKES & PONDS PROGRAM

For Aquatic Nuisance Control Permit Program Use Only
Application Number: 4475-ANC

Submission of this application constitutes notice that the entities listed below intend to use pesticides in waters of the State to control aquatic nuisance plants, insects, or other aquatic life; and that the entities below have demonstrated that (1) there is no reasonable nonchemical alternative available; (2) there is acceptable risk to the nontarget environment; (3) there is negligible risk to public health; (4) a long-range management plan has been developed which incorporates a schedule of pesticide minimization; and (5) there is a public benefit to be achieved from the application of a pesticide or, in the case of a pond located entirely on a landowner's property, no undue adverse effect upon the public good. Submit a permit review fee of $75 for a private pond or $500 for all other waterbodies, made payable to the State of Vermont. All information required on this form must be provided, and the requisite fees must be submitted to be deemed complete.

A. Applicant Information

1. Entity's Name: Lake Eden Association
2a. Mailing Address: PO Box 213
2b. Municipality: Eden | 2c. State: VT | 2d. Zip: 05652
3. Phone: 770 356-1274 | 4. Email: cbrennanvt@gmail.com

B. Pesticide Applicator Information (Check box if same as above in Section A: ☐)

1. Entity's Name: Solitude Lake Management
2a. Mailing Address: 590 Lake Street
2b. Municipality: Shrewsbury | 2c. State: MA | 2d. Zip: 01545
3. Phone: 888 480-5253 | 4. Email: mbellaud@solitudelake.com

C. Application Preparer Information (Check box if same as above: Section A ☐ and/or B ☐)

1. Preparer's Name: Vincent Brennan
2a. Mailing Address: 5638 Route 100
2b. Municipality: Eden Mills | 2c. State: VT | 2d. Zip: 05653
3. Phone: 404 281-2598 | 4. Email: VINB039@yahoo.com

D. Waterbody Information

1. Name of waterbody: Eden Lake - Eden 2. Eden - Lamoille
3. Are there wetlands associated with the waterbody? ■ Yes ☐ No
Contact the Vermont Wetland Program: (802) 828-1535 for additional information. - OR 4/8/2025
4. Are there rare, threatened or endangered species associated with the waterbody? X Yes ■ No
Contact the Vermont Fish & Wildlife Natural Heritage Inventory: (802) 241-3700 for additional information.
5a. Is this waterbody a private pond (per 10 V.S.A. 5210)? ☐ Yes ■ No If No, skip to Question D6.
5b. Is this private pond totally contained on landowner's property? ☐ Yes ☐ No
5c. Does the private pond have an outlet? ☐ Yes ☐ No
If yes, what is the name of the receiving water from this outlet?
5d. Is the flow from this outlet controlled? ☐ Yes ☐ No
If yes, how and for how long?
6. List the uses of the waterbody – check all that apply:
☐ Water supply ☐ Irrigation ■ Boating ■ Swimming ■ Fishing ☐ Other:

E. Treatment Information

1a. Proposed start date: June 1, 2025

1b. Proposed end date (if known): Sept 2029

2. Aquatic nuisance(s) to be controlled:
Plant/Algae/Animal: Eurasian Water Milfoil
Submit additional information as needed.

3. Pesticide(s) to be used[1]:
Trade Name: ProcellaCor EC
EPA Registration #: see attached
Submit a copy of the Product Label & Material Safety Data Sheet.

4. Provide a map of control activity area.
Provide location of (each) treatment area in waterbody.

5. Application rate (ppm): See Attached
Explain the above application rate & provide calculations.

6. Attach a narrative description of the proposed project to include the following items:
a) Reason(s) to control the aquatic nuisance;
b) Brief history of the aquatic nuisance in the waterbody;
c) Reason why no reasonable nonchemical alternatives are available; and,
d) Description of the proposed control activity.

7. If you answered "no" to D5b above, then a Long-range Management Plan[2] (LMP) is required:
a) Describe how control of the nuisance species will be conducted for the duration of the permit (must be at least a 5 year time span and incorporate a schedule of pesticide minimization); and,
b) Explain how the LMP will be financed; include a budget and funding sources for each year.

F. Adjoining Property Owner Certification (For additional information, please see the APO Notification Guidance)

JB I certify, by initialing to the left, that I have notified adjoining property owners of the proposed project using the DEC Adjoiner Form template letter that was sent by U.S. Mail.

G. Applicant/Applicator Certification

As APPLICANT, I hereby certify that the statements presented on this application are true and accurate, guarantee to hold the State of Vermont harmless from all suits, claims, or causes of action that arise from the permitted activity; and recognize that by signing this application, I agree to complete all aspects of the project as authorized. I understand that failure to comply with the foregoing may result in violation of the 10 VSA Chapter 50, § 1455, and the Vermont Agency of Natural Resources may bring an enforcement action for violations of the Act pursuant to 10 V.S.A. chapter 201.

Applicant/Applicator Signature: Director of Technical Services Solitude Lake Management Date: 3/12/25

H. Application Preparer Certification (if applicable)

As APPLICATION PREPARER, I hereby certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Application Preparer Signature: Date: 3/12/25

I. Application Fees

Print Form

Refund Policy
Permit Review Fees are non-refundable unless an application is withdrawn prior to administrative review.

Submit this form and the $75 or $500 fee to:

Vermont Department of Environmental Conservation
Watershed Management Division
Aquatic Nuisance Control Permit Program
1 National Life Drive, Davis 3
Montpelier, VT 05620-3522

Municipalities are exempt and do not need to submit fee.

Direct all correspondence or questions to the Aquatic Nuisance Control Permit Program at: ANR.WSMDShoreland@vermont.gov
For additional information visit: https://dec.vermont.gov/

1 The application fee for the aquatic pesticide Aquashade® and copper compounds used as algaecides is **$50** per application.

2 Any landowner applying to use a pesticide for aquatic nuisance control on a pond located *entirely* on the landowner's property is exempt from the Long-

Town of Eden
71 Old Schoolhouse Rd
Eden Mills, VT 05653
802-635-2528

October 8, 2024

To whom This May Concern:

The Eden Selectboard is pleased to support the Lake Eden Association {LEA), in their efforts to continue to manage the spread of Eurasian Watermilfoil (EWM) in Lake Eden.

We have worked closely with the LEA for more than 12 years to prevent the spread of Aquatic Invasive Species and more recently, over the last 3 seasons, to mitigate EWM. We have jointly applied for and managed grants to support these efforts. In addition, the town and its residents have helped to fund these efforts through the appropriation of town funds.

The work the LEA and its many volunteers have done to preserve the health and beauty of the lake has been outstanding and has contributed to the economic vitality of the entire community. Unfortunately, EWM has continued to spread prolifically despite aggressive efforts with DASH, Benthic blankets, Hand harvesting, VIP, programs and the countless hours of the volunteers that have so generously given of their time and support. More aggressive treatment measures will need to be explored to continue to protect the health of the lake and our economy.

We hope that you will favorably consider the LEA 's application. Please feel free to contact the town with any additional information you may need relative to the Town's support of the LEA and this application process. The number at the Town Clerk's Office is: {802} 635- 2528.

Sincerely,

Tim Bullard
Select Board Chairman

Ricky Merin

Clayton Whittemore

LAKE EDEN

Long Term Eurasian Water Milfoil Management Plan

LAKE EDEN Est. 1960 EDEN, VERMONT ASSOCIATION

ARROWWOOD ENVIRONMENTAL

February 2025

TABLE OF CONTENTS

Acknowledgements

The Lake Eden Association would like to thank the many volunteers that have helped us with our mitigation efforts thus far, without them we could not have accomplished what we have. In addition, we are grateful to have the support, both financially and in spirit that the Town of Eden has provided to the Association. They have been supporting our efforts for many years and have stood behind us when EWM was discovered in Lake Eden.

INTRODUCTION

Lake Eden Background

Lake Eden is a 198-acre waterbody in the town of Eden, Vermont. The watershed of Lake Eden consists of 4423 acres of forest, agriculture, and rural residential development (Figure 1). Lake Eden is fed by the Gihon River, which flows into the north end of the lake and flows out of the southwestern part of the lake. Lake Eden is also fed by four smaller, unnamed streams: two entering the southeastern bay, one entering the eastern side of the lake and one entering the western side just north of the public beach.

FIGURE 1. LAKE EDEN WATERSHED

The Lake Eden system is underlain by schists and phyllites from the Stowe Formation (Ratcliffe et al. 2011). The underlying bedrock can impact the chemistry of the water, in this case resulting in a moderately alkaline lake. Chemistry and nutrient content of the water is also highly influenced by the nature of the surface water inputs. The nature of these inputs, in turn, are influenced by the land use in the surrounding watershed. Land use in the watershed can therefore have a large impact on water quality in the lake. Land use in the Lake Eden watershed is a mixture of forested lands, agricultural fields, and rural residential development. In their analysis of watershed land use, Vermont Department of Environmental Conservation considers the Lake Eden watershed to be "moderately disturbed." This is based on the amount of land use under development or agricultural use within the watershed that may have an impact on water quality in the lake (Vermont Department of Environmental Conservation 2024).

Lakes are typically classified based on physical parameters such as size, depth, trophic status and alkalinity. Trophic status is a way to categorize different lakes based on the amount of biologically useful nutrients in the water (mainly phosphorus and nitrogen). Oligotrophic lakes are lakes with very low nutrients available for plant (including algae) growth. Because of this low amount of growth, plant and algae productivity is low and water clarity can be quite high. Mesotrophic lakes have a moderate degree of nutrients available for plant growth and eutrophic lakes are those with a large amount of nutrients. Eutrophic lakes can have low water clarity because of the higher degree of algae growth that is possible when nutrients such as phosphorus are plentiful.

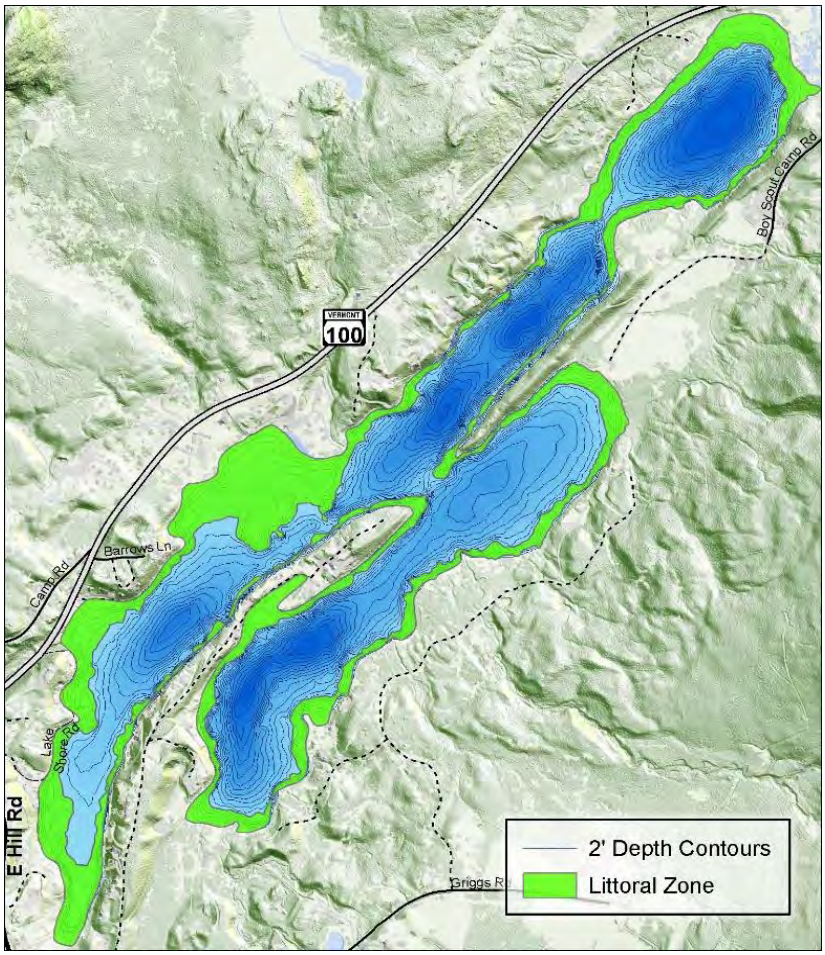


FIGURE 2. LAKE EDEN LITTORAL ZONE

Since phosphorus is typically the limiting nutrient for aquatic plant growth, a common measurement to determine trophic status is to measure the phosphorus content of the lake during spring turn-over. This is the phosphorus that will be available for plant and algae growth during the growing season. Based on these spring phosphorus measurements, Lake Eden is considered a mesotrophic lake. Other measures of trophic status such as the measure of algae growth (chlorophyll a) also indicate that the lake is in the mesotrophic category, though has been in the oligotrophic category in the past. (Vermont Department of Environmental Conservation 2024).

The maximum depth in the lake is approximately 40 feet. A map of the lake showing the bathymetry is shown in Figure 2. The contours of the bathymetry shown in this map have a direct impact on the nature and extent of aquatic vegetation growth in the lake. Aquatic growth (both native and non-native) is driven by access to nutrients and access to light. In Lake Eden, limited access to light has resulted in aquatic plants being generally absent from areas that are deeper than 12 feet. This 12-foot line is considered the general border of the functional littoral zone for the lake and is shown in Figure 2. This should therefore be considered the available habitat for both native and non-native aquatic plants. Along much of the shore, the lake-bottom drops off fairly quickly, resulting in a narrow littoral zone. This is contrasted by the many shallow bays at the ends of the lake as well as the large shallow area near the public beach. These areas are shallow enough to provide suitable habitat for abundant aquatic plant growth.

Lake Eden Association

Lake Eden Association (LEA) is a 501(c)(3) non-profit organization that was founded in 1960. The primary mission of the association is to protect and promote the well-being of the lake and its ecosystems. The LEA accepts members from any geographic area, however most of the 80+ members live on or near Lake Eden. The LEA has a 5-person Board of Directors and meets regularly throughout the year, but minimally once per year in conjunction with an annual meeting for all members. The LEA has been focused on water clarity testing and E. coli sampling and participates in the Lay Monitoring Program requirements. The LEA also manages the greeter program,

Vermont Invasive Patroller (VIP) program and, in recent years, the EWM mitigation programs. These consist of Diver Assisted Suction Harvesting (DASH), benthic blankets management, hand harvesting, fund raising, permit application management and community outreach.

The goals of the EWM management plan are:

- To maintain the recreational activities of Lake Eden including swimming, boating and fishing.
- To Protect native plants and animals and allow them to flourish
- To mitigate the growth of EWM using a variety of methods including DASH, hand harvesting, benthic blankets and herbicide treatment.
- To minimize the use of herbicide treatments in the lake over time.
- To minimize the possibility of other invasive species entering the lake or the spread of EWM into other waterbodies in Vermont.
- To monitor, via annual surveys, the spread of invasive aquatic species throughout the lake.

HISTORY OF EWM COLONIZATION AND MANAGEMENT IN LAKE EDEN

Eurasian watermilfoil was first discovered in Lake Eden in 2022. Since that time, three major "hot spots" in the lake have been identified: the Public Swimming Beach, the Boat Launch and the Scout Camp. These areas have developed well-established and persistent populations of this aggressive invasive species. Since 2022, EWM has spread from these hot spots to establish scattered populations throughout the littoral zone. These hot spots as well as other areas in the lake are shown on the map in Figure 3. A history of EWM establishment and control in the lake is presented below.

2022

In June 2022 a small patch of EWM was identified by a lake resident/VIP team member, in the area in front of the public swimming beach. Shortly after, a larger 20' by 20' area of EWM was found in the shallow area east of the town beach. This area was promptly cordoned off to keep boats away prior to DASH. The LEA sprang into action and immediately contacted the Vermont DEC Lakes and Ponds Division for guidance. Thanks to assistance from the Lakes and Pond Division, hand harvest divers and surveyors were engaged within a few weeks. LEA also applied for and received a rapid response permit for benthic blankets and DASH harvesting. The area of the first infestation was likely accelerated by highboat traffic which resulting in the prolific spread via fragmentation, in the following months. The LEA hired surveyors to document EWM throughout the lake in July and again in October. Later in the summer of 2022 LEA hired DASH divers that not only harvested 450 lbs of EWM but also laid 17 benthic blankets in the initial infestation area. All DASH was assisted by a team of local volunteers that devoted many hours retrieving EWM fragments and preparing benthic blankets for use. In addition Kim Jensen presented an informational session on EWM and multiple social media/newsletter posts were made.

2023

An aquatic plant survey was conducted in beginning of season to determine the current status of EWM in the lake. Hand harvest education seminars were conducted, and hand harvest volunteers were recruited. In addition, the VIP program was expanded from 8 people to 19 people and "hands on" education seminars were provided by Kim Jensen of the VT Lakes and Ponds Division. DASH was performed for 10 days resulting in 1,296 lbs of EWM harvested. EWM was then discovered in a new area by the Boat Launch on the north end of the lake and quickly spread throughout that region. An additional 8 benthic blankets were purchased, and 17 original blankets were moved to the boat launch region. The LEA began fundraising for the rising costs of mitigation efforts and spoke at the Town of Eden annual meeting to educate and inform the local community of EWM and its long-term effects if left untreated. In July the status of EWM was presented at the LEA annual meeting and to Scout camp leadership. LEA made numerous posts on social media and in the LEA newsletters. In addition, LEA conducted hand harvest trainings and the team expanded from 4 to 11 members. Some members purchased, at their own expense, underwater breathing compressors to assist them with hand harvesting. Hand harvesting continued weekly throughout the summer. A post-season survey was conducted by

Arrowwood Environmental to provide focus for treatments in the Summer of 2024.

2024

In spite of increased mitigation efforts, EWM continued to spread throughout the lake. The boat launch area became a particularly troublesome area because of the high volume of boat traffic. The areas between the benthic blankets and the shoreline were inaccessible for both DASH and hand harvest teams due to shallow water and deep muck. This zone quickly became densely infested with EWM. The LEA advertised and hosted a community education program on herbicide treatments including a panel discussion. . Presentations were made on the threats of EWM and spread prevention measures. A plant survey was conducted in the fall by Arrowwood Environmental. The LEA also received a 100% unanimous vote from the LEA annual meeting participants to proceed with an herbicide permit application. DASH was increased to 12 days resulting in 1,143 lbs being removed and the hand harvest team expanded to 5. LEA met with the Town of Eden Select Board to inform them of progress and gain support for next steps. Presented at the annual town meeting in Eden and a "write up" was included in the written annual town report. Presentations on EWM and spread and prevention measures were completed throughout the community. . Hand harvest team expanded from 11 to 16 members. We also further developed the VIP program and modified patrol zones from 5 large areas to 30 more manageable patrol zones.

"IN SPITE OF SIGNIFICANT INCREASES IN MITIGATION EFFORTS, THE SURVEY MAPS SHOWED WE WERE LOSING THE BATTLE TO EWM"

Colleen Brennan Secretary Eden Lake Association

TABLE 1. LEA EWM CONTROL COST HISTORY

Year	Control activity	Total costs
2022	Surveys, VIP Program, DASH, hand harvesting, greeter program and Benthic Blankets w/rebar,	$39,116
2023	Surveys, VIP Program, DASH, hand harvesting, greeter program, Benthic Blankets w/rebar, buoys, misc supplies, permits, equipment for hand harvesters and VIPs such as SNUBA, wet suits, buoys and collection bags.	$44,359
2024	Surveys, VIP Program, greeter program, DASH, buoys, permits, hand harvesting and VIP supplies	$45,467

TABLE 2. LEA EWM CONTROL ACTIVITY

Control Activity	Operator	Dates	Objective
Greeter Program	LEA	2006 - 2024	To inspect all watercraft entering and exiting the lake for invasive species and to educate on spread and prevention measures.
VIP Program	LEA	2006 - 2024	To inspect the littoral zones of the lake for invasive species and to document any new plant life identified.
Hand-harvesting	LEA Hand Harvest Team	2022 - 2024	To hand remove EWM via use of SNUBA and SCUBA gear.
DASH	Swampquana	2022-2024	To remove EWM utilizing Diver Assisted Suction Harvesting.
Bottom barriers	LEA	2022-2024	To eliminate EWM by use of benthic blankets that deprive the plant of sunlight and oxygen.
Public Outreach	LEA	2022-2024	To educate the local residents on the health of Lake Eden, the infestation of EWM, the negative impact of EWM on Lake Eden and the mitigation practices being used by LEA as well as how individuals can assist in mitigation programs.
Aquatic Plant Surveys	Arrowwood Environmental	2022 - 2024	To survey the plants, both native and invasive, in Lake Eden. To document the location and quantity of EWM throughout the lake. To determine via surveys, the spread and trends of EWM proliferation and to monitor effect of EWM and mitigation treatments on native plants.

Greeter Program

Since 2006 the LEA has operated the Greeter Program at the state boat access in the northwest corner of the lake. It operates 7 days a week from Memorial Day to Indigenous People Day in late October. Direct program costs in 2024 were $18,009 and resulted in 913 boat inspections and 4 incidents of milfoil detected on boats. Some data was lost in 2024 but there are approximately 1,200 boats are inspected annually during the Greeter Program.

Paid Greeter staff check boats and trailers for invasive plants and animals. Lake Eden has a strong team of Greeters that inform boaters on spread and prevention measures, state boating laws and idiosyncrasies of the lake such as shallow areas to be aware of. They also identify areas of the lake where EWM infestation is dense and prone to fragmentation. Greeters serve as unofficial harbormasters, assisting with , boat launching and retrieving, parking trailers, and as sources of information.

Public Outreach

The Lake Eden Association has multiple ways of communicating with the Lake Eden homeowners as well as the Town of Eden and surrounding community residents. Below are the key elements of our Public Outreach Program:

Friends of Lake Eden Facebook page

This public Facebook page was created in 2012 and has posts from lake residents and users on activities around the lake, water quality samplings, loon updates etc. We regularly post EWM activities and pictures such as DASH boats and EWM harvests. We also use the facebook page to recruit volunteers and to educate on EWM and spread and prevention measures.

Lake Eden Association Website. (www.lakeedenvt.org)

This website is the main website used by the LEA to share all aspects of enjoying Lake Eden including updates on EWM (what it is, where it is, how to avoid), water quality reports, history, upcoming activities, shoreline protection programs, updates on EWM, spread and prevention measures, and much more. We also provide links to related state of VT websites, videos on community meetings on herbicide treatment and EWM, as well as underwater and aerial views of our lake.

Town of Eden Annual Meetings

Since the discovery of EWM in Lake Eden, the LEA has presented at the annual town hall meetings. We present informational data on EWM, the threats it poses, the status of EWM in Lake Eden, mitigation efforts/plan, and on spread & prevention measures. The town meetings have been well received, and each year the town residents have voted in favor of providing funds to assist with mitigation and the Greeter Program costs.

Community Education Forum and Panel Discussion

In June of 2024, the LEA hosted a community forum on the potential use of herbicides in Lake Eden. This 2+ hour event was held at the local elementary school. It was promoted in the local News and Citizen newspaper, Front Porch Forum, Friends of Lake Eden Facebook page, LEA newsletters, Town Website and posted on bulletin boards around town. The event was attended by over 54 people. We had a panel discussion with representatives from the VT DEC Lakes and Ponds division, SOLitude approved applicator, Arrowwood Environmental surveyors and aquatic biologist, and the President of the Federation of VT Lakes and Ponds (FOVLAP). The panel discussion was well received, and many questions were asked and answered. The entire meeting was videoed, and a link is on the Lake Eden Association website, The link was also provided on the facebook page in in LEA newsletters.

Annual Lake Eden Association Meeting

The annual meeting of the Association is promoted to the entire community and is posted on the Facebook page, at Town hall, the town beach, and Eden General Store. Each year a portion of the meeting is dedicated to educating on EWM in Lake Eden. We prepare posters, videos and handouts to keep everyone informed and up to date on all mitigation efforts and plans. We designed and distributed door hangers that informed about Lake Eden boat safety, being a good neighbor and EWM impact. This year the members voted unanimously to pursue a permit for herbicide treatment in Lake Eden.

Targeted Local Outreach

The LEA has provided 3 seminars to scouts at the Scout Camp which is located on the northeast portion of the lake. Educating the Scouts and leaders on what EWM is, what we are doing to fight it and what they can do to help. Education on EWM was worked into the SCOUTS' campers program. These programs were well received, and we had Scouts join our volunteer efforts to mitigate the spread by participating in our VIP program.

The LEA sponsored Lakeshore property improvements to reduce nutrient loading and erosion. This was followed by a community "show and tell" event including a tour of that project and presentations on Lake Healthy property practices.

We also sponsored an education program on healthy lakes with the elementary school children at Eden Elementary School. Puppet shows and art contests were part of this program with movie ticket winners awarded to the top entries for each grade.

LEA hosted a hands-on VIP training in 2023. All members of the community were invited to learn and experience hands-on, the different types of invasive species in VT lakes and ponds. This program was well attended by over 20 people.

Local Publications

We have posted updates and articles in LEA newsletters, on social media (Facebook and Front Porch Forum) and in the News and Citizen. Written updates were included in the Town of Eden annual report for the past 2 years.

CURRENT STATUS OF EWM IN LAKE EDEN

In August 2024, Arrowwood Environmental performed an aquatic plant inventory of Lake Eden, including an inventory of EWM distribution and abundance

The state of EWM infestations in 2024 in Lake Eden are divided up by the locations shown in Figure 3 and summarized below.

High EWM Populations

Boat Launch

The Boat Launch area is a shallow bay with abundant native aquatic vegetation and mucky substrates. EWM has been documented at the Boat Launch site since it was first documented in 2022. At that time, scattered individual plants were documented near the launch and a larger infestation southeast of the launch. In 2023, more plants were documented near the launch, and a very large infestation became established in the shallow areas just east of the launch. Installation of benthic barriers helped to control these large infestations, but EWM has become established in all of the areas around the benthic barriers. This includes a dense infestation in the very shallow (1' deep) waters along the northern margin of the lake. Control in this area has included the installation of benthic barriers, frequent hand-pulling and DASH. Despite these control measures, EWM numbers have steadily increased from 2022-2024.

The EWM infestations in this area pose a particular threat to the lake because of the boat traffic that is common in this area. Fragments of EWM churned up by motorboat propellers can float to other parts of the lake and establish new infestations. This is likely the cause of the increase EWM in the Northwest Quadrant (see below). In addition, the shallow depths

and mucky substrates in this area preclude hand-pulling and DASH control activities. In addition - benthic blankets are also not effective here as they can not be placed close to shore due to the "muck".

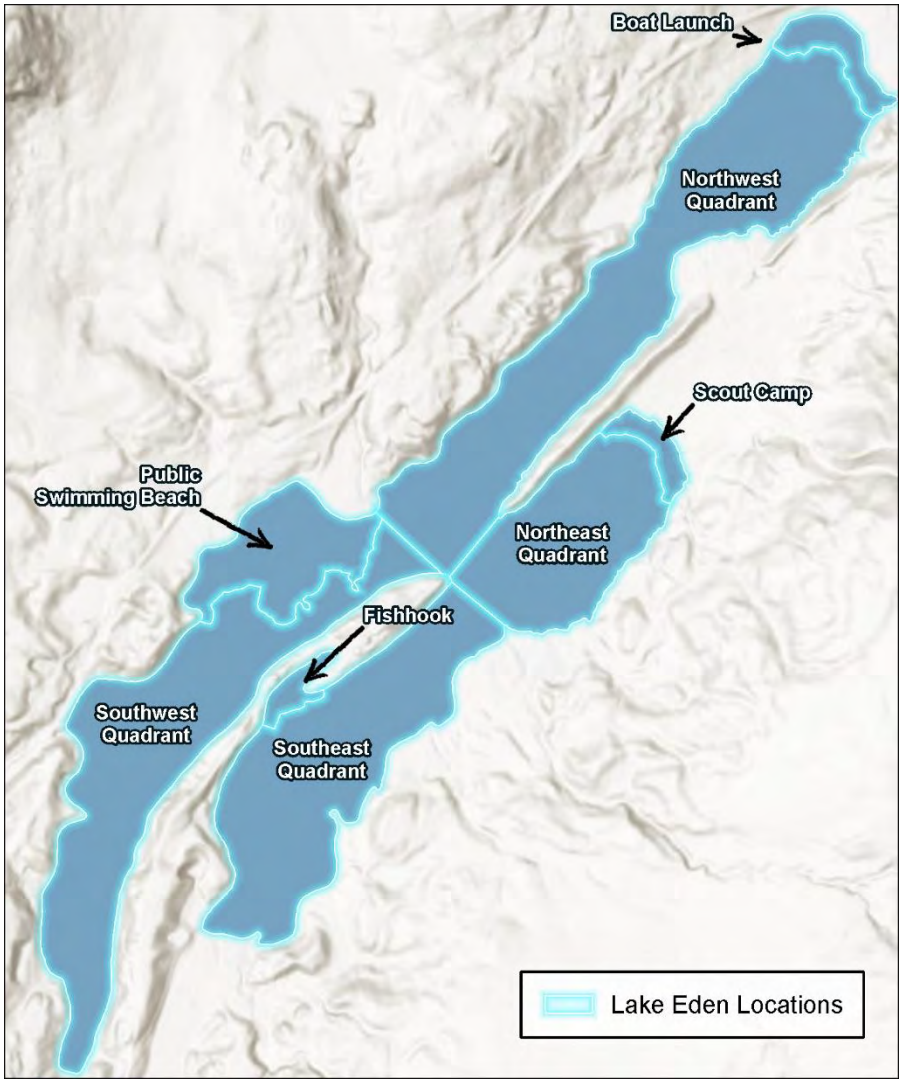


FIGURE 3 LAKE EDEN PLACE NAMES

Northwest Quadrant

The Northwest Quadrant is characterized by a relatively narrow littoral zone before steep drop-off. Substrates are a mixture of silt and a layer of silt over cobble and gravel. The littoral zone northeast of the powerline is fairly wide and offers suitable habitat for EWM. South of the powerline, the littoral zone is narrower and EWM habitat is limited. In 2022, EWM was documented in the Northeast Quadrant as scattered plants near the boat launch and northeast of the powerline. In 2023, despite hand-pulling control efforts, these populations persisted. In 2024, EWM increased northeast of the powerline and near the boat launch and spread to areas southwest of the powerline. Control in this area has included frequent hand-pulling and DASH.

The spread of EWM in this area is likely the result of the source population at the boat launch. EWM fragments from boat motors are likely drifting into this area and forming new populations.

Scout Camp

The Scout Camp is a shallow bay with a wide littoral zone and abundant submerged aquatic vegetation. In 2022, 47 EWM plants were documented in this bay. By June of 2023, the EWM infestation increased substantially to 142 plants. Despite control efforts, 179 EWM plants were documented in this area in August of that year. This area was targeted with intensive harvesting just prior to plant survey in 2024, resulting in only 26 plants documented in August of 2024. Regardless of DASH efforts - plants continue to thrive here.

The persistent population of EWM in this bay could act as a source population for further infestation into the Northeast and Southeast Quadrants. Control of EWM in this bay is therefore crucial to containing EWM on this side of the lake.

Public Swimming Beach

The Public Swimming Beach area consists of a wide littoral zone with extensive suitable habitat for aquatic plant growth. Near shore areas are shallow, but most of this site contains deeper waters ranging from 6-12 feet deep. EWM was first discovered in this area in 2022 and has persisted since that time. During the 2022 survey, scattered EWM plants were documented in the eastern end of this area. By 2023, EWM was found all throughout this area totaling 430 plants as well as a dense 280 square foot patch with too many plants to count. This area was the focus of intensive DASH and hand-pulling control efforts in 2024. The August survey documented 33 plants widely scattered over this large area. This indicates that, even with intensive DASH and hand-pulling, EWM in this area has not been eradicated.

The deeper waters in this area present a challenge for detecting and therefore controlling EWM. Depending on the season, light, and lake conditions, low visibility can prevent detection of EWM from the surface. This is especially true of isolated EWM plants or plants that do not grow tall enough to approach the water surface. Because of this, underwater surveys are sometimes needed to ensure that all EWM plants have been located so that they can be harvested. Given the large area with suitable habitat in the Public Swimming Beach Area, detection of all EWM plants is a logistical challenge.

The Public Swimming Beach area contains not only the beach, but a campground with heavy motorboat traffic. Heavy motorboat traffic can facilitate EWM spread to the rest of the lake. While small, dense patches of EWM can be demarcated with buoys to exclude motorboats, signage and buoys are often ignored. In addition, widespread scattered plants of EWM also pose a particular management problem in that they cannot be easily demarcated or avoided by motorboats.

Given the historic abundance of EWM in this area and the large amount of suitable habitat that is present here, continued spread of EWM in the Public Swimming Beach area is likely to occur. In addition, since this area sees heavy motorboat traffic, EWM populations in this area could act as source populations for the rest of the lake.

Low EWM Populations

Northeast Quadrant

The Northeast Quadrant consists of a fairly narrow littoral zone along the northern shore and a wider littoral zone along the southern shore. The southern shore therefore contains more habitat for aquatic plants, including EWM. So far only scattered EWM plants have been documented in the southwestern corner of this area. However, given the proximity to the Scout Camp EWM, spread into this area is likely to occur. It should be noted that LEA volunteers have consistently found plants in this area and have harvested them regularly throughout the summer and just prior to the formal survey.

Southeast Quadrant

This area consists of a fairly wide littoral zone and numerous shallow bays which provide habitat for native aquatic vegetation and EWM. In 2022 this area had little to no EWM plants. However, in 2023 and 2024 increasing amounts of plants were found and are beginning to spread throughout this Quadrant. Aggressive hand-pulling has occurred throughout this area since 2022.

Fishhook

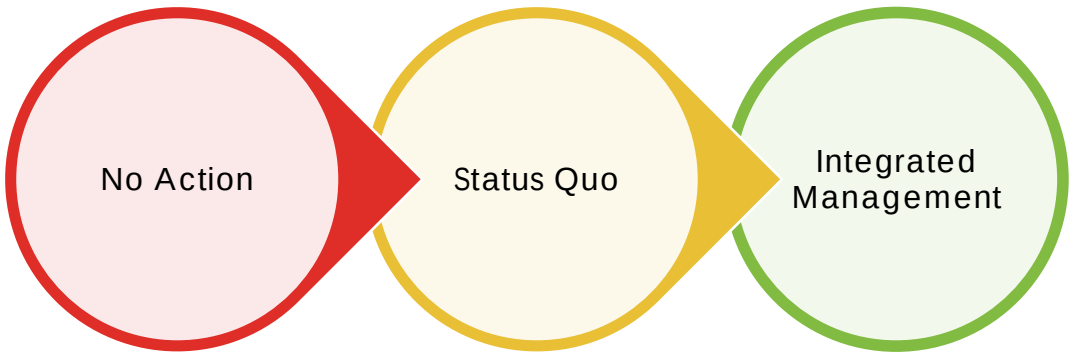
The Fishhook area consists of a small, shallow bay dominated by the Water Lily Aquatic Community. This area contains very good habitat for EWM. Only a single EWM plant was documented in this area in June of 2023 during the survey process. Prior to this survey, however, approximately 10 plants were harvested. Given the suitable habitat present in this area, the number of EWM plants is increasing each year.

Southwest Quadrant

The Southwest Quadrant is characterized by a very narrow littoral zone along the southern shoreline. The northern shoreline, however, includes a wide shallow bay and a wide littoral zone along the shore. The southern end of the lake in this area consists of a shallow bay. All of these areas provide suitable habitat for growth of aquatic vegetation, including EWM. This Quadrant has virtually no plants in 2022. By 2024 this Quadrant showed significant increase in plant numbers. Beginning in the cove there were large blooms of EWM that were hand harvested. Late summer showed new plants growing slightly west of the cove in 10 feet of water. Given the proximity to the Public Swimming Beach populations, it is likely that this area will become infested lacking more significant control. Floating fragments of EWM, presumably from the Swimming Beach, have been documented in the Southwest Quadrant on numerous occasions

EWM MANAGEMENT ALTERNATIVES

Three management alternatives have been explored and are explained below along with the likely outcomes of each approach and preferred management recommendations.



Alternative 1: No action

APPROACH: The first management alternative consists of a hands-off approach to the management of EWM in the lake. This approach would involve the retirement of the greeter program, the public outreach, the DASH control efforts and the bottom barriers. No actions to control the growth or spread of EWM would be undertaken.

LIKELY OUTCOME: Based on the ecology and life history of EWM, it is likely that this species would become even more dominant in the lake if this alternative were pursued. EWM would likely spread outward from the "hot spots" of the Boat Launch, Public Swimming Beach and Scout Camp. Spread can occur by natural fragmentation but would be accelerated in areas that receive motorboat traffic, such as the Boat Launch and Public Swimming Beach. EWM would become denser where it is currently only sparse, and it would spread to areas of the lake where it is currently not found. The shallow bays of the Southeast and Southwest Quadrants and Fishhook would become infested. It would likely occupy the narrow littoral zones around the rest of the lake.

EWM would likely become established within the swimming areas of the Public Beach and the Scout camp, hindering these recreational uses. Boating in areas where it forms dense infestations may also become problematic.

As EWM becomes more dominant throughout the lake, aquatic plant species diversity would likely decline. In addition to serious declines in recreational opportunities in the lake and a decrease in plant diversity, the approach of "no action" may preclude the possibility of ever controlling EWM in the future. Once populations become so well established, the chance of implementing significant control (as well as the prohibitive cost of attempting such control) is lost.

MANAGEMENT RECOMMENDATION: Based on the high costs of this alternative outlined above, the LEA does NOT recommend this approach.

Alternative 2: Status Quo

APPROACH: Continue with status quo of direct control using bottom barriers, hand harvesting and DASH and indirect control with public outreach and the greeter program. This approach does not include use of herbicide, though it may increase the amount of DASH control that needs to occur, based on EWM population levels.

LIKELY OUTCOME: The attempted control of EWM in Lake Eden using bottom barriers, hand-harvesting and DASH has been occurring since EWM was discovered in the lake in 2022. As the data in Section 3 shows, EWM has continued to spread despite these intensive control efforts. The likely outcome of continuing with this approach is that EWM would continue to spread throughout the lake. Continued control activities in the Public Swimming Beach may be able to keep the EWM from establishing dense populations. However, as outlined above, detection of EWM plants in this area is difficult and it is unlikely that complete control will ever be achieved in this area. Therefore, EWM fragments will continue to be spread by motorboat activity and EWM spread will continue to other parts of the lake. This is similarly true in the Boat Launch Area. EWM in the shallow areas of this bay cannot be controlled using the current means. EWM will therefore continue to spread from these areas into the rest of this bay and the rest of the lake.

The likely outcome of this alternative is that EWM will continue to spread in the lake. The areas where it is only sparsely abundant would likely become more densely infested. As more of the lake becomes infested, the number of dense populations will increase beyond the capacity of benthic barriers, hand-harvesting and DASH to control them.

MANAGEMENT RECOMMENDATION: Ramping up the DASH and barriers to try and match the increase in EWM populations is an alternative worth considering. However, there are two factors which make this approach problematic. First, the cost of these treatments exceeds the cost of other treatment options (such as herbicide). Second, evidence shows that the growth of EWM is outpacing the ability to control its spread with these methods. Despite active management of EWM since its discovery 2022, EWM continues to spread throughout the lake. Evidence shows that these control methods are not sufficient to slow the spread of EWM in the lake. For these reasons, LEA does NOT recommend this management approach.

Alternative 3: Integrated Management Approach

APPROACH: This option consists of incorporating limited use of ProcellaCOR EC along with bottom barriers, hand-harvesting and DASH for direct control, while continuing the greeter program and public outreach for indirect control. As outlined below, herbicide treatments will focus on the "hot spots' where EWM is well established. DASH will be used in areas where EWM is more sparse over larger areas. Bottom barriers will continue to be employed for locally dense infestations in high priority areas.

LIKELY OUTCOME: Compared to Alternatives 1 and 2, the likely outcome of this Alternative is greater control of EWM in the lake. It is not expected that EWM will be eradicated from Lake Eden with this alternative. However, it is expected that this strategy will reduce the need for annual use of herbicide in the future. This will prevent the significant decrease in recreational use of the lake and maintain the existing plant diversity of the native aquatic plant communities

MANAGEMENT RECOMMENDATION: EWM continues to be a problem in the Lake despite the intensive control activities undertaken by LEA since it was discovered in 2022. Therefore, there is no reason to believe that the management approach in Alternative 2 would be any more effective in the future. Indeed, as EWM becomes more widespread and abundant under that alternative, the current management regimen will become ineffective. Given the growth of EWM, a more intensive management approach is needed before EWM spreads even further. Alternative 3 is the only alternative that includes the possibility of controlling this aggressive invader in the Lake. For these reasons, LEA recommends undertaking this alternative.

EWM MANAGEMENT RECOMMENDATIONS

The proposed management plan uses herbicide treatment to target the dense and moderate EWM infestation areas in Year 1 comprising 25 acres. Hand-harvesting in Year 1 will focus on the scattered EWM plants that are not controlled by herbicide. In Years 2-5, herbicide will only be used if EWM infestations reach levels that cannot be controlled by other methods (see Thresholds for Action Section). DASH will be used in Years 2-5 to treat areas that have a moderate EWM density or smaller areas that harbor dense infestations as well as to install and remove benthic blankets. Hand-Harvesting in Years 2-5 will stay consistent with the approach used in Year 1, targeting scattered EWM infestations that are too small to justify DASH control. Justification for this approach is provided below.

TABLE 3. FIVE-YEAR MANAGEMENT RECOMMENDATIONS

	Year 1	Year 2	Year 3	Year 4	Year 5
Herbicide Treatment	Treat dense infestations up to 40% of the littoral zone	None	Follow up treatment on dense infestations only as necessary up to 25% of the littoral zone	None	Follow up treatment on dense infestations only as necessary up to 10% of the littoral zone
DASH	Crews to remove benthic barriers	Treat moderately infested or small, dense areas of EWM. 2025 10-year permit application will be submitted to extend past the 3 year rapid response permit.			
Hand Harvesting	Pull scattered EWM plants that are present outside of treated areas				
Bottom Barriers	None proposed if herbicide is applied	Apply to Boat Launch area or other small, dense infestations if necessary. 2025 10-year permit application will be submitted to extend past the 3 year rapid response permit.			
Greeter Program	Continue greeter program to prevent further EWM introduction				
Public Outreach	Continue public outreach				

TABLE 4. SHORT AND LONG TERM GOALS OF EWM MANAGEMENT METHODS

Control Activity	Targeted Application	Short Term Goals	Long Term Goals
Hand-harvesting	Areas with scattered EWM plants	Decrease abundance of EWM in scattered populations to prevent further spread	Decrease the need for this labor-intensive control method
DASH	Areas with dense EWM not being controlled by herbicide	Support control of EWM in areas not targeted by herbicide	Conduct maintenance-level mitigation on moderate-dense areas of EWM
Bottom barriers	Small areas with dense EWM or shallow areas where harvesting is not feasible	Support control of EWM in areas not targeted by herbicide	Reduce EWM levels enough that barriers are not necessary. Lacking sufficient EWM reduction, long term use in the Boat Launch area may be required, although as noted the plants closer to shore are not accessible to benthic blankets
ProcellaCOREC	Larger areas with extensive, dense EWM	Decrease overall abundance of EWM in lake by targeting extensive areas of dense infestation	Discontinue use of herbicide if EWM levels can be reduced enough to manage with other methods

ProcellaCOR EC Herbicide Treatment

As EWM abundance increases significantly each year, despite intensive efforts, the need for an additional control activity is warranted. The herbicide treatment plan is included in Appendix 1. The goal of the ProcellaCOR EC treatment is to reduce the EWM population to levels that are manageable without the further (or only sporadic) use of herbicide. For management in 2025, the targeted areas for treatment with ProcellaCOR EC are the larger infestations with high density of EWM. These proposed areas are shown in Figure 4.

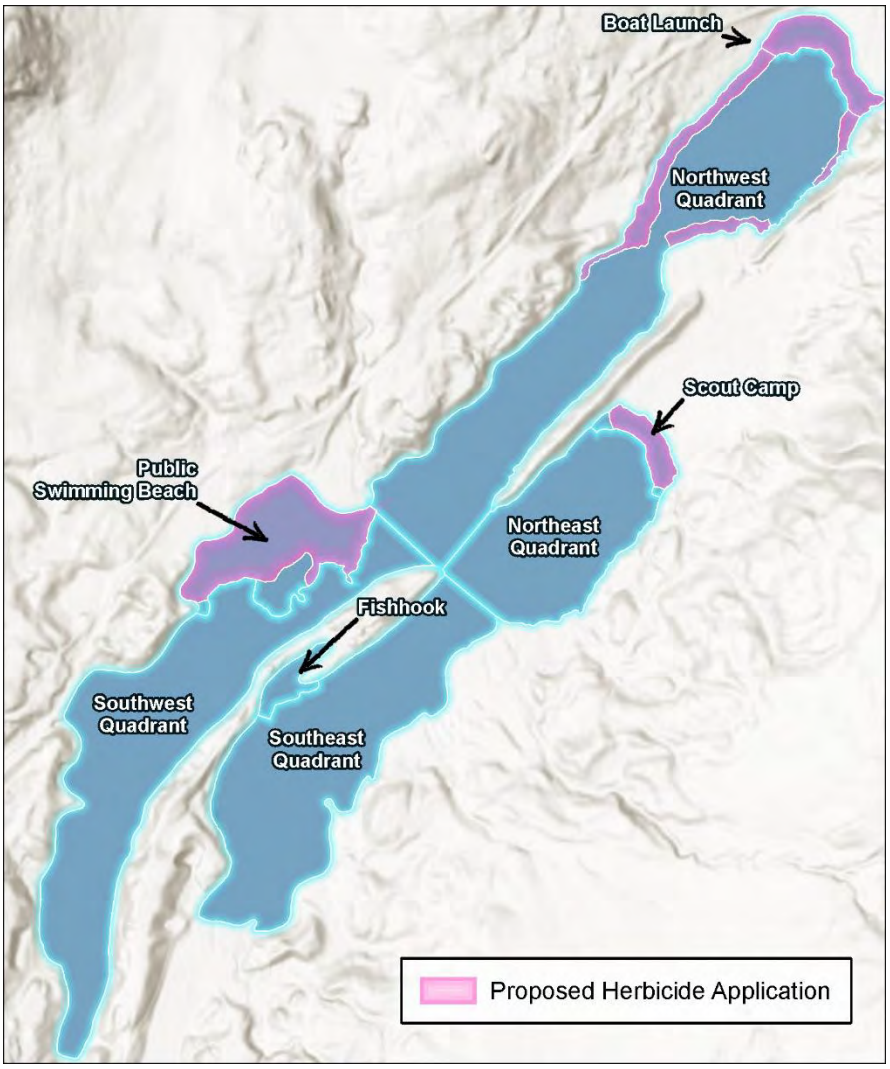


FIGURE 4. PROPOSED HERBICIDE TREATMENT AREAS

The short-term goal of this management method is to decrease the overall abundance of EWM in lake by targeting extensive areas of dense infestation. Long term, the goal is to discontinue use of herbicide if EWM levels can be reduced enough to manage with other methods.

There is a constraint on Herbicide, DASH, and Bottom Barrier treatments imposed by the State of Vermont to 40% of the littoral zone of any lake. The littoral zone in Lake Eden is 64-acres, allowing for 25.6-acres to be treated each year. The areas shown as proposed herbicide treatment areas in Figure 4 comprise 25.5 acres and are detailed in Table 5

TABLE 5. PROPOSED HERBICIDE TREATMENT AREAS

Name	Ac.	Comments
Public Swimming Beach	12.8	Wide littoral zone and abundant EWM
Northwest Quadrant	6.0	Narrow littoral zone, scattered and persistent EWM
Boat Launch	4.3	Shallow bay with dense EWM
Scout Camp	2.3	Bay with dense EWM

A pre-treatment plant survey is planned for spring and will help target the final treatment areas for 2025.

Further information about ProcellaCOR EC application and testing is presented in Appendix 1.

Pesticide minimization plan

The integrated control of EWM in Lake Eden as proposed in this plan includes the minimum use of herbicide necessary to reduce EWM to manageable levels. It is anticipated that the initial herbicide treatment will result in a significant reduction in EWM levels, which can then be managed using DASH, hand-harvesting and benthic barriers. In order to achieve this level of control, the Year 1 (2025) treatment plan requires treatment of 25.5 acres, or 40% of the littoral zone. It is anticipated that in Year 2, no follow-up herbicide treatment will be necessary. By Year 3, if there are isolated, dense EWM infestations that cannot be controlled by other means, follow-up herbicide treatment may be necessary. If this follow-up treatment is necessary, it is anticipated that only 25% or less of the littoral zone would be treated. It is anticipated that Year 4 will not require any herbicide treatment and that EWM can be controlled by other methods. If dense EWM infestations are present in Year 5, it is anticipated that these will be much less widespread and could be controlled by herbicide treatment of 10% or less of the littoral zone. It is hoped that herbicide treatments in Year 3 and Year 5 will not be necessary at all. These treatments will only occur if EWM abundance reaches levels that cannot be controlled by other methods. This 5-year schedule shows a substantial decrease in herbicide use over time.

Hand-Harvesting

Hand-harvesting will focus on scattered EWM plants that are growing outside of the proposed herbicide treatment areas. Scattered EWM plants have been documented along the shores of all four Quadrants as shown on the map in Appendix 2. These plants must be controlled either by hand harvesting or a DASH crew to prevent them from establishing dense populations. The short- and long-term goals for this management technique are to control EWM in these scattered populations.

Diver Assisted Suction Harvesting (DASH)

Diver Assisted Suction Harvesting (DASH) was performed on the Lake in 2022, 2023 and 2024. In the past, DASH control efforts focused on the most densely infested areas. In 2025, these areas will be the focus of the herbicide treatment, freeing up the DASH control on areas that are moderately dense and/or scattered populations if needed. This may include scattered populations in the four Quadrants that have not been controlled by herbicide or, in the long term, that may have developed after herbicide treatment. DASH divers will be utilized for benthic blanket removal as well.

The short-term goals of this management method are to support control of EWM in areas not targeted by herbicide by controlling moderately dense and/or scattered EWM infestations. Long term, it is hoped that EWM will be controlled to the degree that DASH is needed only for

maintenance-level eradication on EWM infestations.

Bottom Barriers

Bottom barriers will be used to target localized areas of dense EWM that are small in size or used in areas that are too shallow for hand-harvesting and DASH treatment.

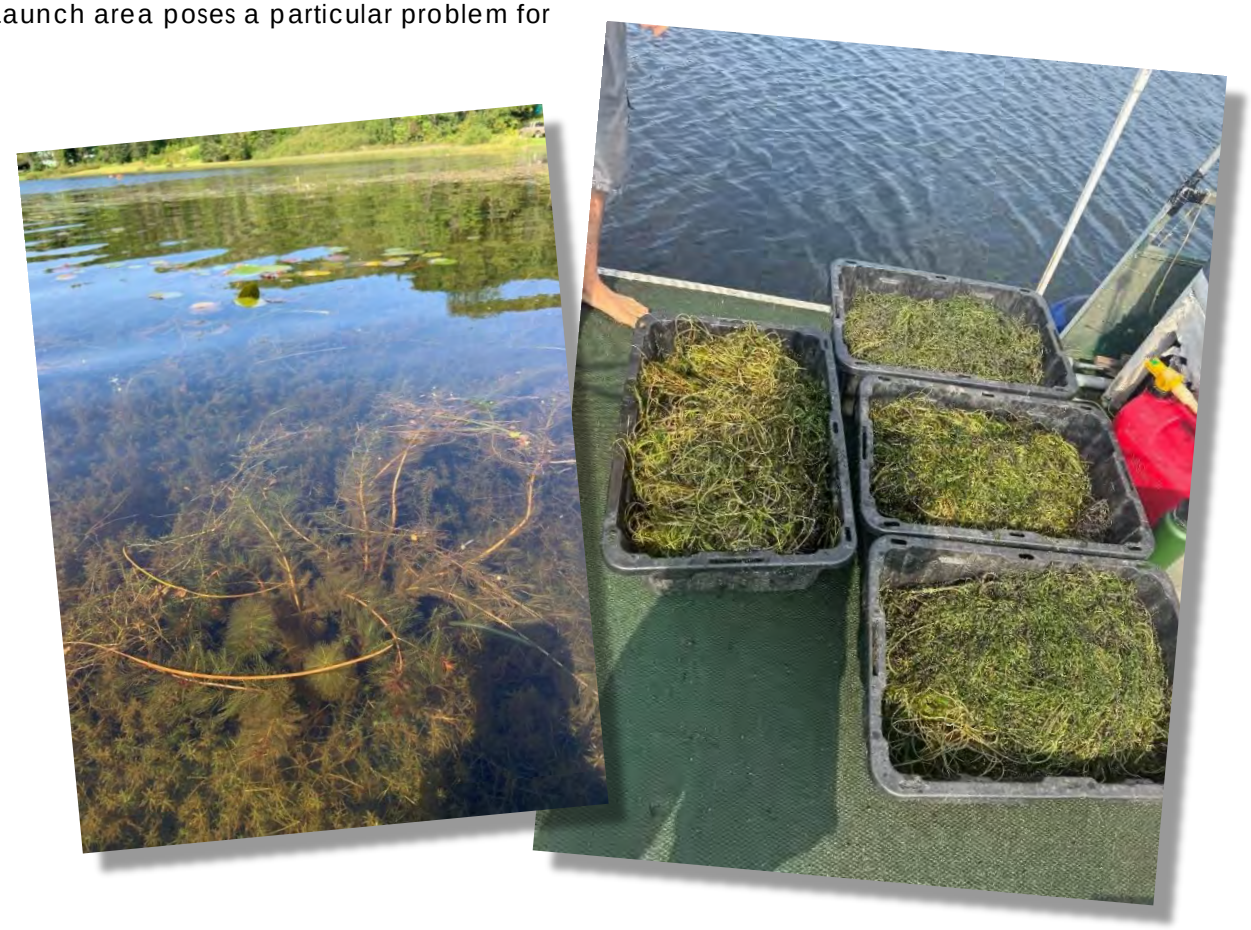
The short-term goals of this management method are to efficiently control small areas of dense EWM that are not targeted by other management methods. Long-term, it is hoped that EWM will be controlled to the degree that bottom barriers are not needed or needed only rarely. However, the Boat Launch area poses a particular problem for EWM management in that it is too shallow to control using hand-harvesting, blankets or DASH. Lacking sufficient EWM reduction from herbicide, long term use in the Boat Launch area may be required.

Greeter Program

As outlined above, LEA has undertaken a consistent Greeter Program in the past. This program will continue to be operational for the five-year management plan window with the goal of preventing further introduction of EWM or other invasive species as well as preventing the spread of EWM into other Vermont water bodies.

Public Outreach

An extensive public outreach effort has been ongoing as outlined above. LEA will continue these efforts and expand the range of content provided. Community engagement in the EWM management approach and outcomes of the management activities will be an integral part of the public outreach.



THRESHOLDS FOR FOLLOW-UP HERBICIDE APPLICATION

At least eight other public lakes in Vermont have been treated with ProcellaCOR EC since it was registered in 2019. It has replaced Sonar (active ingredient Fluridone) and Renovate (active ingredient Triclopyr) as the herbicide of choice for EWM control in Vermont for several reasons. ProcellaCOR EC has a significantly shorter concentration-exposure-time (CET) requirement than triclopyr, which makes it effective for theshoreline spot-treatments. ProcellaCOR is also applied targeting in-water concentrations of less than 10 parts per billion, as opposed to the 1.5-2.0 parts per million (1500-2000 ppb) rates that are needed for triclopyr. Thus, less herbicide needs to be applied and restrictions on using lake water for irrigation and domestic purposes are shortened to a few days. Additionally, ProcellaCOR EC has proven to be extremely selective for EWM control and generally provide nuisance level control in treated areas for a 2-3 year period.

Considering that the EWM infestation in Lake Eden is fairly recent, it is hoped that long-term control will be achieved following ProcellaCOR EC treatments and that non-chemical control strategies will be able to be employed to manage EWM regrowth. Three factors will be considered when determining if follow up ProcellaCOR EC treatments are warranted: 1) density and extent of localized EWM infestation; 2) configuration and location of the localized EWM infestation, and 3) overall level of EWM in the lake. The density and extent of the localized EWM infestation will be the primary factor considering follow up herbicide treatment. In general, follow up treatment will be considered if areas infested with EWM >50% comprise >0.5 acres or areas infested with >75% comprise >0.25 acres. The second factor is the location and configuration of the EWM infestation. Areas that limit the influence of dilution with untreated water (i.e. coves or round or square blocks as opposed to long narrow strips) will have a better likelihood of successful treatment. In addition, shallow waters in the Boat Launch area, currently infested with EWM, preclude treatment by hand-harvesting or DASH. Infestations in this area are most effectively treated with herbicide. The final yet important consideration is that the other control methods (DASH, hand-harvesting, bottom barriers) are limited in the total acreage/amount of EWM that they can address in a given year. For example, if overall infestation levels in the lake are beyond the capacity of the non-chemical methods, chemical methods may be necessary. While follow-up herbicide treatment is not preferred, it may be required if successful long-term control and containment of EWM is to be achieved

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EWM MONITORING SCHEDULE

The purpose of the monitoring is to determine the efficacy of the control activities and to provide data that can guide future control activities. In order to meet this goal, a regular schedule of monitoring has been proposed that can act as a feedback loop for management activities. For this reason, the planned control activities outlined in this management plan are subject to change based on the results of monitoring. This adaptive management strategy is the best way to ensure that appropriate control methods are being implemented in the most efficient manner possible.

TABLE 6. 2025 EWM MANAGEMENT TIMELINE

Task	2025											
	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Submit DEC Permit	■											
Pre-Treatment EWM Survey					■							
Submit Finalized Treatment Plan to DEC					■	■						
Conduct Herbicide Treatment						■	■					
Conduct Hand-Harvesting for Scattered EWM						■	■	■	■			
Conduct DASH Treatment												
Conduct Post-Treatment Monitoring									■	■		
Report on EWM to DEC											■	■

EWM monitoring will consist of both volunteer-based visual inspection and professional aquatic vegetation surveys. The aquatic vegetation survey will consist of grid point sampling and visual littoral surveys. The grid point sampling will be employed in order to compare aquatic plant diversity and abundance with previous inventories. The visual littoral surveys will be used to more directly map the distribution and abundance of EWM. During these inventories, special attention will be paid to the treatment areas to assess the efficacy of the treatment.

RARE/SENSITIVE SPECIES

The Vermont Natural Heritage Inventory (NHI) maintains a list of species that are rare, threatened and endangered in the state. Determination of how rare or common a particular species is in the state is based on rarity rankings (Table 7) assigned to each species by Vermont NHI. In addition, some species have been designated as Threatened or Endangered and fall under the regulations for species protection under Vermont law.

The Vermont NHI has records of multiple uncommon and rare species documented in Lake Eden over the past 40 years. In addition, recent inventories of aquatic species in the lake have discovered other rare species. All of the known species uncommon and rare species (S1-S3-ranked) in the lake are listed in Table 7.

TABLE 7. PLANT RARITY RANKING

S-Rank	Description
S1	Very Rare
S2	Rare
S3	Uncommon
S4	Common
S5	Common and widespread

TABLE 8. UNCOMMON AND RARE SPECIES KNOWN FROM LAKE EDEN

Latin Name	Common Name	State Rank	Comments
Isoetes lacustris	Lake quillwort	S1	Documented in 1987 but not seen in the lake since that time
Potamogeton vaseyii	Vasey's pondweed	S2	Abundant in the lake in 2022, but absent in 2023 and 2024
Ranunculus aquatilis var.diffusus	White water crowfoot	S3	Documented in 1987 but not seen in the lake since that time
Elodea nuttalii	Nutall's waterweed	S3	Documented in 2012, but not seen in the lake since that time

None of the species known from Lake Eden are listed as threatened or endangered in Vermont. None of the species listed in Table 8 are currently known to exist in the lake. It is not unusual for aquatic plant species to exhibit population fluctuations. Vasey's pondweed, for example, was abundant throughout the lake during the 2022 aquatic plant inventory but has been absent since that time.

Different EWM control activities differ in their potential impacts to non-target species. . None of the species listed in Table 8 are known to be susceptible to ProcellaCOR at the dosages typically used in Vermont waters (Heilman 2019; Beets, Heilman, and Netherland, 2019.; Richardson, Haug, and Netherland 2016; Mudge et al. 2021). Given this, it is not expected that herbicide treatment will have an impact on any rare

or uncommon species in the lake. During hand-harvesting and DASH control, EWM is specifically targeted for removal. No impacts on these species are therefore expected during these control activities. Benthic barriers, however, have the effect of completely smothering all aquatic vegetation along with the targeted EWM. If uncommon or rare species are present in these areas, those individuals would likely be killed.

As mentioned above, none of these species are known to have existing populations in the lake. For this reason, no impacts to these species are expected from the 2025 control activities. Yearly monitoring of EWM and inventories of aquatic plant species are proposed as part of this management plan. If any of these rare or uncommon plants are documented during these inventories, management activities will be adapted to avoid or minimize impacts to these species.

In addition to these rare species, water lily plants (*Nymphaea spp.*) are known to be sensitive to the ProcellaCOR herbicide. Water lily plants are known from the Boat Launch area and the Fishhook area in Lake Eden. In these areas, water lilies have a fairly sparse distribution, with percent cover values in the 5-25% range. Typical impacts to water lily plants from exposure to ProcellaCOR herbicide consist of partial leaf necrosis (yellowing or browning of leaf tissue), leaf epinasty (twisting of the leaves and stems) and/or loss of foliage. Plants typically outgrow these effects with full recovery seen a year after herbicide treatment. No herbicide treatment is recommended in the Fishhook area. Herbicide application in the Boat Launch area may result in impacts to water lily plants. Given the sparse distribution of water lily and the temporary impacts from the herbicide, it is not expected that herbicide treatment would negatively impact the water lily population long term.

Finally, wetlands in the vicinity of Lake Eden are shown in Figure 5. Wetlands are located along the shores of Lake Eden in the Boat Launch, Scout Camp, and two areas in the Northwest Quadrant.

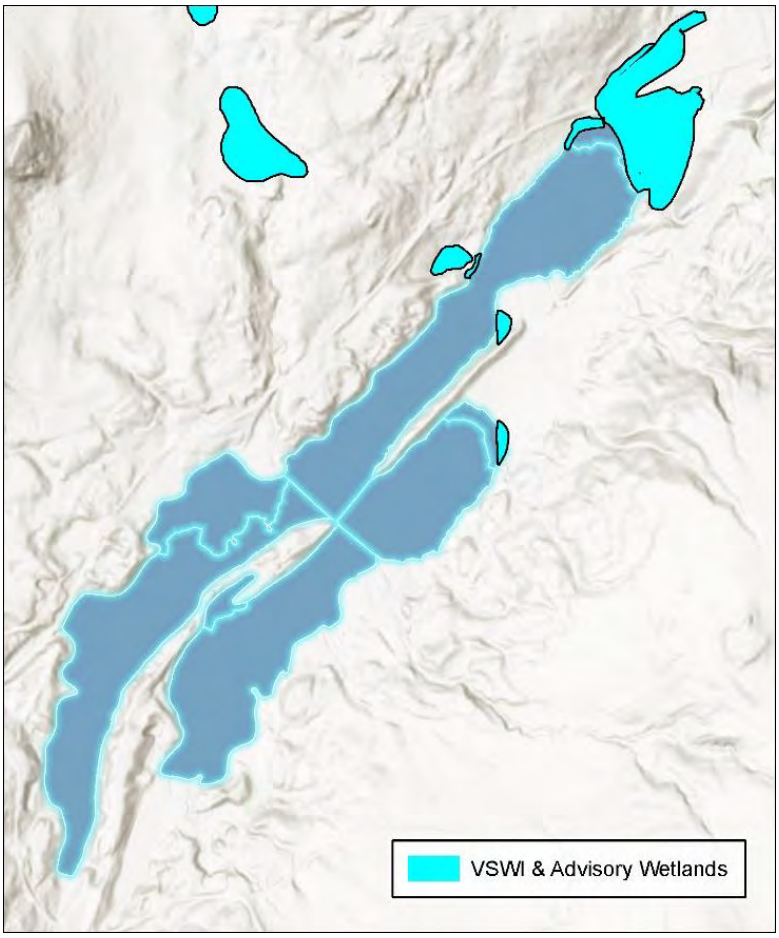

FIGURE 5. MAPPED WETLANDS IN THE LAKE EDEN VICINITY

BUDGET

The following budget assumes 2 annual plant surveys for monitoring impact of treatment and focus areas. DASH costs will continue in untreated areas of lake each year. Bottom barrier costs consist predominantly of replacing damaged blankets. Greeter program assumes a 5% annual increase (COL or expansion). The current hand harvest team today is predominantly volunteer lake association members but due to "burn out" a budget for paid hand harvesters to assist has been included.

TABLE 9 MANAGEMENT BUDGET

Control Activity	2025	2026	2027	2028	2029
Herbicide Treatment	$35,000		$26,000		$40,000
DASH	$2,800	$9,000	$9,000	$9,000	$9,000
Hand Harvesting	$200	$1,000	$2,000	$2,000	$2,000
Bottom Barriers		$500		$500	
Pre-Treatment Monitoring	$3,500	$3,600	$3,700	$3,800	$4,000
Post Treatment Monitoring	$3,500	$3,600	$3,700	$3,800	$4,000
Greeter Program	$22,000	$22,700	$24,000	$24,720	$25,500
Permitting	$6,000		$500		$500
Notifications (letters, mailings etc)	$500		$500		$500
LEA Expenses	$1,000	$1,000	$1,000	$1,000	$1,000
TOTAL	$74,500	$41,400	$70,400	$44,6200	$86,500

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APPENDICES

Appendix 1

Herbicide Treatment Plan

Appendix 2

Maps of Eurasian Water Milfoil in Lake Eden 2022-2024

Appendix 3

Lake Eden EWM and Aquatic Vegetation Reports 2022-2024

PROCELLACOR™ EC HERBICIDE TREATMENT PLAN

After receiving its full aquatic registration from the EPA in February 2018, ProcellaCOR™ EC has been used in numerous locations throughout the country for control of milfoil species and other susceptible, invasive aquatic plants. Since 2018 in New England alone, SŌLitude has applied ProcellaCOR™ EC at dozens of locations in all six New England states the control of variable milfoil (*Myriophyllum heterophyllum*) and Eurasian watermilfoil (*Myriopyllum spicatum*). In Vermont, ProcellaCOR™ EC has replaced Sonar (fluridone) or Renovate (triclopyr) for EWM control and has been the only herbicide permitted and applied over the past several years due to its efficacy, selectivity, rapid half-life and favorable toxicology profile. Results of all ProcellaCOR™ EC treatments performed in Vermont to date have been positive, achieving nearly complete control (>95% biomass reduction) of targeted EWM growth during the year of treatment, with little or no impact to non-target native plants. Documentation on the selectivity of ProcellaCOR™ EC at Vermont projects has been provided to VT DEC annually, and it has proven to be even more selective for EWM control in Vermont lakes than fluridone or triclopyr.

Recently issued ProcellaCOR™ EC herbicide permits issued by Vermont DEC for other waterbodies are conditioned such that a maximum of 40% of the littoral zone can be managed in any one calendar year. This management includes the use of DASH, bottom barriers and/or herbicide, but excludes hand-pulling as that can be done at any time without a permit. We understand that the Lake Eden Association (LEA) is proposing 25.5 treatment acres for the 2025 season.

The 40% management limitation to the littoral zone of a given waterbody is the protective measure that DEC has provided in order to minimize any significant impacts to the waterbody as a resource to all of its users. Additionally, the 40% threshold allows for wildlife habitat to remain protected. For example, EWM is not an ideal fish habitat, but if few native aquatic plant species are present within the respective waterbody, then EWM is likely providing habitat. As such, the intention is not to impact the entire habitat in order to maintain an appropriate balance within the system; a compromise. Based on ProcellaCOR™ EC's reduced risk profile issued by the US EPA and its overall brief presence within the water (24-48 hours maximum; reported photolytic half-life is 0.07 days or 1.68 hours), there are no cumulative adverse impacts anticipated to affect the lake as a resource for its users.

Excellent selectivity and minimal impact to non-target species has been demonstrated with ProcellaCOR™ EC treatments that have been performed in Vermont and the Northeast to date. Of the other species reported in Lake Eden, the only plant that is expected to show impact following treatment white waterlily (*Nymphaea odorata*). Waterlilies typically show discoloration epinasty (leaf and stem twisting) and loss of foliage, depending on their proximity to the treatment area(s), before outgrowing the symptoms and recovering as a population. Full recovery is usually seen by the end of the second growing season. In order to limit impact to waterlilies, we would recommend application rates of 3 Prescription Dose Units (PDUs) and potentially avoiding treatment where waterlilies are growing altogether if practical.

Use of this herbicide is intended to supplement LEA's current integrated, long range pest management program outlined in theEWM Management Recommendations section. Herbicide treatment will be used to target areas of the most abundant EWM growth, while the non-chemical techniques will be utilized on smaller and more widely scattered patches in subsequent years. The

program objective will be to initially reduce the distribution and density of EWM and subsequently minimize herbicide use.

The treatment program being proposed at Lake Eden in 2025 involves the treatment of approximately 25.5 acres of EWM growth or 40% of the littoral zone. EWM growth in these areas is now too abundant to be cost-effectively managed using suction harvesting, bottom barriers or hand-pulling.

ProcellaCOR™ EC herbicide is used as a one-time application during each year when it is to be used; however, which control method (DASH, bottom barriers, ProcellaCOR™ EC, etc.) is the most appropriate for use will be determined annually based on EWM densities and distributions. It is anticipated that treatment areas would experience multiple years of control following one treatment effort. However, it is understood that any fragments entering the treated area(s) from unmanaged areas elsewhere in the lake may allow for the population to be reestablished within that area. Thus, diligent control and spread prevention measures, as LEA has already undertaken and will continue, must be taken by all lake users in order to mitigate future spread potential at Lake Eden as well as other waterbodies nearby.

The treatment program is expected to follow the following timeline and protocol:

Date	Task
May	● Early season survey to develop final treatment map. ● Submission of map and specific treatment plans to DEC for review and approval. ● Perform required pre-treatment notifications.
June	● Schedule and conduct ProcellaCOR™ EC herbicide treatment
July – September	● Surveys / inspections and sampling
November	● Submission of annual report identifying preliminary plans for upcoming year
December / January	● Project review and meeting with DEC, as necessary

Based on the recent treatment experiences with ProcellaCOR™ EC herbicide at other New England lakes and from SePRO Corporation manufacturer input, the following protocols are recommended for the proposed ProcellaCOR™ EC treatment at Lake Eden in 2025 and future years, if needed:

1. Formulation – ProcellaCOR™ EC aquatic herbicide, liquid formulation.

2. Application – A solution of ProcellaCOR™ EC diluted with lake water would be prepared in a mixing tank onboard the treatment boat and the solution will be evenly injected throughout the designated treatment areas using trailing drop hoses and a calibrated pumping system. This is a sub-surface injection.

3. Timing – Treatment would be scheduled for anytime between early June and mid-late August (temperature dependent), when there is sufficient EWM growth to maximize herbicide uptake.

4. Rate – The recommended application rate (dose) is based on the percentage of the waterbody being treated and the susceptibility of the target plant. EWM has proven to be especially susceptible to ProcellaCOR™ EC allowing for low application rates to be used. The EPA label allows for application of 25 Prescription Dose Units (PDUs) per acre-foot of water being treated. Based on the high susceptibility of EWM, the recommended application rate for Lake Eden in 2025 is 3 PDUs per acre-foot. The 3 PDU application rate is only 12% of the maximum allowable application rate listed on the product label. Should smaller-scale maintenance treatments be required in subsequent years, the application rates may increase to 4-5 PDU's to overcome the effects of dilution, but rates higher than 5 PDU per acre foot will not be proposed to ensure selectivity. In addition, treatment rates will be limited to maximum of 3 PDU's around populations of waterlilies or other susceptible native plants.

Herbicide	**ProcellaCOR™ EC** Liquid formulation EPA Reg. No.: 67690-80 Active Ingredient: florpyrauxifen-benzyl 2.7% 1 PDU is equal to 3.2 fl. oz.
Application Rate	3 PDU's per acre-foot is proposed for the 2025 treatment program 3-5 PDU's per acre-foot may be applied in subsequent years
Treatment Area	Up to approximately 25.5 acres in 2025
Total product to be Applied	If electing to treat all 25.5 acres or 40% of the littoral zone at a rate of 3 PDUs per acre-foot, total product applied will be approximately 390 PDUs. **Actual quantity to be applied will be determined after the May 2025 pre-treatment inspection.*
Target Concentration	1 PDU of ProcellaCOR™ EC (3.2 fl. oz) achieves 1.93 ppb/acre foot The proposed application rate of 3 PDU/ac-ft will result in concentrations of 5.79 ppb within the treated areas.
Treatment Timing	Between early June and late August 2025.

	Delay treatment until there is sufficient active EWM growth to maximize herbicide uptake. The preferred treatment window is expected to fall between early-mid June.
Method of Application	The liquid formulation will be diluted with lake water and evenly applied throughout the designated treatment areas using a calibrated pumping system and trailing drop hoses. GPS systems on the treatment boat will be used to provide real-time navigation and to ensure that the herbicide is evenly applied throughout the designated treatment areas.

IMPACTS TO NATIVE PLANT COMMUNITY AND WILDLIFE

Significant adverse impacts to the native plant community are not expected from the proposed ProcellaCOR™ EC herbicide treatment at Lake Eden. Data gathered by SePRO Corporation during the product registration process and actual results documented since the 2018 treatment season has shown that EWM is highly susceptible to low rates of ProcellaCOR™ EC. Few, if any, adverse impacts are expected on most non-target native plants at the rate anticipated for use at Lake Eden.

At treatments performed by SŌLitude since 2018, the only temporary impacts observed on native plant species that are reported to be in Lake Eden, is on white waterlily (*Nymphaea odorata*). Impacted waterlily plants usually grew out of the symptoms after a period of several weeks, with full recovery seen by the end of the second growing season. There are additional species listed on the ProcellaCOR™ EC label which may be susceptible to treatment, however they are not known to be present within Lake Eden. Further, all potentially susceptible species have susceptibilities dependent upon their proximity to the treatment areas and the dose being applied (e.g. if a patch of waterlilies is not located close to any treatment area, it would be anticipated that the waterlilies would be unimpacted).

No impact to State protected or rare plant species is anticipated following treatment with ProcellaCOR™ EC herbicide at Lake Eden, since no protected species were documented during the 2024 survey.

Following a ProcellaCOR EC application, the EWM plants within the treatment areas would be anticipated to follow a similar decomposition timeline as follows:

- Within a week of treatment – EWM plants are anticipated to be leaning over within the water column
- Within two weeks of treatment – EWM plants are anticipated to be leaning and more fallen over within the water column, beginning to become discolored, and if touched, the plants would be anticipated to easily break apart. However, fragments of these plants are no longer viable.
- Within three weeks of treatment – EWM plants are anticipated to be completely fallen within the water column and be difficult to find even along the bottom sediment.

As a result of the timeframe of decomposition, and minimal amount of area to be managed utilizing ProcellaCOR™ EC relative to the overall waterbody acreage, there is no additional

concern for an increase of available nutrients to stimulate an algal bloom beyond what may be present in any one given year at a waterbody of Lake Eden's nature.

The permit application is anticipated to be conditioned to limit EWM management (all herbicide use, diver-assisted suction harvesting, and benthic barrier use) to 40% of the littoral zone. The 40% threshold was established by DEC to maintain and protect existing fish and wildlife habitat, as a result, the habitat will not be changed significantly enough to be permanently changed. Overall, EWM is not a beneficial habitat for fish for a variety of reasons.

Based on the ecotoxicological testing completed for ProcellaCOR™ EC, there was no toxicity observed for avian, fish, or other species exposed to the product during both short and long-term studies. It should be noted that these testing efforts included higher concentrations than even those available at the maximum label rate.

WATER USE RESTRICTIONS AND NOTIFICATIONS

Water Use Restrictions – The only water use restrictions listed on the current ProcellaCOR™ EC label are all centered around the use of ProcellaCOR™ EC treated water for irrigation purposes. There are no restrictions on using ProcellaCOR™ EC treated water for drinking water, swimming or fishing.

However, it is anticipated that Vermont DEC will condition the permit similarly to others issued for ProcellaCOR™ EC in recent years; on the day of treatment and out of an abundance of caution, no use of the treated waterbody and associated outlet stream up to one mile downstream is recommended for any purpose, including swimming, boating, fishing, irrigation, and all domestic uses. Additional advisories and recommendations related to irrigation and the use of treated waters are to follow what is listed on the ProcellaCOR™ EC label.

Irrigation restrictions vary depending on what is being irrigated. Turf may be irrigated immediately after treatment without restriction. Irrigation of landscape vegetation and other non-agricultural plants can occur once ProcellaCOR™ EC concentrations are determined to be less than 2 ppb or by following a waiting period that is 7 days for the use rates being proposed.

Based on sample results of prior ProcellaCOR™ EC applications in Vermont, it is not anticipated that this product will travel downstream through the outlet given the increased dilution at its headwaters, plus any absorption by EWM assuming it were to travel outside of the bounds of Lake Eden.

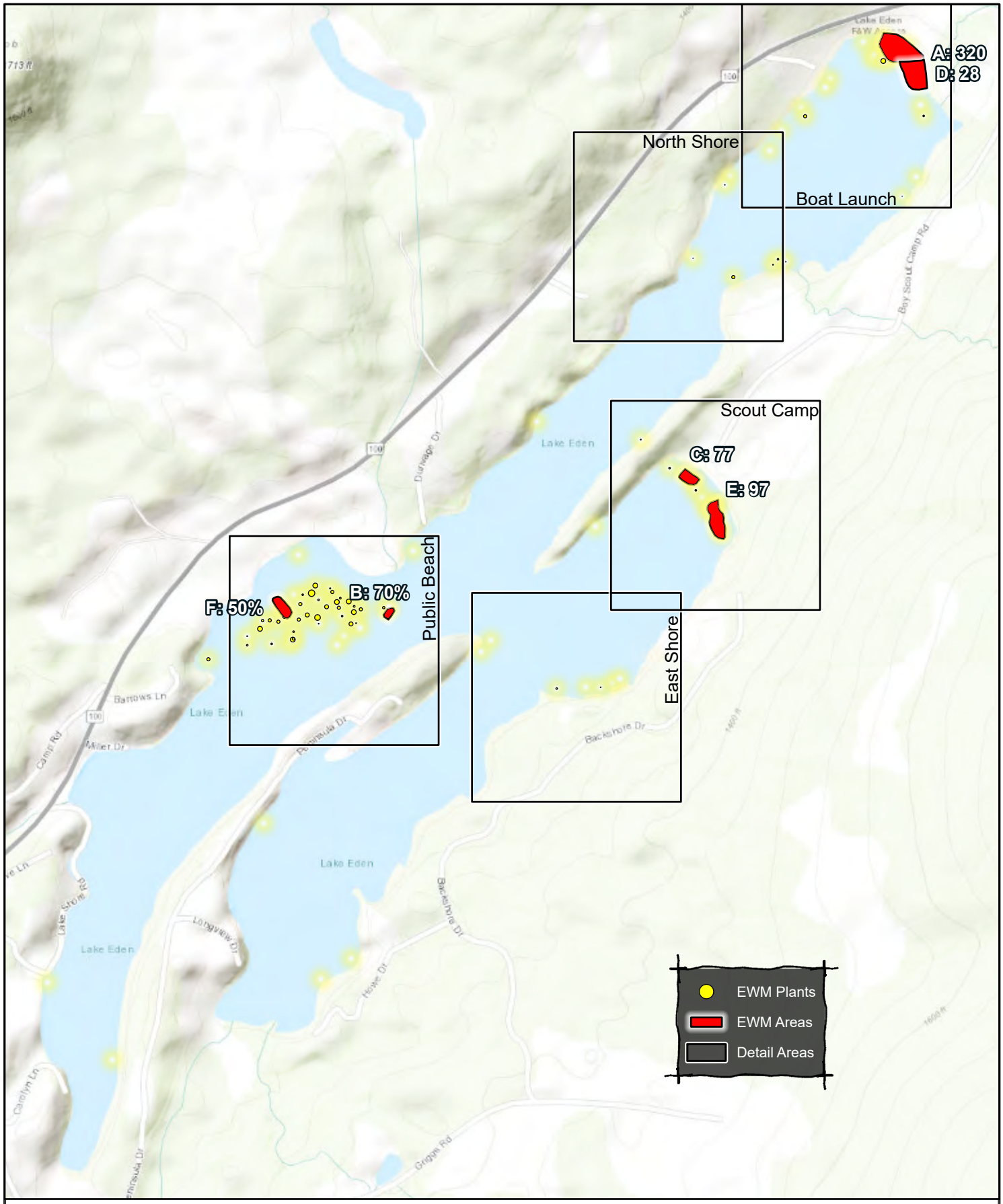
Based on prior ProcellaCOR™ EC application review in Vermont, the Vermont Department of Health had issued a favorable drinking water review for this product, which states application according to the label would pose a negligible risk to public health. It is anticipated the agency's review for Lake Eden would be similar.

Written Notification – In accordance with the Vermont DEC permit conditions, all direct waterfront abutters of the treated waterbody and up to one mile downstream will be notified in writing by USPS mail. This will include notification of permit application submission and prior to any herbicide treatment, which will occur two weeks in advance of the date of treatment.

Posting – In accordance with VT DEC permit requirements, the adjacent shorelines and access points to the lake will be posted with signage warning of the pending herbicide application and water use recommendations to be imposed. The signs will include language specified by VT DEC for this purpose. The signage will be the source of information for the specific treatment areas and water use restrictions and will include the website(s) where additional treatment information can be accessed.

SURVEYS AND MONITORING

Consistent with other Five-Year Integrated Management Plans for Vermont waterbodies and existing efforts undertaken by the LEA, the organization proposes to continue the comprehensive late season aquatic plant survey as conditioned in the permit. By conducting annual survey efforts, changes in EWM and native aquatic plant species distributions and densities can be tracked effectively to align management efforts for the following season. In addition, an interim, one month post-treatment survey will be conducted to assess ProcellaCOR™ EC efficacy.



Lake Eden: Eurasian Watermilfoil August 2023

Thursday, August 31, 2023 File: LakeEden:8.5x11 Report 2023-1

Prepared By: A Worthley *NAD 1983 StatePlane Vermont FIPS 4400*

0 105210 420 630 840 Feet

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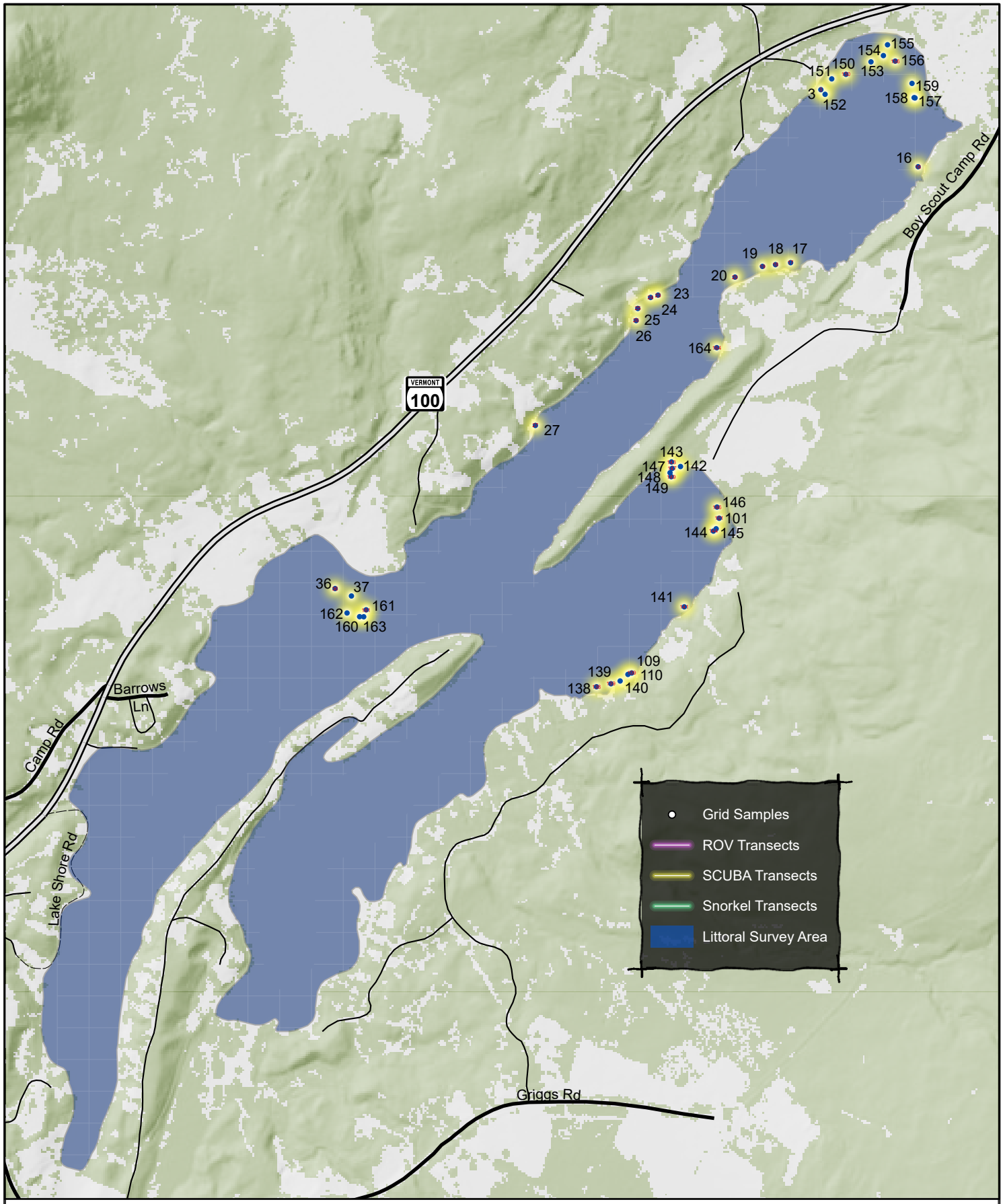

Lake Eden: Eurasian Watermilfoil 2022

Monday, August 29, 2022 File: LakeEden:8.5x11 Report

Prepared By: A Worthley *NAD 1983 StatePlane Vermont FIPS 4400*

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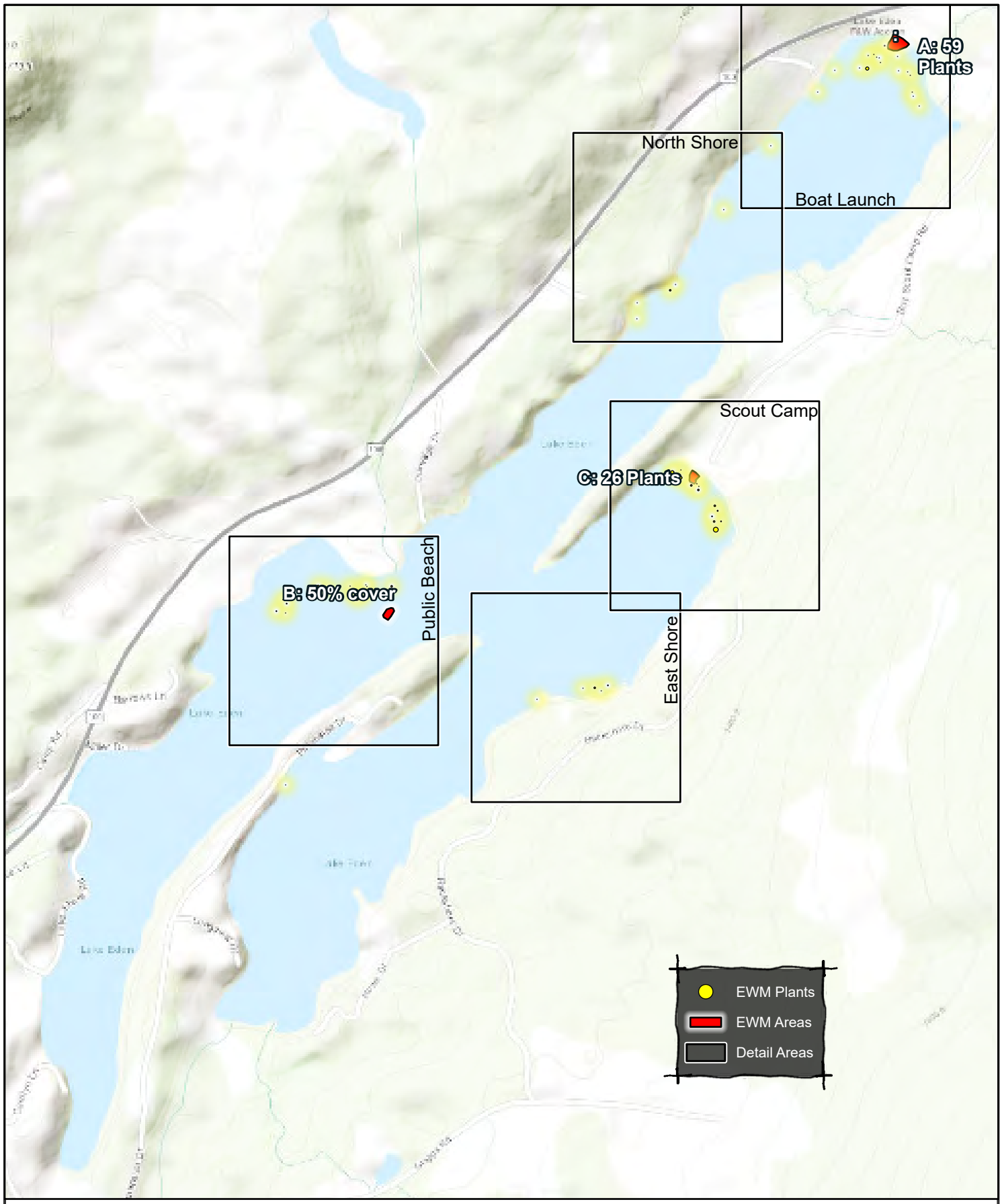

Lake Eden: Eurasian Watermilfoil 2023

Monday, June 19, 2023 File: LakeEden:8.5x11 Report 2023-1

Prepared By: A Worthley *NAD 1983 StatePlane Vermont FIPS 4400*

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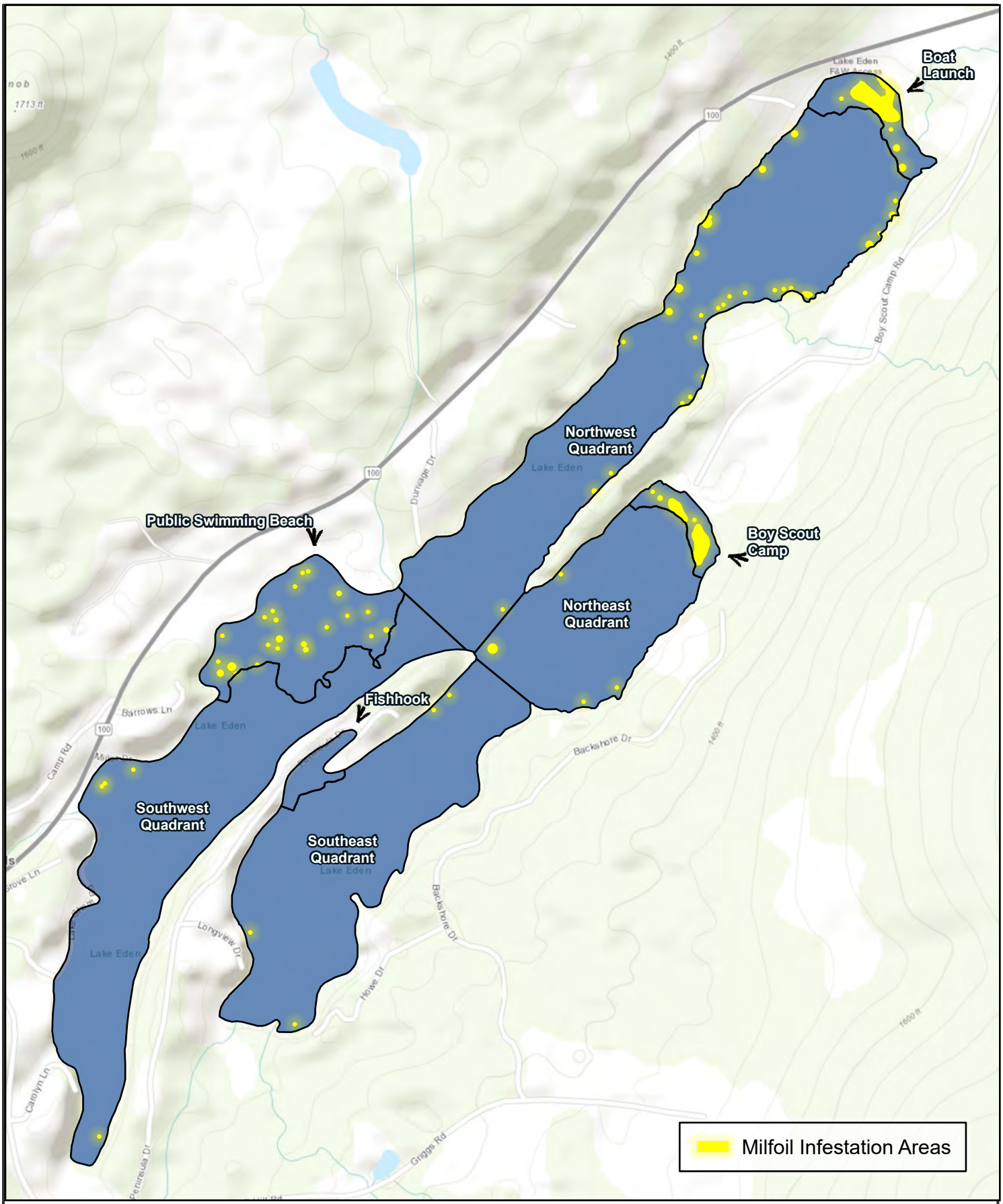

Lake Eden Eurasian Watermilfoil 2024

Thursday, January 09, 2025 File: LakeEden:Report Appendix 2024

Prepared By: A Worthley *NAD 1983 StatePlane Vermont FIPS 4400*

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Lake Eden
Eurasian Water Milfoil Inventory

August 30, 2022

Lake Champlain Basin Program

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This project has been funded by an agreement awarded by the Great Lakes Fishery Commission (GLFC) to NEIWPCC in partnership with the Lake Champlain Basin Program (LCBP). The contents of this document do not necessarily reflect the views and policies of NEIWPCC, LCBP, or GLFC, nor does NEIWPCC, LCBP, or GLFC endorse trade names or recommend the use of commercial products mentioned in this document.

1. Introduction

In July of 2022, Vermont Department of Environmental Conservation (VTDEC) was made aware of the presence of Eurasian water milfoil (EWM) in Lake Eden, Vermont. Arrowwood Environmental (AE) was retained by the Lake Champlain Basin Program (LCBP) to conduct an inventory of EWM in the Lake to aid in the control efforts being undertaken by VTDEC. This brief report summarizes the methods and findings of that inventory.

2. Methods

The study area for the inventory consisted of the entire waterbody of Lake Eden with the exception of the areas that VTDEC had previously demarcated as containing EWM. The shoreline boundary was derived from the Vermont Hydrography Dataset (VHD).

Three different methods were used to inventory for the presence of invasive species: 1) Visual Littoral Surveys; 2) Grid Point Sampling, and; 3) Underwater Transects. The methodology used for each of these survey types is outlined below.

a. Visual Littoral Survey

The entire perimeter of the lake was circumnavigated in a motor boat and the littoral zone was visually surveyed for the presence EWM. Water visibility allowed for the survey of areas 8 feet deep and less with this method. The map in Appendix 2 shows the areas that were surveyed using this method. When EWM was detected, a GPS point was taken along with a count of the number of plants present and the water depth.

b. Grid Point Sampling

The Grid Point Sampling method provides a standardized procedure of inventorying deeper areas of the lake that cannot be otherwise sampled by the Visual Littoral Survey method. A grid of points 60m apart was overlaid on areas within the lake that were 20’ deep and shallower. This resulted in a total of 132 grid points throughout the lake. Grid points that were within demarcated swimming areas or areas with EWM were not sampled during the field work, resulting in data

collected from a total of 123 grid points. Locations of the grid points are shown on the map in Appendix 2.

The lake boundary and predetermined grid point locations were uploaded to an iPhone XR data collector, running ArcGIS Collector and Survey123 field data collection applications. This system was used to navigate to each grid point using a motorboat. An aquatic survey rake was used to take a vegetation sample at each point location. In waters shallower than 8', a rake on a pole was used to sample vegetation. In waters deeper than 8', a survey rake attached to a rope was used to sample vegetation. Rake fullness, as outlined in Table 1, was recorded for each sample to obtain information about vegetation density (Hauxwell et al. 2010; Madsen et al. 1996). Each aquatic plant on the rake was identified to species. All data was recorded using a digital data form on the data collection unit.

Table 1. Vegetation Abundance Categories for Grid Point Sampling Method

Rake Category	Abundance
None	No plants present on rake
Single	A single plant present on rake
Low	Sparse vegetation present on rake
Medium	Moderate amount of vegetation on rake, typically enough to cover center of the rake but not the tines
High	Large amount of vegetation on rake, typically enough to cover the rake tines

c. Underwater Transects

The Underwater transects consisted of three different methods: 1) Snorkeling; 2) SCUBA and 3) Remotely Operated Vehicle (ROV). Snorkeling was used in the vicinity of the Boy Scout camp where the water was too deep to allow viewing EWM from the boat but shallow enough to allow viewing of EWM from the surface while snorkeling. The SCUBA and ROV transects were

conducted in deeper areas (8'-15' depths) where viewing EWM was only visible while underwater. The locations of underwater transects were selected based on the vicinity of known EWM and the presence of appropriate habitat in deeper areas. The locations of the underwater transects is shown on the map in Appendix 2.

When EWM was found during the underwater transects, a marker buoy was placed at the location and GPS data collection occurred from the motorboat.

3. Results

A total of 43 locations of EWM were documented during the inventory. In some cases, only a single EWM plant was documented at a specific location, in other cases, as many as 120 plants were documented. Data for each of these locations is presented in the table in Appendix 1 and shown on the map in Appendix 2. Most of the occurrences were in the northeastern part of the lake. The southeastern half of the lake did not contain any rooted EWM, though a few floating fragments of this species were noted and removed. No EWM was discovered on the sampling rake while conducting the grid point sampling, though in 2 grid points, EWM was noted nearby. Grid point sampling is useful for conducting sampling in deeper waters and may detect EWM if there are dense infestations but did not prove a useful tool if EWM plants are sparsely distributed and abundant in low numbers.

A total of 13 aquatic species were noted during the inventory and are listed in Table 1. This is not a complete species list for the lake, only those species that were documented on the sampling rake or noted incidentally. Of particular note is the presence of Vasey's pondweed (*Potamogeton vaseyii*) throughout the lake. This is a rare (S2-ranked) species in Vermont that was present throughout the lake and appeared to be a healthy population with many individuals in flower or fruit.

Latin Name	Common Name	S-Rank	Plant family
Eleocharis palustris	marsh spike-rush		Cyperaceae
Equisetum fluviatile	water horsetail		Equisetaceae
Eriocaulon aquaticum	pipewort		Eriocaulaceae
Elodea canadensis	water-weed		Hydrocharitaceae
Najas flexilis	common naiad		Hydrocharitaceae
Nymphaea odorata	waterlily		Nymphaeaceae
Potamogeton amplifolius	broad-leaved pondweed		Potamogetonaceae
Potamogeton epihydrus	ribbon-leaved pondweed		Potamogetonaceae
Potamogeton gramineus	grass-leaved pondweed		Potamogetonaceae
Potamogeton illinoensis	Illinois pondweed		Potamogetonaceae
Potamogeton robbinsii	Robbins' pondweed		Potamogetonaceae
Potamogeton spirillus	common snailseed pondweed		Potamogetonaceae
Potamogeton vaseyi	Vasey's pondweed	S2	Potamogetonaceae

References Cited

Arrowwood Environmental. 2018. Lake Ninevah Aquatic Plant Inventory. Report submitted to the Town of Mount Holly and the Ninevah Foundation. 22 pages. December 7, 2018.

Hauxwell, Jennifer, Susan Knight, Kelly Wagner, Alison Mikulyuk, Michelle Nault, Meghan Porzky, Shaunna Chase, and J Hauxwell. 2010. "Recommended Baseline Monitoring of Aquatic Plants in Wisconsin: Sampling Design, Field and Laboratory Procedures, Data Entry and Analysis, and Applications." https://www.uwsp.edu/cnr-ap/UWEXLakes/Documents/ecology/Aquatic Plants/PI-Protocol-2010.pdf.

Madsen, John D, Jay A Bloomfield, James W Sutherland, Lawrence W Eichler, and Charles W Boylen. 1996. "The Aquatic Macrophyte Community of Onondaga Lake: Field Survey and Plant Growth Bioassays of Lake Sediments." *Lake and Reservoir Management* 12 (1): 73–79. https://doi.org/10.1080/07438149609353998.

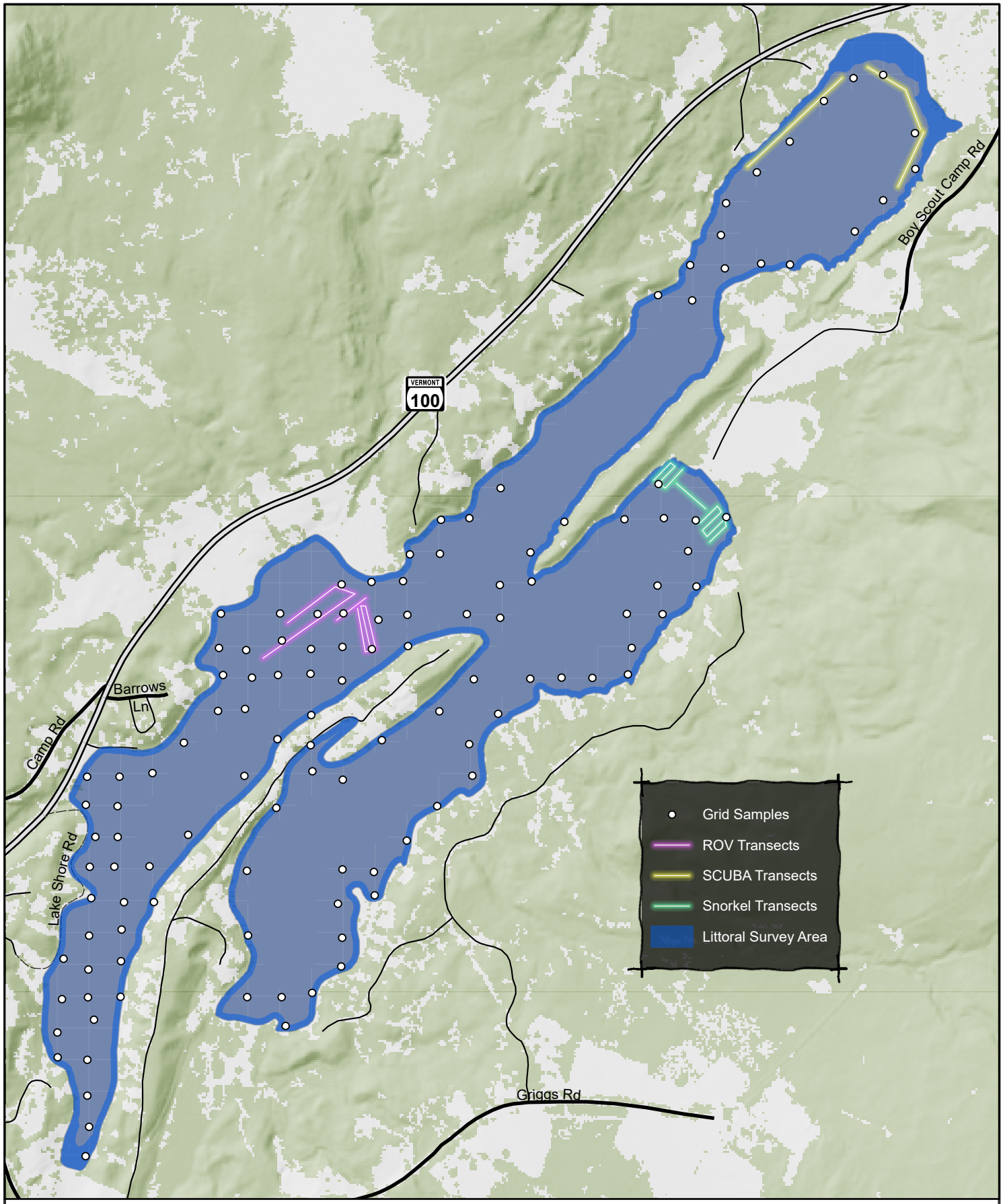
Appendix 1

Table of EWM Occurrences

ID	DEPTH	# Plants	Area	Creation Date	Lat	Long
3	6	2 plants	5' diameter area	8/15/2022	44.727716	-72.497252
16	7	1 plant		8/15/2022	44.726406	-72.494935
17	7	1 plant		8/15/2022	44.724776	-72.497973
18	5	2 plants		8/15/2022	44.724743	-72.498333
19	1	1 plant		8/15/2022	44.724713	-72.498644
20	1	2 plants		8/15/2022	44.724530	-72.499298
23	13	4 plants		8/15/2022	44.724224	-72.501131
24	7	1 plant		8/15/2022	44.724185	-72.501310
25	2	1 plant		8/15/2022	44.723998	-72.501614
26	4	1 plant		8/15/2022	44.723792	-72.501654
27	8	1 plant		8/15/2022	44.722010	-72.504054
36	9	3 plants		8/15/2022	44.719239	-72.508827
37	10	1 plant		8/15/2022	44.719112	-72.508438
101	8	2 plants		8/16/2022	44.720434	-72.499675
109	7	2 plants	20’ apart. One in 4’ water	8/16/2022	44.717804	-72.501760
110	4	3 plants	5' diameter area	8/16/2022	44.717780	-72.501850
138	8	12 plants	10’diameter area	8/16/2022	44.717570	-72.502599
139	7	17 plants	12’ diameter area	8/16/2022	44.717621	-72.502254
140	6	1 plant		8/16/2022	44.717668	-72.502035
141	6	1 plant		8/16/2022	44.718928	-72.500507
142	1	1 plant		8/16/2022	44.721312	-72.500597
143	1.5	1 plant		8/16/2022	44.721390	-72.500812
144	10	5 plants	20 ft diameter area	8/16/2022	44.720215	-72.499813
145	10	30 plants	20 ft diameter area	8/16/2022	44.720255	-72.499747
146	4	1 plant		8/16/2022	44.720623	-72.499727
147	8	1 plant		8/16/2022	44.721280	-72.500795
148	9	3 plants	5 ft diameter area	8/16/2022	44.721206	-72.500846
149	11	3 plants	5 ft diameter area	8/16/2022	44.721139	-72.500817
150	11	1 plant		8/19/2022	44.727976	-72.496654
151	7	2 plants		8/19/2022	44.727899	-72.496992
152	8	2 plants		8/19/2022	44.727636	-72.497151
153	9	1 plant		8/19/2022	44.728188	-72.496057
154	3	3 plants		8/19/2022	44.728294	-72.495762
155	2	1 plant		8/19/2022	44.728478	-72.495663
156	0	2 plants		8/19/2022	44.728200	-72.495479
157	6	7 plants	20 ft diameter area	8/19/2022	44.727580	-72.495030
158	8	~120 plants	20 ft diameter area	8/19/2022	44.727575	-72.495008
159	11	~50 plants	In area just outside buoys	8/19/2022	44.727822	-72.495080
160	11	1 plant		8/19/2022	44.718761	-72.508243
161	11	1 plant		8/19/2022	44.718877	-72.508087
162	11	2 plants		8/19/2022	44.718823	-72.508543
163	11	4 plants	5 ft diameter area	8/19/2022	44.718759	-72.508145
164	10	1 plant		8/19/2022	44.723332	-72.499732

Appendix 2

Maps of Survey Types and EWM Occurrences



Lake Eden: Sample Locations 2022

Monday, August 29, 2022 File: LakeEden:8.5x11 Report

Prepared By: A Worthley *NAD 1983 StatePlane Vermont FIPS 4400*

0 105210 420 630 840 Feet

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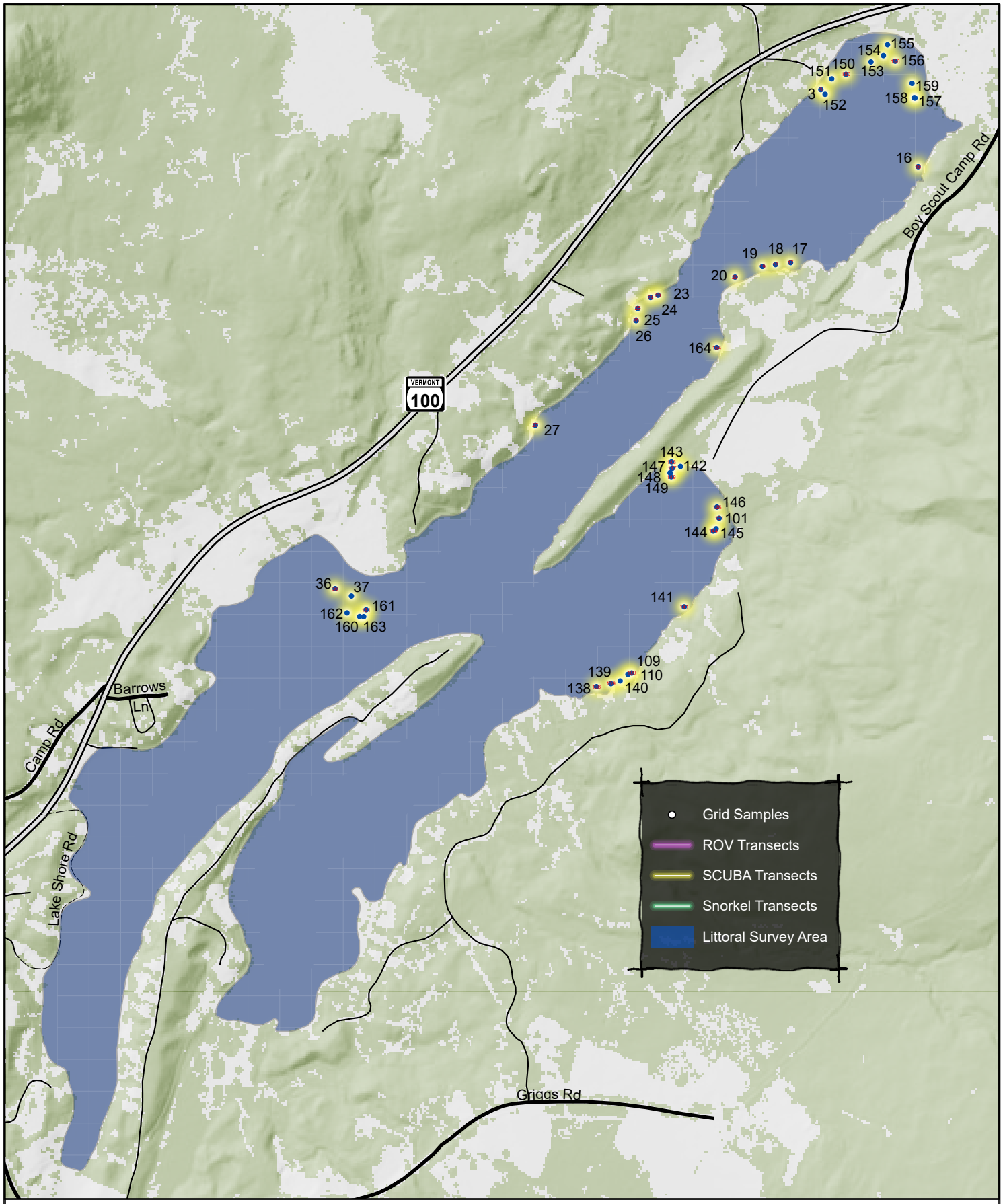

Lake Eden: Eurasian Watermilfoil 2022

Monday, August 29, 2022 File: LakeEden:8.5x11 Report

Prepared By: A Worthley *NAD 1983 StatePlane Vermont FIPS 4400*

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Lake Eden
2023 Late Summer
Eurasian Water Milfoil Inventory

October 17, 2023

Lake Champlain Basin Program

NE IW PCC

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1. Introduction

In June of 2023, Arrowwood Environmental was retained by the Lake Eden Association to conduct surveys of Eurasian water milfoil (EWM) in Lake Eden, Vermont as part of an ongoing effort to manage this invasive species in the lake. An early season, pre-treatment, survey of EWM in the lake was conducted in June, 2023 and reported on under separate cover (Lake Eden Pre-Treatment EWM Inventory, June 19, 2023). This report summarizes the methodology and results of the late summer survey conducted in August 2023.

2. Methods

The study area for the inventory consisted of the entire waterbody of Lake Eden as defined by the shoreline derived from the Vermont Hydrography Dataset (VHD). The entire littoral zone was inventoried using two different methods: 1) Visual Littoral Surveys; 2) Underwater Surveys. The methodology used for each of these survey types is outlined below.

a. Visual Littoral Survey

The entire perimeter of the lake was circumnavigated in a boat and the littoral zone was visually surveyed for the presence of EWM. A motorboat was used for the majority of the littoral zone, while a kayak was used for shallow areas less than 4' deep. Water visibility allowed for the survey of areas 8 feet deep and less with this method. In some cases, vigorous plants of EWM could be detected in water 10' deep. When EWM was detected, a GPS point was taken and data on the number of plants, area that the plant(s) occupy, and water depth was collected. For surveys conducted from a motorboat, water depth was determined by sonar from a Humminbird Helix 7 G2 sonar unit. For surveys conducted from a kayak, water depth was determined by submersing the kayak paddle to the lake bottom. Lake depth readings were rounded to the nearest ½ foot. The area occupied by EWM plants was based on a visual estimate.

All data was collected using custom digital data forms on iPhone 10 unit running ArcGIS Field Maps and Survey 123 software. These data forms include drop-down menus for plant species, water depth, and invasive species abundance and extent. The drop down-menus and digital nature

of the data forms minimize possible errors in data entry. The field data was synced online with the AE servers at the end of each field day. Raw data will be stored on the AE servers for a period of 5 years.

The map in Appendix 2 shows the areas that were surveyed using this method.

b. Underwater Surveys

Underwater Surveys were conducted in high priority areas where Visual Littoral Surveys were deemed insufficient for detecting EWM due to depth. These three areas were: Boat Launch, Boy Scout Camp, and Public Swimming Beach. In the deeper (>10' deep) areas of each of these sites, underwater surveys were conducted in transects. At the Boat Launch and Public Swimming Beach sites, the underwater transects were conducted with SCUBA gear. At the Boat Launch site, it was determined that a snorkel transect was sufficient to detect EWM. At both the Boat Launch and Boy Scout Camp sites, underwater transects were conducted across the bays. Additional underwater meander searches for EWM were also conducted at the Boy Scout Camp to ensure that all of the appropriate habitat was surveyed and all EWM was detected. Underwater transects at the Public Swimming Beach consisted of four parallel transects that were approximately 200ft long and 25ft apart. The direction of the transects followed an azimuth using an underwater compass and the length was determined by counting kicks. Underwater visibility was approximately 10' resulting in a 20' wide transect.

During the transect, the diver was equipped with multiple numbered marker buoys. When EWM was detected, a marker buoy was placed and notes on the number of plants, area that the plant(s) occupy, and water depth was noted on an underwater writing slate. Once the transect was completed, the marker buoys were navigated to from a boat and data entered into the digital data form on the GPS unit.

c. Mapping EWM Occurrences

When EWM was detected, a GPS point was taken along with a count of the number of plants present, area occupied by the plants and the water depth. In some cases, the population of EWM was abundant and counting individuals was not realistic. In these circumstances, the infestation boundaries were GPSed using the same techniques outlined above for GPSing point locations of EWM. Once the boundaries are mapped, a percent cover of EWM within the entire mapped infestation was recorded.

3. Results

Point and polygon locations of EWM mapped in the Lake using the above methods are shown in Appendix 2. These maps were previously submitted to the Lake Eden Association on August 31, 2023 for use in guiding late summer EWM control activities. Tables 2 and 3 in Appendix 1 list each location along with number of plants, area occupied by the occurrence and water depth.

Table 1 shows a comparison of EWM data from June to August 2023.

Table 1. June to August 2023 EWM Abundance Comparison

	Site Name	Plant Count June 2023	Plant Count August 2023	Change
Point Data	Throughout Lake	155	544	+389
Polygon Data	A: Boat Launch	59	320	+261
	D: Boat Launch	8*	28	+20
	E: Boy Scout Camp	78*	97	+19
	C: Boy Scout Camp	26	77	+51
	B: Public Beach	50% cover	70% cover	+ 20% cover
	F: Public Beach	0	50% cover	+ 50% cover

** In June, the data at these sites were collected as point data*

As can been seen from the data in Table 1, there was an increase in EWM plants at every site in the Lake. From the plant count data (i.e. excluding the percent cover data) there was an overall increase in number of EWM plants in the lake of 740 plants from June to August. Part of this increase may be attributable to the fact that EWM can be difficult to detect in June when the plants are just starting to grow. This error is likely more pronounced in the deeper areas where EWM is most easily detected when it is reaching the surface later in the season. However, even in shallow areas like the Public Boat Launch, there was a marked increase in EWM infestation in these areas. Of particular note is Area B, which, despite being controlled by a DASH treatment, rebounded and increased in cover by August. In general, the largest increase in number of plants occurred in the Public Swimming Beach Area. This large area of suitable habitat receives a fair amount of boat traffic which can aid in the spread of EWM.

EWM surfacing near the boat launch
8/28/2023

Preparing for underwater survey
8/24/2023

Public beach site
8/24/2023

Stem of EWM undewater
8/24/23/2023

Appendix 1

Tables of EWM Occurrences

Table 2. EWM recorded from point data

Depth (ft)	Plant Count	Diameter	Latitude	Longitude
4	1	1	44.712548	-72.515682
10	1	1	44.711234	-72.514136
8	3	20	44.718037	-72.511846
10	3	5	44.71843	-72.510922
2	9	10	44.718276	-72.510921
12	6	30	44.718554	-72.510617
11	16	15	44.718694	-72.510555
8	1	1	44.715247	-72.51053
10	10	20	44.718698	-72.510385
13	5	10	44.718298	-72.510339
11	8	20	44.718675	-72.510179
9	4	20	44.71876	-72.510036
6	1	1	44.718287	-72.50991
10	23	30	44.718372	-72.509835
11	11	10	44.718505	-72.509817
8	8	15	44.718383	-72.509817
8	1	1	44.719132	-72.509808
4	1	1	44.719813	-72.509706
10	15	20	44.718711	-72.509692
10	10	20	44.718975	-72.509655
10	4	10	44.719134	-72.509599
11	13	25	44.71879	-72.509491
10	30	40	44.719159	-72.509388
12	21	30	44.71929	-72.509299
11	15	35	44.718747	-72.509246
11	3	10	44.719046	-72.509222
10	2	5	44.718642	-72.509219
10	1	1	44.712605	-72.509162
11	23	25	44.718929	-72.50903
7	24	7	44.719241	-72.508945
11	6	20	44.71918	-72.508893
11	1	1	44.719073	-72.508863
12	21	30	44.71901	-72.508784
12	2	1	44.718276	-72.508782
11	11	20	44.718912	-72.508738
11	7	11	44.719075	-72.508704
10	4	10	44.718771	-72.508659
12	1	1	44.718425	-72.508624
11	7	30	44.719019	-72.508502
11	7	25	44.718637	-72.508449
10	1	1	44.712949	-72.508448
11	17	30	44.718838	-72.508381
11	5	11	44.718936	-72.508372
11	2	5	44.71865	-72.508328
12	1	1	44.718571	-72.508233
11	3	20	44.718886	-72.508214
10	3	15	44.718914	-72.507668
6	1	1	44.719879	-72.506972
8	1	1	44.718167	-72.505348

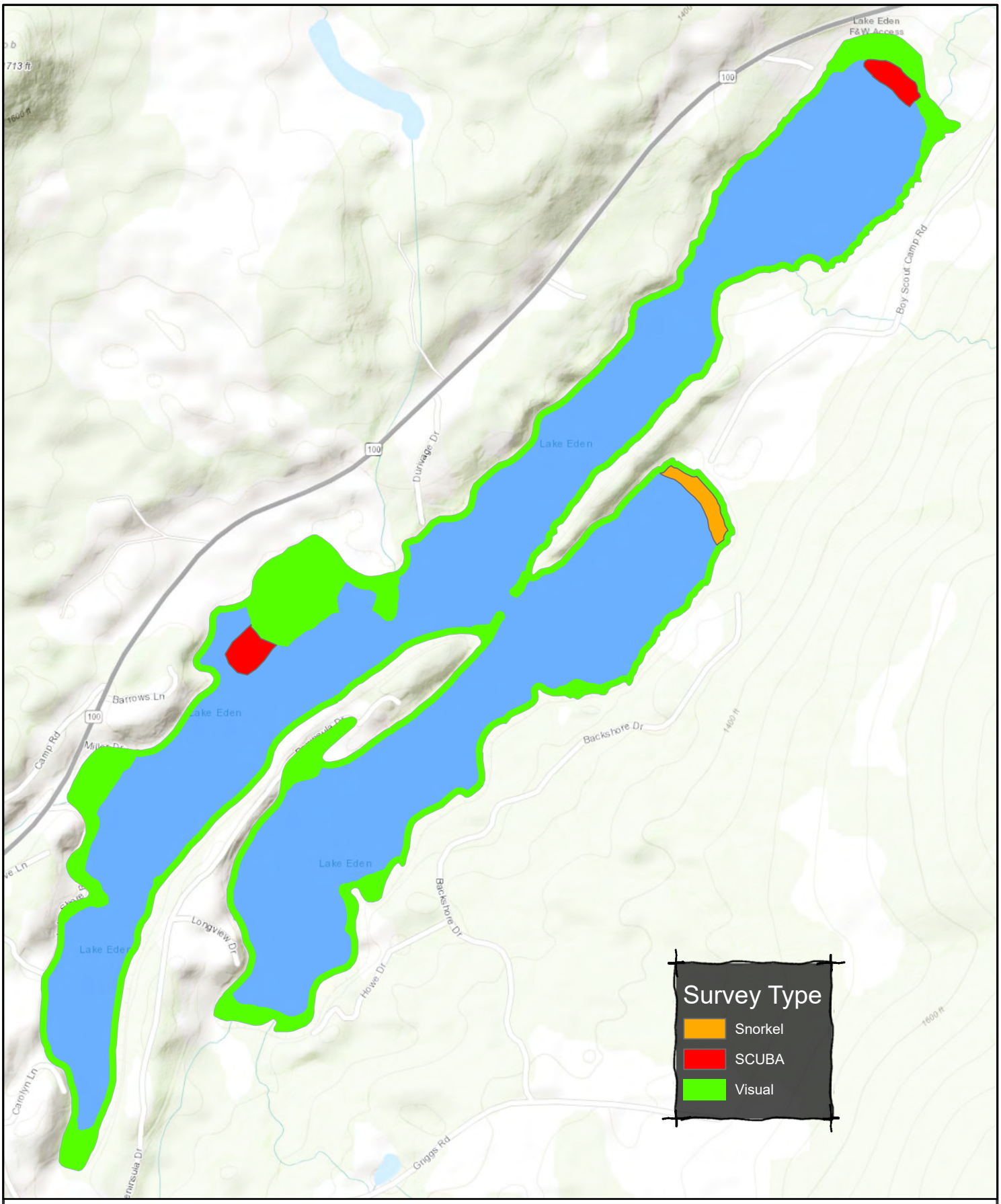
Depth (ft)	Plant Count	Diameter	Latitude	Longitude
8	1	1	44.718356	-72.505119
6	1	1	44.722072	-72.504021
7	8	10	44.71754	-72.503547
6	1	1	44.717564	-72.502847
7	1	1	44.720296	-72.502627
4	2	4	44.717562	-72.5025
8	1	1	44.717639	-72.502209
4	1	1	44.717708	-72.502039
7	2	5	44.72177	-72.501543
1	2	10	44.721285	-72.500857
4	1	1	44.721218	-72.500514
5	9	15	44.7211	-72.500322
6	6	2	44.724849	-72.500298
3	8	12	44.721056	-72.500287
12	2	10	44.720909	-72.500231
13	1	1	44.720783	-72.50008
12	1	1	44.720622	-72.49994
13	15	10	44.720587	-72.499908
12	3	10	44.720544	-72.49986
10	12	20	44.720691	-72.499769
6	2	5	44.720596	-72.499765
7	6	20	44.720662	-72.499735
8	2	8	44.720271	-72.499669
5	1	1	44.720157	-72.499626
3	3	3	44.726098	-72.49954
6	1	1	44.726244	-72.499425
5	2	20	44.724531	-72.499338
6	1	1	44.726678	-72.498464
3	2	5	44.724741	-72.498392
10	18	10	44.724833	-72.498274
8	1	1	44.727019	-72.498189
7	2	5	44.724792	-72.498092
7	1	1	44.727409	-72.497724
10	2	20	44.727264	-72.497627
9	2	1	44.727754	-72.497143
8	2	1	44.7279	-72.497028
5	1	1	44.728524	-72.496236
1	1	1	44.728243	-72.496018
5	1	1	44.728299	-72.495966
3	1	1	44.728487	-72.495852
4	4	8	44.72849	-72.495796
3	10	10	44.728599	-72.495765
10	13	30	44.728203	-72.495764
8	1	1	44.728247	-72.495654
4	2	10	44.72828	-72.49565
8	2	2	44.725905	-72.495314
4	1	1	44.726233	-72.494982
3	1	1	44.727459	-72.494874
6	6	10	44.727269	-72.494801

Table 3. EWM recorded from polygon data

Site Name	Plant Count	Depth
A: Boat Launch	320 plants	1-2'
D: Boat Launch	28 plants	1-2'
E: Boy Scout Camp	97 plants	8-12'
C: Boy Scout Camp	77 plants	5-12'
B: Public Beach	70% cover	10'
F: Public Beach	50% cover	10'

Appendix 2

Maps of Survey Areas and EWM Occurrences



Lake Eden: EWM August 2023 Survey Types

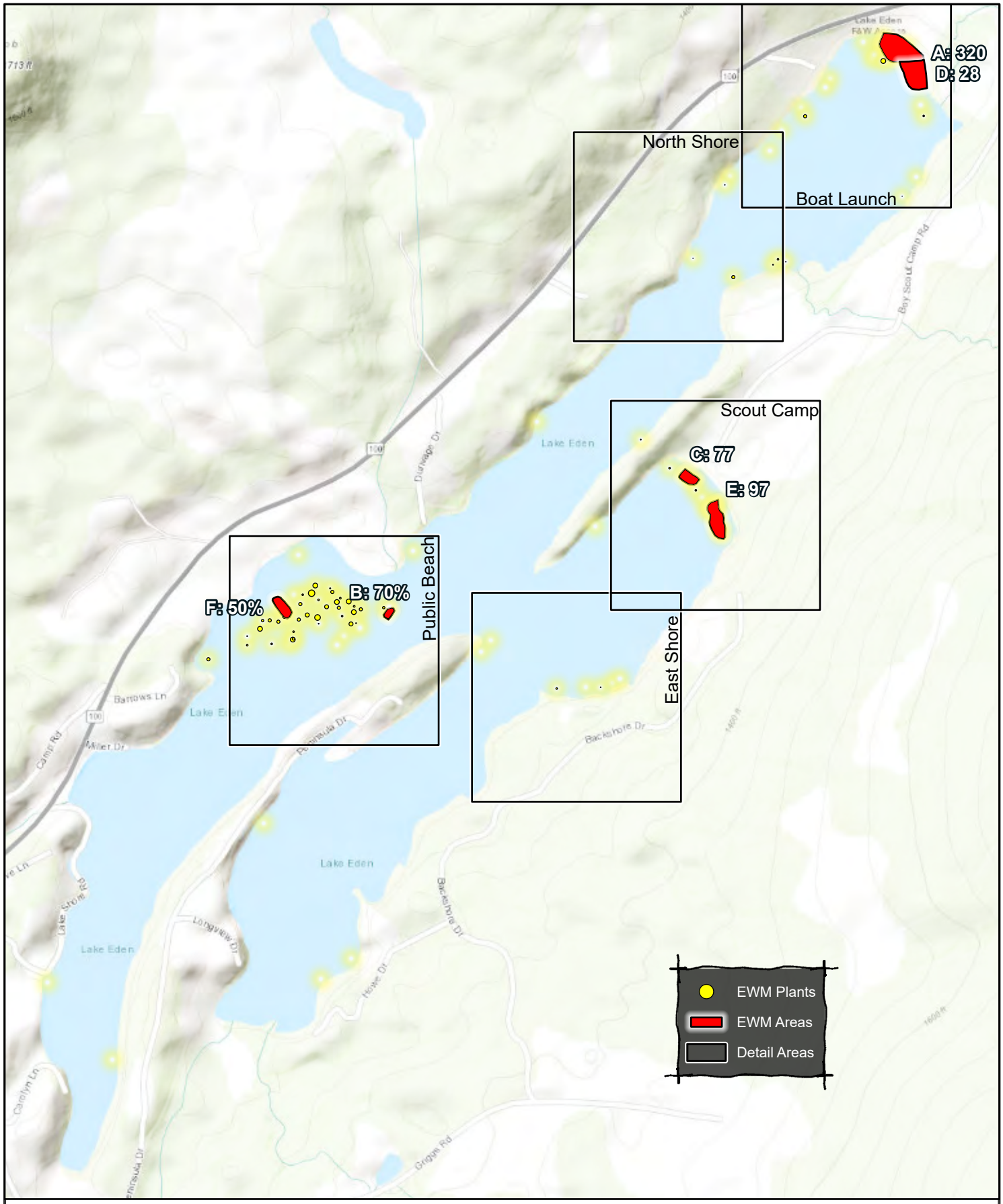
Friday, October 13, 2023 File: LakeEden:8.5x11 Report 2023-1

Prepared By: A Worthley *NAD 1983 StatePlane Vermont FIPS 4400*

0 105210 420 630 840 Feet

N W E S

ARROWWOOD ENVIRONMENTAL
950 BERT WHITE ROAD
HUNTINGTON,VT 05462
(802 434-7276 FAX: (802) 329-3259



Lake Eden: Eurasian Watermilfoil August 2023

Thursday, August 31, 2023 File: LakeEden:8.5x11 Report 2023-1

Prepared By: A Worthley *NAD 1983 StatePlane Vermont FIPS 4400*

0 105210 420 630 840 Feet

N W E S

ARROWWOOD ENVIRONMENTAL
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HUNTINGTON,VT 05462
(802 434-7276 FAX: (802) 329-3259

Lake Eden: EWM August 2023 DETAIL: Boat Launch

Thursday, August 31, 2023 File: LakeEden:8.5x11 Report 2023-2

Prepared By: A Worthley *NAD 1983 StatePlane Vermont FIPS 4400*

0 25 50 100 150 200 Feet

N W E S

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Lake Eden: EWM August 2023 DETAIL: East Shore

Thursday, August 31, 2023 File: LakeEden:8.5x11 Report 2023-2

Prepared By: A Worthley *NAD 1983 StatePlane Vermont FIPS 4400*

0 25 50 100 150 200 Feet

N W E S

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Lake Eden: EWM August 2023 DETAIL: North Shore

Thursday, August 31, 2023 File: LakeEden:8.5x11 Report 2023-2

Prepared By: A Worthley *NAD 1983 StatePlane Vermont FIPS 4400*

0 25 50 100 150 200 Feet

N W E S

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Lake Eden: EWM August 2023 DETAIL: Public Beach

Thursday, August 31, 2023 File: LakeEden:8.5x11 Report 2023-2

Prepared By: A Worthley *NAD 1983 StatePlane Vermont FIPS 4400*

Feet
0 25 50 100 150 200

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Lake Eden: EWM August 2023 DETAIL: Scout Camp

Thursday, August 31, 2023 File: LakeEden:8.5x11 Report 2023-2

Prepared By: A Worthley *NAD 1983 StatePlane Vermont FIPS 4400*

0 25 50 100 150 200 Feet

N W E S

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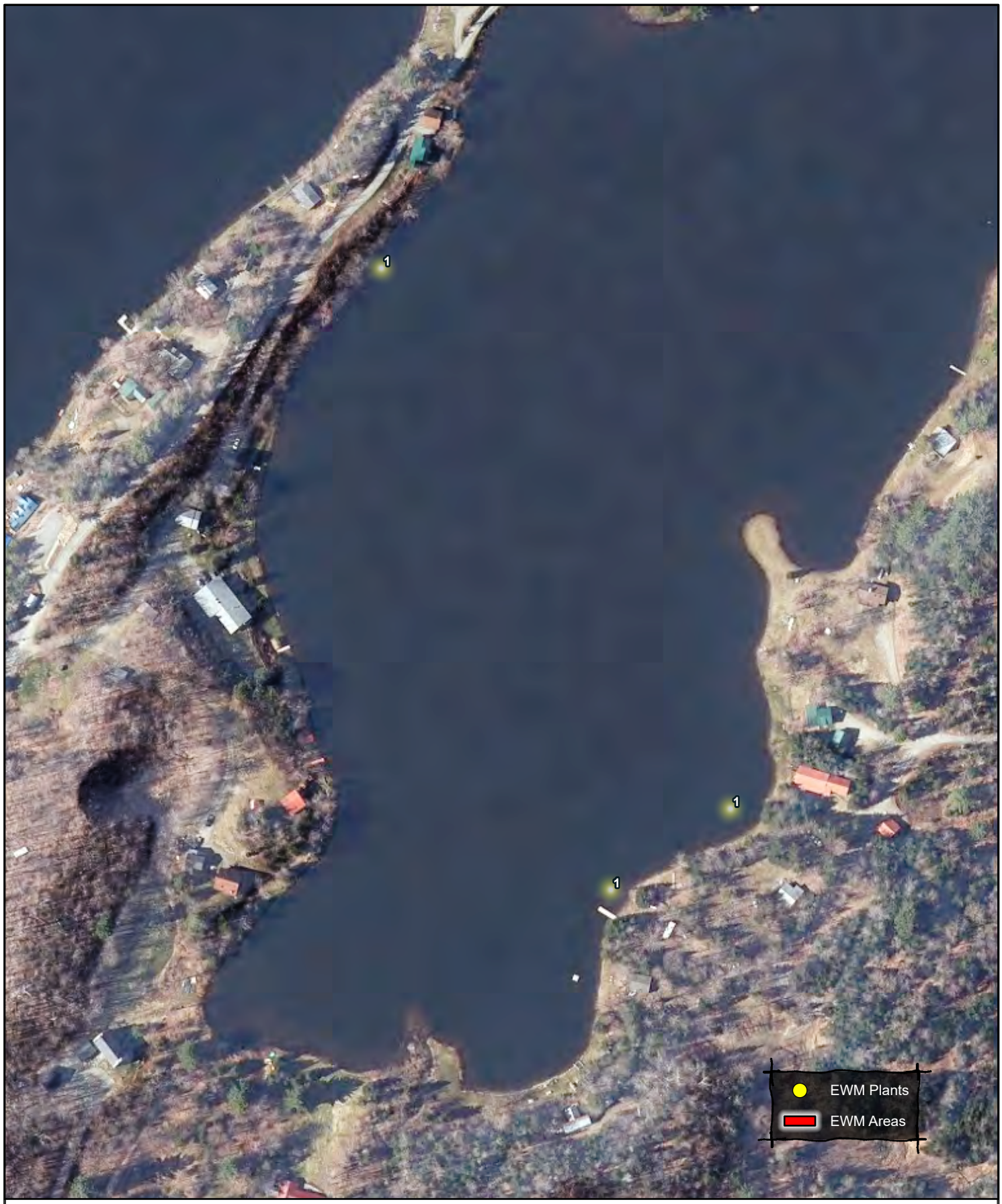

Lake Eden: EWM August 2023 DETAIL: Southeast Bay

Thursday, August 31, 2023 File: LakeEden:8.5x11 Report 2023-2

Prepared By: A Worthley *NAD 1983 StatePlane Vermont FIPS 4400*

Feet
0 25 50 100 150 200

N
W E
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Lake Eden: EWM August 2023 DETAIL: Southwest Bay

Thursday, August 31, 2023 File: LakeEden:8.5x11 Report 2023-2

Prepared By: A Worthley *NAD 1983 StatePlane Vermont FIPS 4400*

Feet
0 25 50 100 150 200

N
W E
S

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LAKE EDEN
2024 AQUATIC MACROPHYTE SURVEY

Report Submitted to the

Lake Eden Association

November 7 , 2024

ARROWWOOD ENVIRONMENTAL
950 BERT WHITE ROAD
HUNTINGTON,VT 05462
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Contents

1. Introduction

Arrowwood Environmental (AE) was retained by the Lake Eden Association (LSCA) to conduct an inventory of aquatic macrophytes in Lake Eden in Eden, Vermont. The inventory is part of an ongoing effort to control Eurasian watermilfoil (*Myriophyllum spicatum*, EWM) in the lake. EWM was discovered in Lake Eden in 2022. Since that time, an aggressive inventory and control effort has been undertaken to control the spread of this invasive species.

2. Methods

The study area for the inventory consisted of the entire waterbody of the Lake Eden system with the shoreline boundary derived from the Vermont Hydrography Dataset (VHD). Only aquatic species and emergent species that typically occur within aquatic plant communities were included in this inventory. This includes aquatic vascular plants as well as macroalgae, together considered aquatic "macrophytes."

Field work was conducted by Michael Lew-Smith and Eric Hagen of Arrowwood Environmental on September 10 and 11, 2024. During the field work, the lake was circumnavigated with a motorboat. The motorboat was used for the majority of the inventory while a kayak was used to inventory shallow areas.

Two different methods were used to inventory aquatic macrophytes in Lake Eden: Grid Point Sampling and Visual Littoral Surveys. The methodology used for each of these survey types is outlined below.

a. Grid Point Sampling

The Grid Point Sampling method provides a systematic and standardized procedure for sampling aquatic vegetation in lakes and ponds (Hauxwell et al. 2010). Grid point locations were developed by creating a matrix of grids 60 meters apart over the entire littoral zone of the lake. For this

process, the littoral zone was defined as 2X the Secchi depth, or 20' deep. This resulted in a total of 132 grid point sampling locations throughout the littoral zone of Lake Eden as shown in Appendix 2.

The lake boundary and predetermined grid point locations were uploaded to an iPhone or iPad data collector, running ArcGIS Collector and Survey123 field data collection applications. An ortho-photo basemap project was created on the iPhone/iPad with the grid point locations for use during the fieldwork. This system was used to navigate to each grid point using a boat. All data was recorded using a digital data form on the data collection unit. Tables 1 and 2 list the data and categories of data that were collected at each grid point.

Table 1. Aquatic sampling rake data collected at each grid point

METRIC	***Description and categories***	
RAKE FULLNESS	*Amount of aquatic vegetation on the sampling rake*	
	None	No plants present on rake
	Single	A single plant present on rake
	Low	Sparse vegetation present on rake
	Medium	Moderate amount of vegetation on rake, typically enough to cover center of the rake but not the tines
	High	Large amount of vegetation on rake, typically enough to cover the rake tines, difficult to bring into the boat
SPECIES ABUNDANCE	*Ranking of abundance of each species on sampling rake*	
	Single	A single plant present on rake
	Low	Species was sparse on rake
	Medium	Species was moderately abundant on rake
	High	Species was abundant on rake

An aquatic survey rake was used to gather the vegetation data at each point location. In waters shallower than 8', a rake on a pole was used to sample vegetation. In waters deeper than 8', a survey rake attached to a rope was used to sample vegetation. Rake fullness, as outlined in Table 1, was recorded for each sample to obtain information about vegetation density (Hauxwell et al.

2010; Madsen et al. 1996). Each aquatic plant on the rake was identified to species, if possible. Specimens that were difficult to identify in the field were collected and examined under a dissecting scope. Voucher specimens of many species recorded in the lake were collected and stored at either the Arrowwood Herbarium or at the Pringle Herbarium at the University of Vermont. The abundance of each species on the rake was recorded using the categories outlined in Table 1.

Table 2. Vegetation abundance and site data collected at each grid point

METRIC	***Description and categories***	
BIOMASS	*Amount of plant growth vertically in the water column*	
	None	*No aquatic plants present*
	Low	*Plants growing only as a low layer above the sediment*
	Moderate	*Plants growing well into the water column but generally not reaching the water surface*
	High	*Plants filling the water column and/or surfacing enough to be a possible recreational nuisance*
	Very High	*Plants filling the water column and completely covering the surface; obvious nuisance conditions*
PERCENT COVER SUBMERGED	*A record of the percentage of the lake bottom covered by submerged aquatic plants using the following cover categories: <1%; 1-5%; 5-25%; 25-50%; 50-75%; 75-100%*	
PERCENT COVER FLOATING	*A record of the percentage of the lake surface covered by floating aquatic plants using the following cover categories: 1-5%; 5-25%; 25-50%; 50-75%; 75-100%*	
NONNATIVE INVASIVE SPECIES (NNIS)	*Presence of invasive species with species name and number of plants or percent cover of NNIS plants using the following cover categories: <1%; 1-5%; 5-25%; 25-50%; 50-75%; 75-100%*	
SEDIMENT TYPE	*Type of sediment present using the following categories: Bedrock; Boulder; Cobble; Gravel; Sand; Silt; Clay; Muck*	
WATER DEPTH	*Depth of water taken using sonar (from motorboat) or kayak paddle (from kayak).*	
AQUATIC NATURAL COMMUNITY	*Type of aquatic natural community present at grid point*	

In addition to rake data, vegetation abundance and general site data (described in Table 2) was collected at each grid point.

Overall plant biomass data is used to understand the potential for aquatic plants growing at levels high enough to reach nuisance conditions. The categories for this metric are shown in Table 2.

Since this metric measures potential nuisance conditions, it is largely dependent upon water depth in addition to plant growth. Dense plant growth in the water column, for example, does not generally present nuisance conditions if it is well below the surface of the lake. The same amount of growth, however, in very shallow water would potentially create nuisance conditions.

Percent cover of both submerged and floating aquatic plants was recorded at each grid point using the categories shown in Table 2. Recording percent cover of aquatic plants is a similar metric as the biomass but not dependent on water depth. If submerged vegetation was growing dense enough that it was laying on the surface of the water, it was considered a floating aquatic plant for this metric. If submerged vegetation could not be seen from the boat, this data was left blank.

Figure 1. Aquatic sampling rake

Presence or absence of non-native invasive species was evaluated in an approximately 500 square foot area at each grid sampling point. Data on either the number of plants or the percent cover that the plants occupy was recorded as outlined in Table 2. If an NNIS infestation was widespread, "off-grid" sampling points were used to determine the boundaries of the infestation (see Visual Littoral Survey methods below).

Water depth and sediment type data were collected at each grid point as outlined in Table 2. For each grid point where the aquatic natural community was known, data was collected on the presence of this type.

b. Visual Littoral Survey

While the grid point sampling provides a systematic and repeatable method for sampling aquatic vegetation, it does not provide information about the nature of aquatic vegetation in between the grid points. Relying solely on this method, therefore, has the potential to leave significant gaps in the knowledge of aquatic vegetation in the overall lake. The visual littoral survey method was employed to fill in these gaps and provide a more complete picture of aquatic vegetation. This survey methodology is based on methods from the Vermont Agency of Natural Resources Department of Environmental Conservation (2006) field manual.

When navigating in between grid point locations, aquatic vegetation was viewed from the boat. An "off-grid" data point was taken to document invasive species, record information about aquatic natural communities, record areas of high biomass, document rare species or record other features of interest. Data was recorded on the digital data collection form at these "off-grid" points. Only a subset of the data presented in Tables 1 and 2 was collected at these points related to the specific feature being documented. In some cases, a field sketch map of a particular feature (typically an EWM infestation) was used to document the extent of the feature. This was conducted on the iPhone/iPad using a line feature class.

Mapping the distribution and abundance of NNIS was a major focus of the visual littoral survey data collection effort. When NNIS were discovered outside of the grid points, an "off-grid" point was taken and an estimate of percent cover of the NNIS was used to document the abundance. For single EWM plants or infestations with a smaller extent, a point feature class was used to document the location and abundance. This data included the collection of number of EWM plants as well as spatial extent. For areas with a larger extent, GPS points were taken on the margins of the population to establish infestation boundaries and this data was used to create a polygon feature class.

c. Creating maps of aquatic natural communities and EWM

Once field work was complete, the spatial data was analyzed in ArcGIS. In order to create a complete map of aquatic vegetation in the lake, the grid points and off-grid points were used to create a polygon layer of vegetation. Using ortho-photo interpretation, bathymetric maps of the lake and the field data, a polygon feature class was created of the extent of native aquatic vegetation. This map provides the extent of the aquatic vegetation in the lake at the time of the survey. In addition, this vegetation was broken out by aquatic natural community type

The EWM field data was used to create polygons of EWM locations. In data processing, the point features were converted to polygon features using the spatial data entered in order to standardize data analysis. Each polygon represents the spatial extent of EWM and includes either a count of EWM plants or, for larger and more diffuse infestations, a percent cover of EWM.

The map of EWM in the lake should be viewed in conjunction with ongoing EWM control activities. The presence and density of EWM shown on the maps in this report are, in many cases, dependent on and determined by EWM control efforts. If, for example, Diver-Assisted Suction Harvesting (DASH) occurred on a dense infestation of EWM before the inventory was undertaken, no EWM would be recorded at that location. Conversely, an infestation of EWM may be included on the maps that has since been removed by DASH or other control methods.

d. Macrophyte Species List

A list of all aquatic plant species encountered during the inventory is included in the results section. This list was compiled from the grid point and off-grid point samples and the visual littoral surveys. Grid point rake sampling generally favors larger species and species that are dominant in the lake. This sampling method tends to miss species that are uncommon in the lake, species that occur in isolated habitats, or species that are small or grow along the sediment surface. For this reason, other species that were noted during the visual littoral surveys were also recorded. It was not within the scope of this project to conduct a comprehensive survey of all aquatic vegetation in the lake. There may be additional species occurring in the lake (either sparse in number or located in limited or specialized habitats) that were undetected by these survey methods.

3. Results

The results of the inventory are presented below in four sections: a) Macrophyte Species; b) Native Aquatic Natural Communities; and c) Non-Native Invasive Species.

a. Macrophyte Species

The aquatic plant species documented during the inventory are presented in Table 3. None of the species documented during the 2024 inventory are considered uncommon, rare, threatened or endangered by the Vermont Natural Heritage Inventory.

Table 3. List of plant species documented during the inventory

Latin Name	Common Name	Plant Family
Nitella spp.	stonewort	Characeae
Eleocharis acicularis	needle spike-rush	Cyperaceae
Eleocharis palustris	marsh spike-rush	Cyperaceae
Equisetum fluviatile	water horsetail	Equisetaceae
Eriocaulon aquaticum	pipewort	Eriocaulaceae
Fontinalis sp.	moss	Fontinalaceae
Elodea canadensis	water-weed	Hydrocharitaceae
Najas flexilis	common naiad	Hydrocharitaceae
Vallisneria americana	eel-grass	Hydrocharitaceae
Nymphaea odorata	waterlily	Nymphaeaceae
Potamogeton amplifolius	broad-leaved pondweed	Potamogetonaceae
Potamogeton berchtoldii	Berchtold's pondweed	Potamogetonaceae
Potamogeton epihydrus	ribbon-leaved pondweed	Potamogetonaceae
Potamogeton gramineus	grass-leaved pondweed	Potamogetonaceae
Potamogeton illinoensis	Illinois pondweed	Potamogetonaceae
Potamogeton robbinsii	Robbins' pondweed	Potamogetonaceae
Potamogeton spirillus	common snailseed pondweed	Potamogetonaceae

Analysis of the grid point data is presented in summary form in Table 4. The dataset allows for analysis on the most abundant species that occur on the rake samples shown as the Frequency of Occurrence (FOO). Full results of the rake samples are included in the table in Appendix 1.

The list of species in Table 4 are arranged from most abundant to least abundant species encountered during the 2024 rake sampling.

The data in Table 4 indicates that most of the rake samples lacked any aquatic vegetation (returned a <Null> value). This is the result of the placement of the grid point sample locations. The grid points were located assuming that the littoral zone consisted of the area 20' deep and shallower (approximately 2X the secchi depth). The limit of vegetation in the lake, however, is approximately 15' deep and shallower. All of the points deeper than 15' deep therefore lacked vegetation and returned a null value. Future studies should reconstruct the gird point sampling locations using the 15' depth as the outer limit of the littoral zone.

Table 4. Frequency of occurrence (FOO) data for aquatic plant species in all rake samples

Latin Name	Common Name	# Occurrences (2024)	2024 FOO
<Null>	NA	90	73%
Nitella spp.	stonewort	14	11%
Elodea canadensis	water-weed	13	10%
Potamogeton robbinsii	Robbins' pondweed	12	10%
Eleocharis acicularis	needle spike-rush	5	4%
Eriocaulon aquaticum	pipewort	5	4%
Potamogeton amplifolius	broad-leaved pondweed	5	4%
Potamogeton illinoensis	Illinois pondweed	4	3%
Potamogeton berchtoldii	Berchtold's pondweed	3	2%
Eleocharis palustris	marsh spike-rush	2	2%
Potamogeton epihydrus	ribbon-leaved pondweed	2	2%
Equisetum fluviatile	water horsetail	1	1%
Fontinalis sp.	moss	1	1%
Najas flexilis	common naiad	1	1%
Nymphaea odorata	waterlily	1	1%
Potamogeton spirillus	common snailseed pondweed	1	1%
Sparganium angustifolium	narrow-leaved bur-reed	1	1%
Vallisneria americana	eel-grass	1	1%

Aside from the null values, the three most common species in the lake were stonewort, waterweed and Robbin's pondweed. More information on each of these species is presented in the natural commmunity section below.

b. Native Aquatic Natural Communities

A natural community is an interacting assemblage of organisms, their physical environment, and the natural processes that affect them. Terrestrial natural communities have been well-described in the state (Thompson, Sorenson, and Zaino 2019) but much work still needs to be done on classifying groups of aquatic plants into natural communities. However, such a classification is useful for documenting the diversity of types, ranging from sparsely vegetated rocky shores to densely vegetated mucky bays. These community types not only provide different habitats for aquatic organisms but vary in their susceptibility to NNIS invasion.

Table 5. Natural community types in Lake Eden

Natural Community Type	#	Acres	Biomass
Stonewort Cobble Shore	6	1.6	Low
Shallow Horsetail Shore	4	0.75	Low
Robbins-Illinois Pondweed	1	61.3	Low-High
Water Lily Aquatic Community	1	0.63	Moderate-High
Total	12	64.2	

The littoral zone of Lake Eden contains four different aquatic community types as summarized in Table 5 and shown on the map in Appendix 2. The near-shore areas of the lake are largely composed of the sparsely vegetated cobble shallows of the Stonewort Cobble Shore as well as a few areas dominated by the Shallow Horsetail Shore community. The most widespread and abundant aquatic type in the lake consists of the Robbins-Illinois Pondweed type. Finally, there is also an occurrence of the Water Lily Aquatic Community.

Each of these vegetation types are shown on the map in Appendix 2 and described below.

Stonewort Cobble Shore

This vegetation type is found in shallow depths with rocky cobble and gravel substrates. The shallow waters (less than 4' deep) typically freeze in the winter and are subject to wave action in the summer. This, combined with the relatively nutrient-poor substrates, result in vegetation that is low-growing, rarely exceeding 6" height. The dominant species in this community is stonewort (*Nitella spp.*). This is not a vascular plant, but a macro-algae which is well adapted to growing in these conditions. Percent cover of vegetation in this type is low, ranging from 5-25%. In addition, due to its low-growing nature, overall biomass in this community is also quite low. Other species such as needle spike-rush and common naiad can also be found in these areas, but typically at less than 5% cover. EWM generally does not favor the disturbance regime associated with the habitat of this vegetation type and is therefore generally absent or present at very low cover.

Shallow Horsetail Shore

This community is similar to the Stonewort Cobble Shore community in that it occurs in shallow areas along the shore and around shallow shoals. The most salient feature of this vegetation type is the presence of water horsetail plants (*Equisetum fluviatile*) growing out of the water. The horsetail can be the only plant in these areas, or it can co-occur with scattered plants of Robbin's pondweed, needle-spikerush, and pipewort. The emergent horsetail plants can have the effect of "holding" finer lake sediments like silts (whereas in the Stonewort Cobble Shore type, these are washed away). Sediments in the Shallow Horsetail Shore therefore consist of a layer of silt over coarser sediments such as gravel or cobble. Because of these less wave-washed conditions and more silt build-up, these areas can provide habitat to EWM.

Robbins-Illinois Pondweed Assemblage

This aquatic vegetation type is the most widespread and abundant type in the lake, comprising most of the vegetated littoral zone. It can range in depth from 1 to 13' deep, and the sediments are silts or silt over gravel and cobble. Overall cover of submerged vegetation is highly variable. Well-vegetated areas contain fairly dense growth of native vegetation, while other areas contain only a few scattered plants. In general vegetation is sparse in areas that consist of a narrow littoral zone in between the shore and a steep drop-off. Bays and wider areas of shallow littoral zone contain areas with more dense vegetation. The dominant species in this community type is Robbin's pondweed. This species grows only about 1' tall, but can form a dense "understory" layer over the lake bottom. Other species such as large-leaved pondweed and Illinois pondweed grow much taller than Robbin's pondweed (reaching heights of 8-10') and form a more scattered "overstory". Species such as waterweed and stonewort are also common components of this community, though typically at low cover.

This vegetation type provides the most suitable habitat for EWM in the Lake. These areas, therefore, are where the densest infestations of EWM are likely to occur. In addition, most of the vegetative biomass of the lake occurs in this type. Because these areas are where most of the aquatic vegetation exists, these are the areas that provide most of the habitat for aquatic life, including a wide array of benthic organisms and fish in most stages of their life cycles.

Water Lily Aquatic Community

This community is dominated by the presence of floating-leaved aquatic species such as water lily. This is a well-documented community found throughout the region (Gawler and Cutko 2010; Hunt, Anderson, and Sorenson 2002). This community is typically found where the water is shallow and there is a significant layer of organic muck substrates. This can occur in the sheltered bays of large lakes or throughout the littoral zones of lakes and ponds that are small or shallow. In these areas, the cover of the floating-leaved species can be very high and completely cover the water surface. Water lily plants occur at low abundance in many of the shallow, sheltered bays of the lake. In most cases, however, they occur at such low abundance that they do not define the natural community and are not mapped as Water Lily Aquatic Communities. In Lake Eden, the bay in the Fishhook area is the only mapped occurrence of this community. In this bay, water lilies comprises approximately 50-75% cover. Submerged species such as Robbin's pondweed, waterweed and ribbon-leaved pondweed can be found beneath the water lily. This community offers suitable habitat for EWM, though none has been documented in this community.

c. Non-Native Aquatic Species

Eurasian watermilfoil was the only non-native aquatic species documented in the lake.

The maps in Appendix 2 show the distribution and abundance of EWM in the lake. Since EWM was documented in Lake Eden, there have been a few areas where it has become well-established: the Public Boat Launch, the Boy Scout Camp, and the Public Swimming Area. The lake has been additionally divided up into four quadrats in order to track EWM spread outside of these three "hot spots". All of these areas are shown in Figure 1.

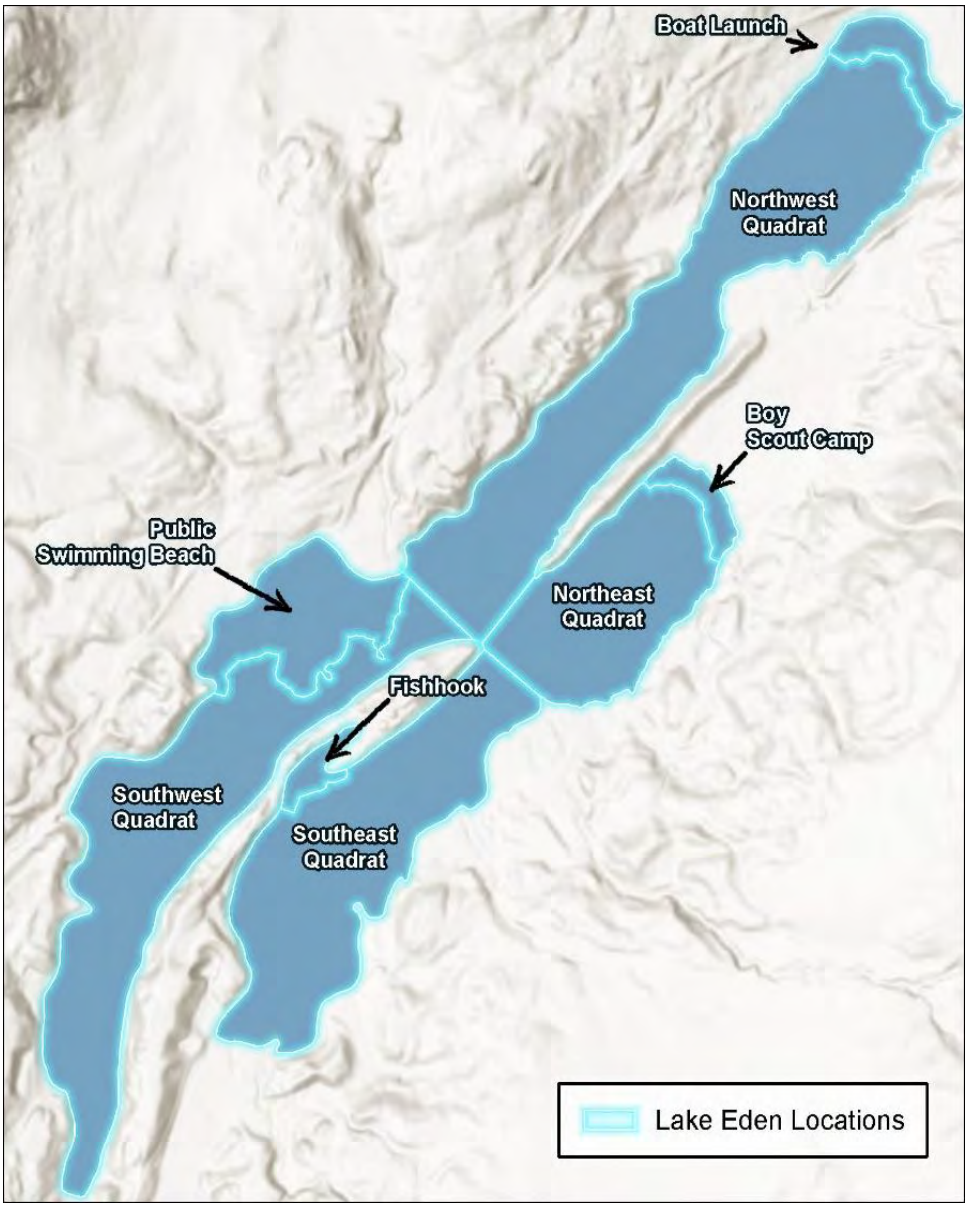

Figure 2 Place Names in Lake Eden

The state of EWM infestations in Lake Eden is summarized in Table 6. This data is from field work conducted in September 10 and 11, 2024 and therefore represents the status of EWM *after* most of the hand-harvesting and DASH work that was conducted as part of the ongoing control efforts.

Table 6. EWM Infestations by Site

Site Name	# EWM Plants	EWM Categories and Acreage			
		Trace (1-5%)	Sparse (5-25%)	Moderate (25-50%)	Moderate-Dense (50-75%)
Boat Launch	8	0.83	0.06		0.06
Boy Scout Camp	36				
Fishhook	0				
Northeast Quadrat	6				
Northwest Quadrat	67		0.04		
Public Swimming Beach	33				
Southeast Quadrat	4				
Southwest Quadrat	4				
Total	158				

Boat Lauch. EWM at the Boat Launch site consists of 8 individual plants as well as three areas where EWM was abundant enough to map using percent cover. The largest of these has 1-5% cover of EWM and sits just on the deeper edge of the Benthic Mats across much of this northern bay. Depth of plants in this area ranges from 4'-12' deep. Two other infestations were mapped on the shallow side of the Benthic Mats: one with sparse EWM cover and one with moderate-dense EWM cover. Both of these exist in very shallow water, generally less than 1' deep. The shallow depths and mucky substrates make these infestations difficult to control.

Figure 3 EWM in Shallow Water Near Boat Launch

Boy Scout Camp. The bay at the north end of the Northeast Quadrat also has a persistent EWM infestation.

In September, 2024, a total of 36 plants were documented in this area. These plants sit in 2' - 12' deep water and are widely scattered across this bay.

Fishhook. This shallow bay is the location of the only water lily community on the lake and contains suitable habitat for EWM. Despite this, EWM has not yet been documented in this area.

Northeast Quadrat. Only 6 EWM plants were documented in this area, three of which occurred together in the southwest corner of this area. Lacking any shallow bays, the overall habitat for EWM in this quadrat is somewhat limited.

Northwest Quadrat. A total of 67 EWM plants were documented in this area of the lake, most of which were found northeast of the powerline. The littoral zone is fairly wide in this area and offers suitable habitat for EWM. South of the powerline, the littoral zone is narrower and EWM habitat is limited. This area of the lake has seen abundant spread of EWM in the last two years. Most of this spread is likely coming from the infestation at the boat launch.

Public Swimming Beach. This part of the lake consists of a relatively shallow and extensive littoral zone area. This bay contains a large area of suitable habitat for aquatic plants, including EWM. The EWM infestation in this area is widespread, abundant and persistent. Most plants in this area are in 4' - 13' deep water and, due to limited visibility, can be difficult to detect. In addition, the widespread nature of the infestation makes control difficult. Thirty-three plants were documented in September 2024 throughout this area.

Southeast Quadrat. The Southeast Quadrat of the lake consists of areas with relatively wide littoral zone as well as some shallower bays. These areas contain suitable habitat for EWM. Despite this, EWM is relatively rare in this area (so far), with only 4 plants documented in September 2024. This is likely due to the fact that it is relatively isolated from the larger populations in the lake. However, it is likely that, lacking EWM control, these areas will be colonized in time.

Southwest Quadrat. Like the Southeast Quadrat, the Southwest Quadrat is home to multiple shallow bays that contain suitable habitat for EWM. However, EWM colonization has been sparse in this area, with only 4 plants documented in September 2024. However, fragments of EWM floating in this area have been documented on multiple occasions. Given the proximity to the large

infestation at the Public Swimming Beach, there is the potential for this area to become more extensively colonized by EWM.

4. Conclusion

Through grid point sampling and visual littoral surveys, the native and non-native aquatic vegetation in the Lake Eden system was mapped in September 2024. The aquatic vegetation in the lake consists of four different natural community types, which were mapped in the lake. The abundance and distribution of EWM throughout the lake was also mapped. This non-native invasive species was found in scattered locations throughout the lake, with more dense infestations present at the Boat Launch, Boy Scout Camp and Public Swimming Beach. Suitable habitat for EWM is present throughout the lake. It is likely that, lacking significant control of this invasive species, EWM will become widespread and abundant in Lake Eden.

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Appendix 1: Aquatic Sampling Rake Data

Appendix 1a. Plant data at each grid point

	Eleocharis acicularis	Eleocharis palustris	Elodea canadensis	Equisetum fluviatile	Eriocaulon aquaticum	Fontinalis sp.	Najas flexilis	Nitella spp.	Nymphaea odorata	Potamogeton amplifolius	Potamogeton berchtoldii	Potamogeton epihydrus	Potamogeton illinoensis	Potamogeton robbinsii	Potamogeton spirillus	Sparganium angustifolium	Vallisneria americana
1								Low		Low		Low		Low			
4								Low					Low	Low			
8	Low						Single				Single	Single					
14			Low			Single		Low					Low				
23	Low							Low									
25								Low							Single		
27			Low		Low											Low	
28			Single					Single									
37													Low				
41	Low							Low									
42														Med.			
50								Single									
51			Single						Low								
52										Low							
59		Low			Low												
68														Low			
69			Low														
70								Low									
72		Single															
78			Low					Low			Low		Low				
79			Low														
80			Low								Low						
81			Low														
88										None				High			
89														Low			
90														Low			
91					Low			Low									
97			Low											Med.			
98			Single														
104								Low									
108			Low											Med.			
114										Low				Low			
116	Low				Low			Low									
127			Low							Low							
130								Low						Low			
131	Low			Low	Low									Low			
132																	Low

Appendix 1b. Site data at each grid point

Survey Point	Depth (ft)	% Cover Floating	% Cover Submerged	Biomass	Sediment
1	4	1	100	Moderate	<Null>
2	10	0	0	None	<Null>
3	10	0	0	None	<Null>
4	5	5	100	Moderate	<Null>
5	13	0	0	None	<Null>
6	10	0	0	None	<Null>
7	14	0	0	None	<Null>
8	2	25	100	High	Muck
9	10	0	0	None	<Null>
10	13	0	0	None	<Null>
11	10	0	0	None	<Null>
12	14	0	0	None	<Null>
13	16	0	0	None	<Null>
14	7	5	100	Moderate	Cobble
15	10	0	0	None	<Null>
16	18	0	0	None	<Null>
17	13	0	0	None	<Null>
18	9	1	100	Low	<Null>
19	16	0	0	None	<Null>
20	16	0	0	None	<Null>
21	7	0	5	Low	Cobble
22	8	0	0	None	<Null>
23	1	0	25	Low	Cobble
24	17	0	0	None	<Null>
25	5	0	100	Low	<Null>
26	8	0	0	None	<Null>
27	2	5	100	Moderate	Cobble
28	8	0	<Null>	Low	<Null>
29	18	0	0	None	<Null>
30	20	0	0	None	<Null>
31	8	0	5	Low	Cobble
32	20	0	0	None	<Null>
33	9	0	50	Moderate	<Null>

Survey Point	Depth (ft)	% Cover Floating	% Cover Submerged	Biomass	Sediment
34	7	0	0	None	<Null>
35	20	0	0	None	<Null>
36	20	0	0	None	<Null>
37	5	0	75	Moderate	Sand
38	9	0	0	None	<Null>
39	13	0	0	None	<Null>
40	5	0	75	Low	Cobble
41	2	0	100	High	<Null>
42	5	0	100	Moderate	<Null>
43	9	0	0	None	<Null>
44	17	0	0	None	<Null>
45	23	0	0	None	<Null>
46	6	1	1	Low	Cobble
47	22	0	0	None	<Null>
48	14	0	0	None	<Null>
49	16	0	0	None	<Null>
50	8	0	5	Low	<Null>
51	3	25	100	Moderate	Muck
52	7	0	75	Moderate	<Null>
53	18	0	0	None	<Null>
54	16	0	0	None	<Null>
55	20	0	0	None	<Null>
56	16	0	0	None	<Null>
57	20	0	0	None	<Null>
58	11	5	0	None	<Null>
59	5	0	25	Low	Cobble
60	17	0	0	None	<Null>
61	10	0	0	None	<Null>
62	17	0	0	None	<Null>
63	20	0	0	None	<Null>
64	20	0	0	None	<Null>
65	20	0	0	None	<Null>
66	17	0	0	None	<Null>
67	13	0	0	None	<Null>
68	6	25	100	High	<Null>
69	9	1	<Null>	None	<Null>
70	12	0	<Null>	Low	<Null>
71	12	0	0	None	<Null>
72	5	0	1	Low	Cobble

Survey Point	Depth (ft)	% Cover Floating	% Cover Submerged	Biomass	Sediment
73	12	0	0	None	<Null>
74	12	0	0	None	<Null>
75	6	5	25	Low	<Null>
76	16	0	0	None	<Null>
77	1	50	75	Moderate	Muck
78	5	0	<Null>	None	Sand
79	10	0	<Null>	Low	<Null>
80	11	0	<Null>	Low	<Null>
81	9	0	<Null>	Low	<Null>
82	3	0	0	None	Cobble
83	20	0	0	None	<Null>
84	20	0	0	None	<Null>
85	9	0	0	None	<Null>
86	20	0	0	None	<Null>
87	16	0	0	None	<Null>
88	5	5	100	High	Muck
89	8	0	<Null>	Low	<Null>
90	8	0	<Null>	Low	<Null>
91	4	0	75	Moderate	<Null>
92	12	0	0	None	<Null>
93	20	0	0	None	<Null>
94	20	0	<Null>	None	<Null>
95	20	0	0	None	<Null>
96	13	0	0	None	<Null>
97	4	0	100	Moderate	<Null>
98	4	5	100	Moderate	Muck
99	20	0	0	None	<Null>
100	21	0	0	None	<Null>
101	16	0	0	None	<Null>
102	10	50	75	Moderate	<Null>
103	13	0	0	None	<Null>
104	5	0	5	Low	Cobble
105	18	0	0	None	<Null>
106	20	0	0	None	<Null>
107	16	0	0	None	<Null>
108	2	25	100	High	Muck
109	27	0	0	None	<Null>
110	14	0	0	None	<Null>
111	10	0	0	None	<Null>

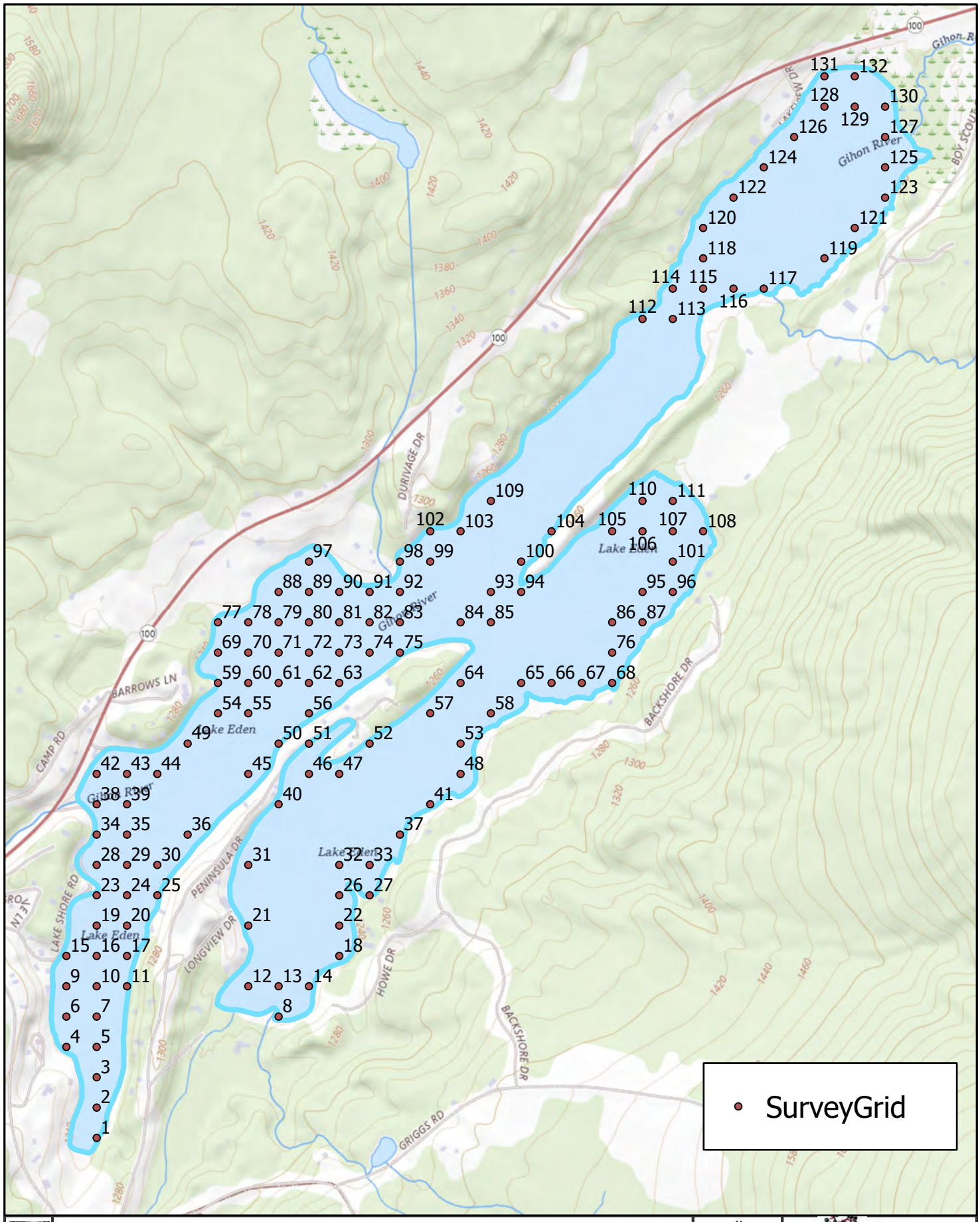
Survey Point	Depth (ft)	% Cover Floating	% Cover Submerged	Biomass	Sediment
112	14	0	0	None	<Null>
113	20	0	<Null>	None	<Null>
114	7	5	50	Moderate	<Null>
115	15	0	<Null>	None	<Null>
116	3	5	100	Moderate	Muck
118	16	0	0	None	<Null>
119	0	0	<Null>	None	<Null>
120	10	0	0	None	<Null>
123	10	0	0	None	<Null>
124	15	0	0	None	<Null>
125	13	0	<Null>	None	<Null>
126	13	0	0	None	<Null>
127	2	25	100	High	<Null>
128	12	0	0	None	<Null>
129	16	0	0	None	<Null>
130	2	50	100	Extremely High	Muck
131	2	0	25	Moderate	Muck
132	3	0	100	High	Muck

Appendix 2: Aquatic Vegetation Maps

Appendix 2a: Lake Eden Grid Point Locations

Appendix 2b: Lake Eden Aquatic Natural Communities

Appendix 2c: Lake Eden Eurasian Watermilfoil Maps



Lake Eden Eurasian Watermilfoil 2024

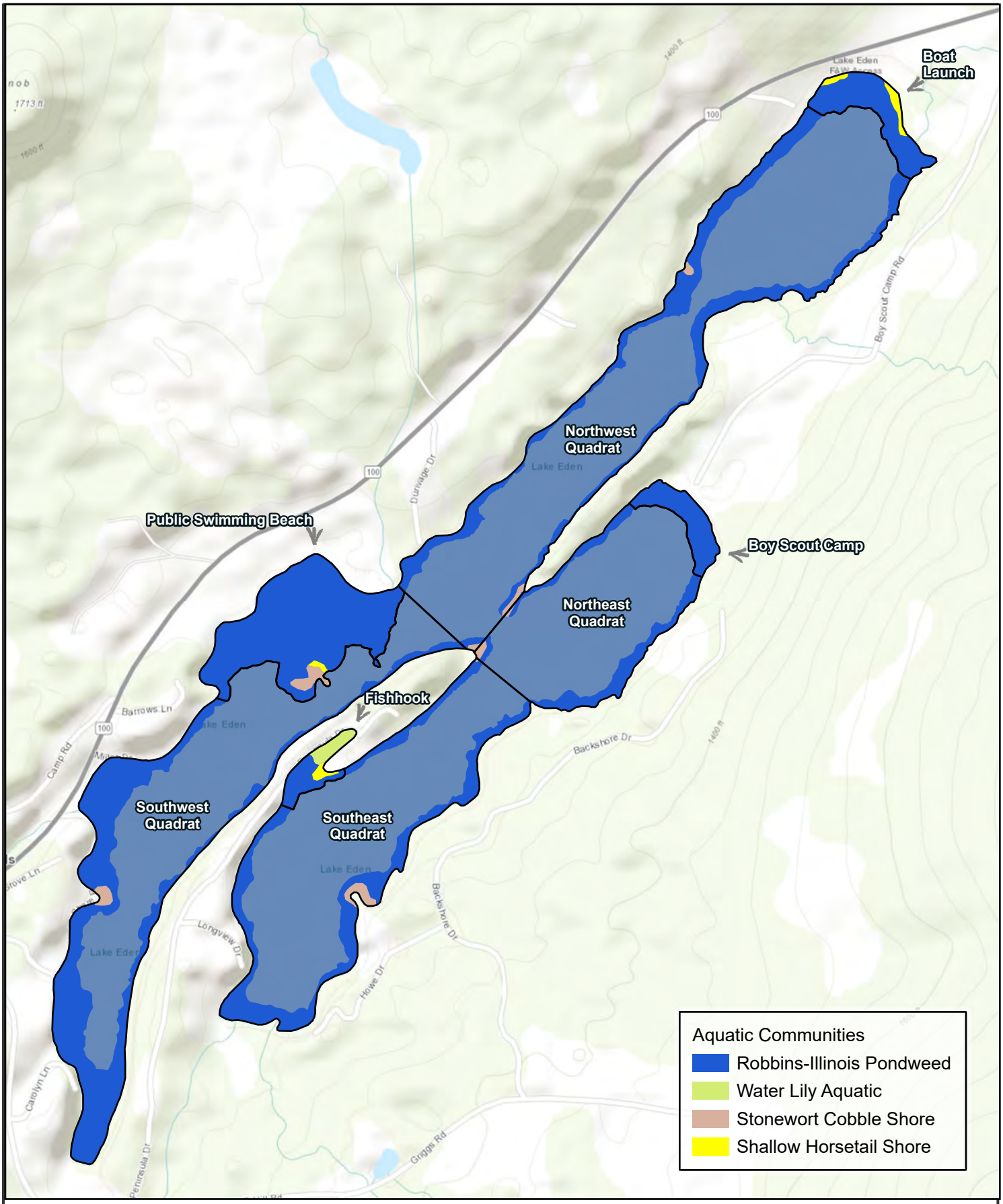
Thursday, November 7, 2024 File: Lake Eden:8.5x11 fieldmap

Prepared By: A Worthley *NAD 1983 StatePlane Vermont FIPS 4400*

0 110220 440 660 880 Feet

N W E S

ARROWWOOD ENVIRONMENTAL
950 BERT WHITE ROAD
HUNTINGTON,VT 05462
(802 434-7276 FAX: (802) 329-2259



Lake Eden Eurasian Watermilfoil 2024

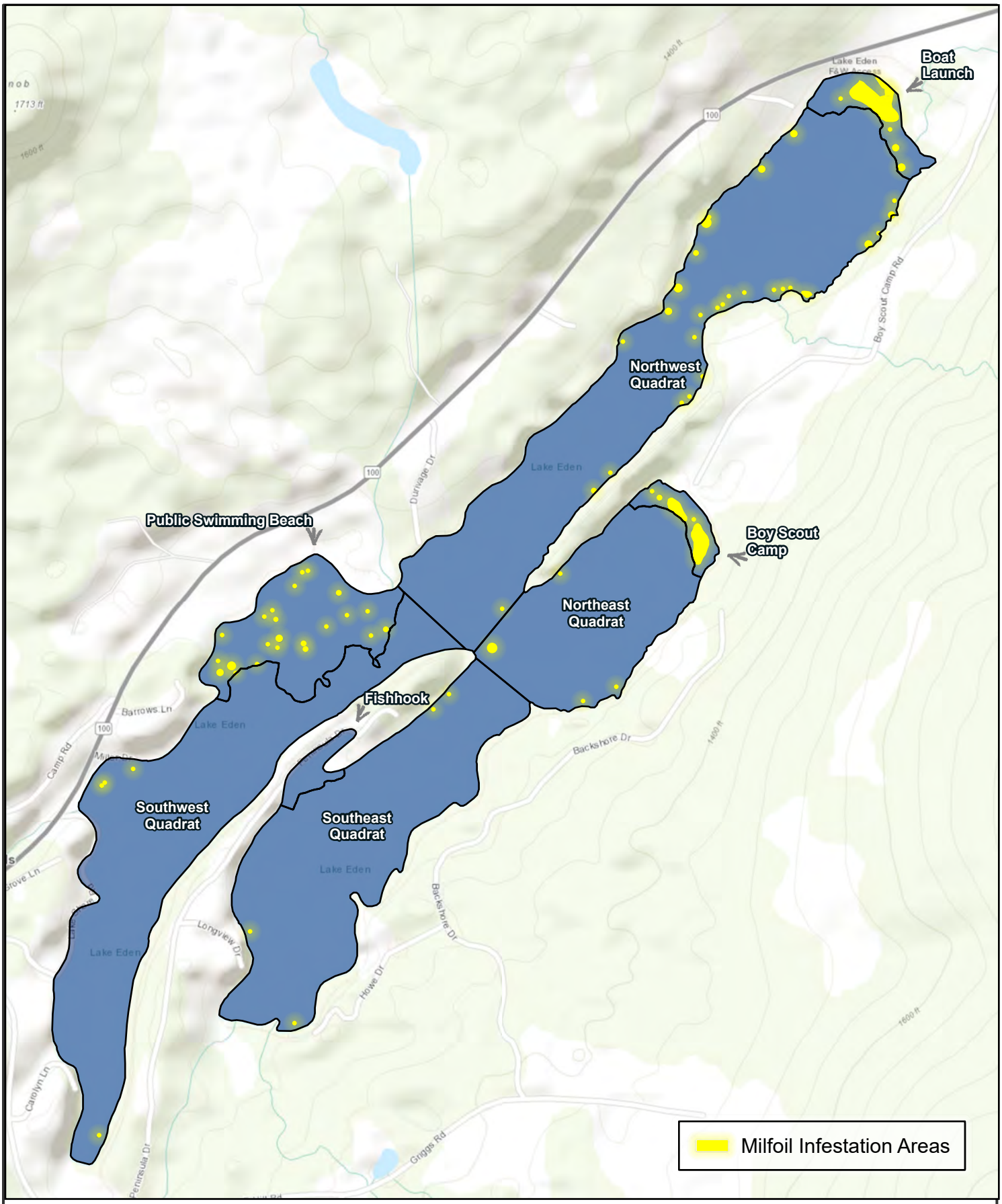
Thursday, November 07, 2024 File: LakeEden:Report Appendix 2024

Prepared By: A Worthley *NAD 1983 StatePlane Vermont FIPS 4400*

0 200 400 800 Feet

N W E S

ARROWWOOD ENVIRONMENTAL
950 BERT WHITE ROAD
HUNTINGTON,VT 05462
(802 434-7276 FAX: (802) 329-3259



Lake Eden Eurasian Watermilfoil 2024

Wednesday, November 06, 2024 File: LakeEden:Report Appendix 2024

Prepared By: A Worthley *NAD 1983 StatePlane Vermont FIPS 4400*

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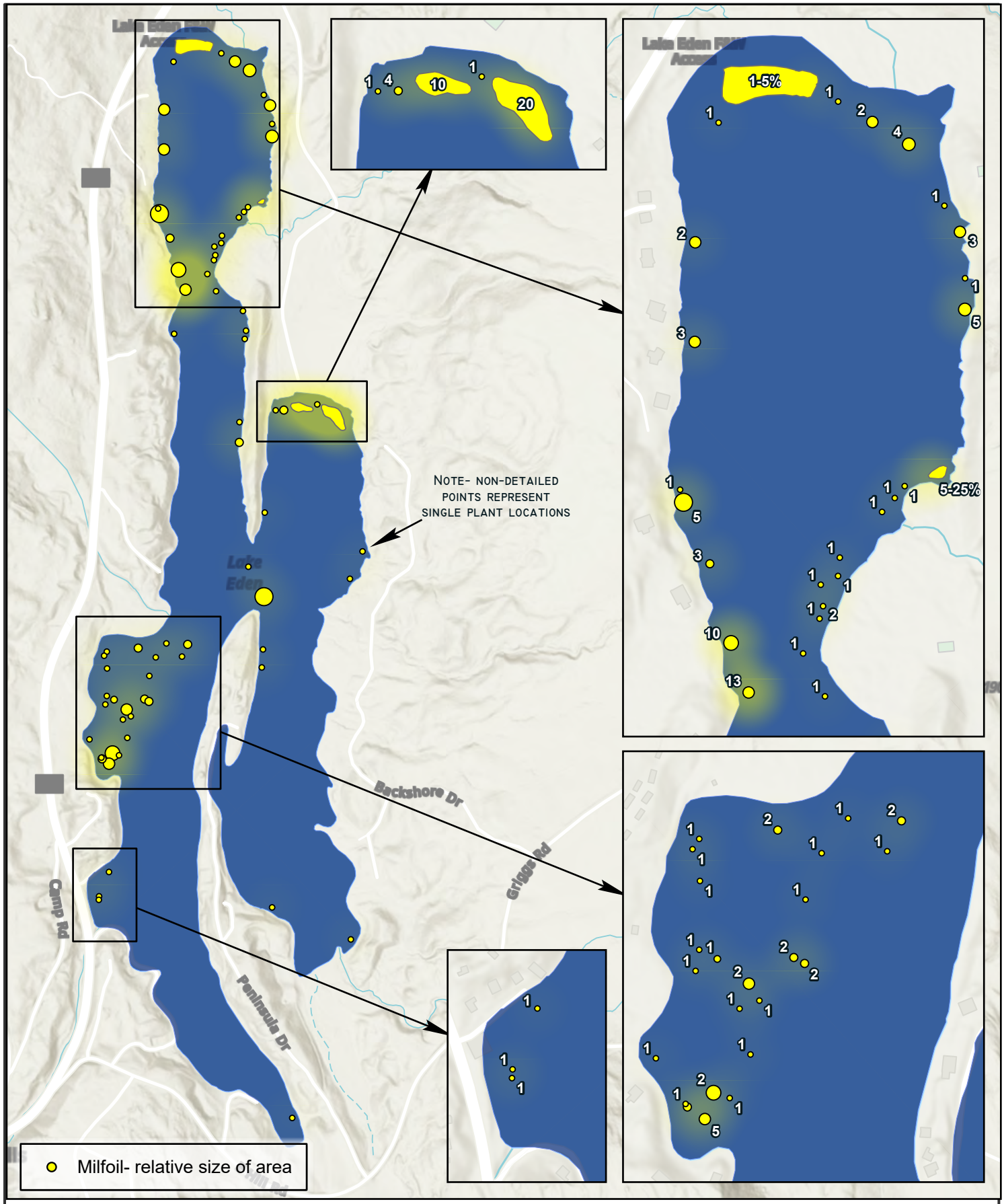
N W E S

ARROWWOOD ENVIRONMENTAL
950 BERT WHITE ROAD
HUNTINGTON,VT 05462
(802 434-7276 FAX: (802) 329-3259



Lake Eden Eurasian Watermilfoil 2024

Monday, September 16, 2024 File: LakeEden:8.5x11 EWM
Prepared By: A Worthley *NAD 1983 StatePlane Vermont FIPS 4400*

0 130260 520 780 1,040 Feet

ARROWWOOD ENVIRONMENTAL
950 BERT WHITE ROAD
HUNTINGTON,VT 05462
(802 434-7276 FAX: (802) 329-3259