AQUATIC NUISANCE CONTROL PERMIT APPLICATION - HERBICIDE

Lake Iroquois

Williston, Hinesburg & Richmond, Vermont

March 2020

APPLICANT:
Lake Iroquois Association &
Lake Iroquois Recreation District

APPLICATOR:
SŌLitude Lake Management
590 Lake Street
Shrewsbury, MA 01545

SŌLITUDE LAKE MANAGEMENT

TABLE OF CONTENTS

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

For Aquatic Nuisance Control Permit Program Use Only
Application Number:

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

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 Iroquois Association

2a. Mailing Address: PO Box 569

2b. Municipality: Hinesburg | 2c. State: VT | 2d. Zip: 05461

3. Phone: | 4. Email: lakeiroquoisassociation@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: 508-865-1000 | 4. Email: ksliwoski@solitudelake.com

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

2a. Mailing Address:

2b. Municipality: | 2c. State: | 2d. Zip:

3. Phone: | 4. Email:

D. Waterbody Information
1. Name of waterbody: Iroquois Lake - Hinesburg 2. Hinesburg - Chittenden

3. Are there wetlands associated with the waterbody? ☒ Yes ☐ No
Contact the Vermont Wetland Program: (802) 828-1535 for additional information.

4. Are there rare, threatened or endangered species associated with the waterbody? ☒ 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 2020	1b. Proposed end date (if known): June 2025
2. Aquatic nuisance(s) to be controlled: Plant/Algae/Animal: Myriophyllum spicatum, Eurasian watermilfoil *Submit additional information as needed.*	3. Pesticide(s) to be used[1]: florpvrauxifen-benzvl Trade Name: ProcellaCOR EC EPA Registration #: 67690-80 *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): 3 PDU/ac-ft; 5.79 ppb/ac-ft *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)

CJC. 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: Christopher Conant Date: 3/02/20

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: [signature] Digitally signed by Kara Sliwoski DN: cn=Kara Sliwoski, o=SOLitude Lake Management, ou, email=ksliwoski@solitudelake.com, c=US Date: 2020.03.03 13:01:25 -05'00' Date: ______

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, Main 2
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: http://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-range Management Plan requirement, as per 10 VSA §1455(e)

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

For Aquatic Nuisance Control Permit Program Use Only
Application Number:

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

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 Iroquois Recreation District

2a. Mailing Address: 7900 Williston Rd, Williston, VT 05495		
2b. Municipality: Lake Iroquois Recreation District	2c. State: VT	2d. Zip:
3. Phone: 802-343-3535	4. Email: jadavis@peakcm.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: 508-865-1000	4. Email: ksliwoski@solitudelake.com	

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

2a. Mailing Address:		
2b. Municipality:	2c. State:	2d. Zip:
3. Phone:	4. Email:	

D. Waterbody Information
1. Name of waterbody: Iroquois Lake - Hinesburg 2. Hinesburg - Chittenden

3. Are there wetlands associated with the waterbody? ☒ Yes ☐ No
Contact the Vermont Wetland Program: (802) 828-1535 for additional information.

4. Are there rare, threatened or endangered species associated with the waterbody? ☒ 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 2020	1b. Proposed end date (if known): June 2025
2. Aquatic nuisance(s) to be controlled: Plant/Algae/Animal: Myriophyllum spicatum, Eurasian watermilfoil *Submit additional information as needed.*	3. Pesticide(s) to be used[1]: florpyrauxifen-benzyl Trade Name: ProcellaCOR EC EPA Registration #: 67690-80 *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): 3 PDU/ac-ft; 5.79 ppb/ac-ft *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)

_____ 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.

Please note: the notices were mailed by LIA, as noted on the prior application form

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: [signature] Date: 2/28/20

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: [signature] Digitally signed by Kara Sliwoski DN: cn=Kara Sliwoski, o=SOLitude Lake Management, ou, email=ksliwoski@solitudelake.com, c=US Date: 2020.03.03 17:04:42 -05'00' Date: _______

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, Main 2
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: http://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-range Management Plan requirement, as per 10 VSA §1455(e)

APPENDIX A

- **Detailed Project Description**
- **2019 Aquatic Plant Management Annual Report**

EXECUTIVE SUMMARY

Non-native and invasive Eurasian watermilfoil has infested Lake Iroquois for at least 30 years. An integrated milfoil management program was eventually initiated. For many years, non-chemical control efforts have been performed, to try and keep Eurasian watermilfoil below nuisance densities. Survey efforts performed in September 2019 identified at least 40 acres that support milfoil in sufficient densities that are too great for management via non-chemical control efforts and warrant herbicide treatment in order to maintain control of EWM growth within Lake Iroquois. Additional details on existing efforts and the proposed project are outlined in the following pages.

PURPOSE

This document outlines a 5-Year Long-Term Management Plan targeting control of Eurasian watermilfoil (*Myriophyllum spicatum*) through continuance of the integrated, non-chemical approaches below. This Plan additionally outlines area-selective (40% or less of littoral zone) application of the aquatic herbicide ProcellaCOR EC. It is sought and anticipated for a five-year permit to be issued, understanding that annual approval for any treatment under that permit is required during any calendar year in which treatment is desired.

LIA proposes to continue the following Integrated Pest Management (IPM) approaches:

1) SCUBA Diver hand-pulling
2) (DASH) Diver Assisted Suction Harvesting
3) Snorkel hand-pulling (volunteer)
4) Selective installation of Benthic Barrier Matting
5) Greeter Program at the boat launch for increased Aquatic Nuisance Species awareness and watercraft inspections
6) Availability of Wash Station for hot wash treatment of watercraft entering and leaving the Lake
7) Vermont Invasive Patroller (VIP) surveys
8) Lay Monitoring for Lake water quality monitoring
9) Continuation of Lake tributary water quality monitoring (Contingent on LaRosa Partnership Program (LPP) funding levels and final approval)
10) Pursuit of grants that address problem areas contributing increased nutrient loads to the Lake
11) Continued pursuit of stream remediation projects that reduce sediment discharge into the lake
12) Collaboration with the Lake Iroquois Recreation District (LIRD) and the surrounding towns to reduce road runoff, and to mitigate erosion and sediment runoff at the beach and from LIRD property.
13) Sponsorship of outreach programs such as Septic Socials, the Lake Wise program, and continued education on shoreline protection and restoration
14) Education – outreach with member communications & volunteer training

INTRODUCTION

Lake Iroquois, known formerly as Hinesburg Pond and hereafter referred to as 'the Lake', is a 229-acre eutrophic kettle pond bordered by the towns of Hinesburg, Williston, and Richmond. The town of St. George also lies within the Lake's watershed. The Lake is situated in a valley bracketed by Dow Hill to the southeast and Mount Prichard on the west. The Lake lies about 15 miles from Vermont's principal urban area of Burlington and is the largest body of water in the LaPlatte River watershed, which drains to the greater Lake Champlain watershed.

The Lake was formed following the receding of the last ice coverage in Vermont about 15,000 years ago. Over the years, the Lake has naturally become more eutrophic, and has been the site of significant human development and use in the last 150 years. A dam constructed on the Lake's outlet in the mid-1800s led the spring-fed body of water to rise above the existing banks and was used to control the water supply to mills downstream in Hinesburg. These mills are no longer operational. Around the 1960s, the dam was intentionally cemented into its top position, retaining the pond at an artificially high level throughout the year. The outflow of the Lake is over the dam in the south end and forms Patrick Brook. It is interesting to note that historic U.S. Geological Survey and Town maps dating back to the 1800s show the stream formerly labeled as Pond Brook all the way to its confluence with the LaPlatte River. This outlet stream first flows into Sunset Lake (formerly known as Lower Pond) and eventually through the Town of Hinesburg, prior to draining into the LaPlatte River on its way to Lake Champlain.

EXISITING CONDITIONS

Presence of the invasive aquatic plant Eurasian watermilfoil was first confirmed in the lake near the state fishing access in 1990 (LIA SOTL Report).

EWM is widely distributed in Lake Iroquois, primarily in dense, continuous beds with plants growing to the surface. Comprehensive plant surveys were done in 2014, 2017 and 2019. The 2014 plant survey conducted by Northeast Aquatic (NEAR) found EWM to be covering approximately 71 acres of Lake Iroquois. DFWI identified 5 meters (~16 feet) as the maximum depth of colonization of EWM in Lake Iroquois. Based on available bathymetry data, approximately 41% of Lake Iroquois, or 100 acres of the lake's 244-acre total surface area, are capable of supporting EWM growth. The lake has a reported average depth of 19 feet and a maximum depth of 37 feet. The lake's watershed is estimated to be 2,618 acres, resulting in a drainage basin to lake basin ratio (DB:LB) of 11:1.

The 2017 plant survey, carried out by Darrin Fresh Water Institute, showed a slight decrease in the amount of EWM detected and no decrease in incidence of native aquatic species from 2014. Incidentally, it also showed some occurrence of curlyleaf pondweed, another aquatic invasive. The 2019 survey, also performed by Darrin Fresh Water Institute, showed a doubling in the frequency of occurrence of EWM – found at 42.6% of the 115 survey points; however, declines in the frequency of occurrence for the majority of native species were observed between 2017 and 2019. In all three of these surveys, EWM was shown to be the most common species present in Lake Iroquois.

Lake Iroquois supports a broad population of native aquatic plants. In 2014, NEAR documented 23 aquatic plant species; 19 were documented in 2017 by DFWI; and 25 in 2019, also by DFWI. Overall, this reflects a decrease in aquatic species present when compared to the 34 aquatic species present in the 2012 Lake Iroquois Association (LIA) species roster. As noted above, the subsequent plant surveys also indicate that EWM is the most commonly occurring aquatic plant species in the lake. If the recent plant composition trends continue, it is possible that EWM will increasingly displace more of the native plant population as it expands further throughout the littoral zone. Curbing EWM's practically unhindered expansion and maintaining dense native plant growth in Lake Iroquois will be paramount to achieving long-term EWM control. The relatively high number of native species for a waterbody of Lake Iroquois' size illustrates the resilience of the system to resume growing in areas where EWM had previously been present.

HISTORY OF AQUATIC NUISANCE SPECIES CONTROL EFFORTS

To date, efforts to control the EWM infestation have included: hand-pulling, installation of benthic barrier mats, diver assisted suction harvesting (DASH), Vermont Invasive Patroller (VIP) volunteers, buoy installation to improve boating channels, Greeter Program that increases Aquatic Nuisance Species (ANS) awareness, and a Boat Wash station. Biological controls in the form of Milfoil weevils (*Euhrychiopsis lecontei*) were also used with limited effectiveness; however, it is noteworthy that it is difficult to source weevils in sufficient quantities.

Since 2009, the Lake Iroquois Association (LIA) has participated in the Vermont Boat Access Greeter Program by maintaining trained greeting staff at the state fishing access to inspect incoming and outgoing boats and trailers, educate boaters on invasive species, and record boater data. In 2016, LIA added a hot water wash station to enable greeters to clean boats as they enter or leave the lake.

Eurasian watermilfoil control efforts at Lake Iroquois expanded as EWM distribution and density increased over the years. Observation of accelerated EWM growth and expansion in recent years prompted LIA to evaluate alternate management strategies. Based on the positive experiences of other Vermont lakes in recent years, LIA began to consider the use of aquatic herbicides as part of an integrated pest management effort.

The Lake Iroquois Association has also undertaken numerous projects to reduce the nutrients and sediments flowing into the lake. These include several grant-funded projects to mitigate runoff from the streams on the west shore of the lake. More recently, the LIA collaborated with the Pine Shore Road Association and the town of Hinesburg to complete an ERP funded project. This project effectively restored the flood plain of the stream running parallel to Pine Shore Drive and mitigated sediment flowing from this Lake tributary. Lake Iroquois Association tributary monitoring program data showed this was one of the worst streams for phosphorous transport into the lake.

The LIA has continued to collaborate with the Lake Iroquois Recreation District on various projects to reduce sediment and nutrients in the lake and to control EWM around the LIRD beach area. These efforts include collaboration with LIRD on redesigning the drainage at the beach and creating a rain garden to reduce beach erosion. Beach erosion had long been a problem causing much of the beach sand to wash into the lake and required LIRD to replenish sand from elsewhere. Since completion of that project in 2015, minimal erosion has occurred at the beach during spring thaw and heavy rainfall events.

The LIA is currently collaborating with the LIRD to design and implement a plan to remediate LIRD's portion of Beebe Lane. This stream shows the highest average phosphorous levels of any feeding the lake based on LIA tributary monitoring program data and experiences considerable sediment transport into the lake. As of 2019, the engineering design is complete and LIRD and LIA are seeking funding for the implementation phase of the project.

The LIA has worked with the LIRD in recent years to provide DASH around the beach area and to help place benthic mats there to maintain a clearer swimming area.

Based on the non-chemical control management efforts undertaken in 2019, coupled with the survey results from DFWI's fall 2019 survey efforts, there are EWM areas within Lake Iroquois that are beyond control with non-chemical means alone. However, the LIA acknowledges that EWM in Lake Iroquois cannot be controlled by ProcellaCOR alone and intends to continue their intensive integrated management program efforts as well.

OBJECTIVES/GOALS

Principal objectives of the five-year integrated management plan being proposed for Lake Iroquois are:

1. Effectively control invasive Eurasian watermilfoil growth to promote a diverse native plant community, to improve fish and wildlife habitat, and to support recreational use of the lake.

2. Achieve multiple-year Eurasian watermilfoil control in treatment areas in order to reduce the scope, frequency and cost of follow-up treatments in subsequent years in order to utilize other control efforts in the IPM.

3. Continue to use a combination of EWM control techniques as outlined in the aforementioned IPM in addition to treatment with systemic-acting ProcellaCOR EC herbicide, to achieve the desired level of EWM control in the most cost-effective fashion, while minimizing non-target impacts.

4. Prevent the introduction and establishment of any other aquatic nuisance species in Lake Iroquois as outlined in the 'Purpose' section above.

The overall goal is not to treat Lake Iroquois on an annual basis, but rather to manage the EWM infestation via the available control methods and their appropriate integration.

PROCELLACOR™ EC HERBICIDE TREATMENT PLAN

After receiving its full aquatic registration from the EPA in February 2018, ProcellaCOR was used in numerous locations throughout the country for control of milfoil and other susceptible invasive aquatic plants. In 2018 in New England, SŌLitude applied ProcellaCOR at approximately a dozen locations in New Hampshire and Connecticut for the control of variable milfoil and Eurasian watermilfoil. In 2019 in Vermont, SŌLitude applied ProcellaCOR at four waterbodies; while many waterbodies in New York, New Hampshire, Massachusetts, Maine, and Connecticut were also treated with ProcellaCOR. Results of all treatments performed to date have been extremely positive, achieving nearly complete control of targeted milfoil growth with little or no impact to non-target native plants. Documentation from use in 2019 on the selectivity of

ProcellaCOR at Vermont projects has been provided to VT DEC, and it has proven to be even more selective for EWM control in Vermont lakes than has been achieved using Sonar (fluridone) or Renovate (triclopyr) herbicide in recent years.

Previously issued ProcellaCOR EC herbicide permits issued by Vermont DEC for other waterbodies have been conditioned such that only a maximum of 40% of the littoral zone (or area where light penetrates enough to support plant growth) 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. The littoral zone of Lake Iroquois is 100 acres, which means only 40 acres can be managed with any method or combination of methods in a given year. For 2020, the LIA is proposing to treat approximately 40 acres with ProcellaCOR EC herbicide.

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 ideal fish habitat, but if few native aquatic plant species are present within the respective waterbody, then EWM is likely acting as some fish 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's reduced risk profile issued by the US EPA and it's 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 treatments that have been performed in Vermont and the Northeast to date. Of the other species reported in Lake Iroquois by DFWI in 2019, the only plants that may show some impact following treatment are coontail (*Ceratophyllum demersum*), and white waterlilies (*Nymphaea odorata*). Coontail is typically not impacted by ProcellaCOR treatments except when using rates of 4+ PDUs/ac-ft; while the white waterlilies may show some discoloration and twisting, depending on their proximity to the treatment area(s), before outgrowing the symptoms.

Use of this herbicide is intended to supplement LIA's current integrated, long range pest management program outlined in the Purpose 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. Undoubtedly, others areas of Lake Iroquois would be significantly more infested with EWM growth if it were not for LIA's diligent and intensive non-chemical management programs. LIA also remains committed to initiating and supporting responsible and practical watershed management protection measures.

The treatment program being proposed at Lake Iroquois involves the treatment of approximately 40 acres of EWM growth that was documented during the survey in September 2019 by DFWI as shown in the attached map(s). EWM growth in these areas is now too abundant to be cost-effectively managed using suction harvesting, bottom barriers or hand-pulling, as was attempted during the summer of 2019 and prior summers.

ProcellaCOR 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, 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 LIA has already undertaken and will continue, must be taken by all lake users in order to mitigate future spread potential at Lake Iroquois as well as other waterbodies nearby.

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

Date	Task
September	Late season survey to document EWM infestation
January	Project review and meeting with DEC, if necessary
February / March	Submission of permit application for 2020 treatment
May	Early season survey to develop final treatment map. Submission of map and specific treatment plants to DEC for review and approval. Perform required pre-treatment notifications.
June	Schedule and conduct ProcellaCOR 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 herbicide at other New England lakes, and input from SePRO Corporation, the following protocols are recommended for the proposed ProcellaCOR treatment at Lake Iroquois in 2020 and future years, if needed:

1. Formulation – Utilize ProcellaCOR™ EC herbicide. This is a liquid formulation.

2. Application – A solution of ProcellaCOR 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.

3. Timing – Treatment would be scheduled for anytime between early June and early September (temperature dependent) period 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 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 Iroquois is up to 3 PDUs per acre-foot. The 3 PDU application rate is only 12% of the maximum allowable application rate listed on the product label.

This treatment strategy was employed at Lake Morey, Lake Hortonia, Lake Saint Catherine and Burr Pond in 2019. All of the aforementioned projects were conducted in the same way that Lake Iroquois' project is proposed under this application. All results from each of those treatments, as well as overall lack of non-target impacts, were incredibly successful.

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	Up to 3 PDU per acre-foot
Treatment Area	Up to approximately 40 acres – see attached map ** Actual acreage is anticipated to be finalized in May 2020*
Total product to be Applied	960 PDUs (24 gals) maximum ** Assumes average depth of 8 feet per treatment area; Actual quantity to be applied may be reduced following pre-treatment inspection to finalize treatment areas in May 2020*
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. Treating 40 acres at 3 PDU will yield a theoretical maximum lake-wide concentration of 0.47 ppb
Treatment Timing	Between early June and early September 2020 Delay treatment until there is sufficient active EWM growth to maximize herbicide uptake
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 with WAAS or differential accuracy 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 herbicide treatment at Lake Iroquois. Data gathered by SePRO Corporation during the product registration process and actual results documented during the 2018 and 2019 treatment seasons have shown that EWM is highly susceptible to low rates of ProcellaCOR. Few, if any, adverse impacts are expected on most non-target native plants at the rate anticipated for use at Lake Iroquois.

At treatments performed by SŌLitude in 2018 and 2019, the only temporary impacts seen were slight stem twisting and leaf curling on watershield (*Brasenia screberi*), white waterlily (*Nymphaea odorata*) and yellow waterlily (*Nuphar variegata*), but the plants grew out of the symptoms after a period of several weeks. Although coontail (*Ceratophyllum demersum*) is on the ProcellaCOR label as a potentially impacted species, it has been observed that only application rates above 4 PDUs/ac-ft have any observable impacts on coontail. Of the 2019 Vermont ProcellaCOR applications, the only impact observed was to the waterlily species at Burr Pond in Sudbury as the treatment area was directly adjacent to the shoreline patch. The waterlily pads turned slightly yellow and brown, had some lifting and twisting of the pads, but eventually grew out of the symptoms before the end of the season. These impacts were anticipated and not of concern.

The ProcellaCOR EC label identifies the species that are susceptible to the herbicide, which include the following species known to be within Lake Iroquois and downstream in Sunset Lake (Lower Pond): watershield (*Brasenia schreberi*), coontail (*Ceratophyllum demersum*), and Eurasian watermilfoil (*Myriophyllum spicatum*). There are additional species listed on the ProcellaCOR label which may be susceptible to treatment, however they are not known to be present within Lake Iroquois or Sunset Lake. Additionally, based on ProcellaCOR experience at other waterbodies in Vermont and the northeast, white waterlilies (*Nymphaea odorata*) can also be susceptible, but only show slight twisting and discoloration symptoms which are outgrown approximately 4-8 weeks following treatment. Further, all potentially susceptible species have susceptibilities dependent upon their proximity to the treatment areas and the dose being applied – i.e. if a patch of watershield is not located close to any treatment area, it would be anticipated that the watershield would be unimpacted. Based on the list of species documented in Lake Iroquois by DWFI in 2019, only white waterlilies and coontail may be impacted depending on their proximity to the treatment area(s). Based on the proposed treatment rate (3 PDUs/ac-ft), there are no impacts anticipated to any coontail plants. A complete list of plant species found in Lake Iroquois can be found in DFWI's 2019 survey report, which is included in this application.

Non-target impacts to Sunset Lake are also anticipated to be minimal, as treatment areas will be located in the northern end of Lake Iroquois. Based on the rapid absorption of ProcellaCOR into EWM plants, if any ProcellaCOR were to flow into Sunset Lake it would be even further diluted; if any impacts were to happen, it would be anticipated that EWM plants would be impacted and nothing else.

No impact to State protected plant species is anticipated following treatment with ProcellaCOR herbicide. Of the State listed species previously observed in Lake Iroquois and Sunset Lake according to the VT DEC Lake Score Card, none are anticipated to be adversely impacted by a ProcellaCOR herbicide treatment.

It is understood that although wetlands are present within Lake Iroquois and Sunset Lake, the only anticipated impact would be that of reduction in EWM plants and all other non-target impacts to wetland areas would be negligible.

Following treatment efforts, the 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 brown and get 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 relative to the overall waterbody acreage, there is no additional concern for an algal bloom beyond what may be present in any one given year at a waterbody of Lake Iroquois' 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 beneficial habitat for fish.

Based on the ecotoxicological testing completed for ProcellaCOR, 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. Additional documentation from the State of Washington's review of ProcellaCOR is attached.

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 treated water for irrigation purposes. There are no restrictions on using ProcellaCOR 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 use in 2019; on the day of treatment, 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 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 applications in Vermont, it is not anticipated that ProcellaCOR will travel downstream past Sunset Lake given the increased dilution at its headwaters, plus any absorption by EWM assuming it were to travel as far as Sunset Lake.

Based on prior ProcellaCOR application review in Vermont, the Vermont Department of Health had issued a favorable drinking water review for ProcellaCOR, which states application accordingly to the label would pose a negligible risk to public health. It is anticipated the agency's review for Lake Iroquois 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 submittal and prior to any herbicide treatment, which will occur two weeks in advance of the date of treatment.

As one mile downstream of Lake Iroquois' outlet is a distance before the outlet of Sunset Lake, the LIA has chosen to notify all direct waterfront abutters on Sunset Lake.

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 LIA, 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.

FIVE-YEAR EURASIAN WATERMILFOIL MANAGEMENT PROGRAM BUDGET ESTIMATES

Project cost estimates for the Five-Year Eurasian Watermilfoil Management Program being proposed at Lake Iroquois is provided in the following table. Please note that these are estimates subject to the availability of funds and any changes in costs.

The five-year management plan and associated project cost estimates are provided to illustrate the applicant's understanding and dedication to the long-term commitment of an integrated EWM management program. According to the DFWI report of 2019, EWM was found in 86% of the littoral zone. These budget estimates assume herbicide treatment in Years 1 and 2 for most of the portion of the littoral zone where EWM is found in order to gain control of the infestation. Thus, in Year 1, 40% (approximately 40 acres at the north end of the lake) of the littoral zone will be treated. In Year 2, an additional 30% to 40% of the littoral zone – the exact amount will depend on the results of the plant survey following the Year 1 treatment – will be treated with herbicide and some bottom barriers will also be used, where practical. In Year 3, it is hoped that no herbicide will be necessary and that non-herbicide methods will suffice to control any remaining EWM. The decision on exact methods to use will depend on the results of the plant survey after each year's management efforts. Years 4 and 5 involve only use of non-herbicide barrier and mechanical methods. This is an estimate only and actual costs will be dependent on needs shown by data collected each year and on availability of funds.

Estimated Program Costs – 2020 dollars	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Description	2020	2021	2022	2023	2024
Herbicide treatment	$ 52,000	$39,000 – 52,000-	$-		$ -
Suction harvesting	$ -	$	$ 15,000	$6,000	$6,000
Benthic Barriers		$500	$500	$500	$500
Monitoring/annual aquatic plant surveys	$ 5,000	$ 3,500	$ 3,750	$ 3,750	$ 3,750
Notification (mailings, signs, etc.)	$1,500	$1,500-	$ -		$ -
LIA Expenses (consultant for permit prep, meetings, miscellaneous)	$4,000				
Totals	$62,500	$44,500- $57,500$	$19,250	$10,250	$10,250

CONCLUSION

These efforts are undertaken to protect the lake ecosystem through reduction and control of invasive EWM. It is an ongoing collaboration between LIA and LIRD, the surrounding towns, lakefront property owners, lake users, and the state of Vermont. These mitigation efforts require an integrated management plan utilizing all available methods of control and stakeholder involvement. This plan strives to achieve this objective. The plan is fiscally sound and will effectively aid reduction and control of EWM meanwhile increasing potential for rebound of native aquatic species. This plan includes continued pursuit of our stream remediation and runoff mitigation projects to achieve nutrient reduction goals. These goals will additionally serve to discourage EWM growth and strive to achieve enhanced lake water quality and a healthy lake ecosystem.

DARRIN
Fresh Water Institute
Lake George, New York
Adirondack Field Station at Bolton Landing

Aquatic Vegetation of Lake Iroquois, Chittenden County, Vermont

Prepared By

Lawrence Eichler
Research Scientist

Darrin Fresh Water Institute
5060 Lakeshore Drive
Bolton Landing, NY 12814
(518) 644-3541 (voice) (518) 644-3640 (fax)
eichll@rpi.edu

December 12, 2019
DFWI Technical Report 2019-10

TABLE OF CONTENTS

List of Tables

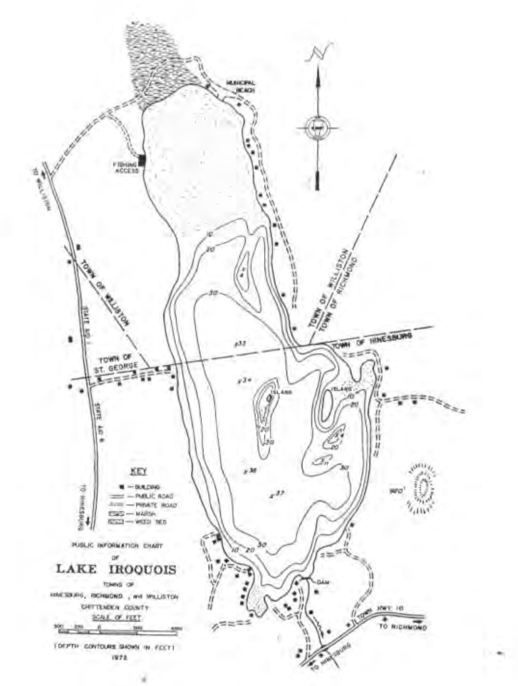
List of Figures

Background.

At the request of the Lake Iroquois Association, quantitative aquatic plant surveys were undertaken for Lake Iroquois, Vermont in September of 2019. The surveys consisted of frequency of occurrence and relative abundance data for all aquatic plant species present in points distributed throughout the lake. Surveys were also designed to be comparable to a prior survey by the author in 2017 (Eichler 2017). The Point-Intercept Rake Toss method presently used by the US Army Corps of Engineers and others was employed. The assessment included the distribution and density of existing aquatic plant communities, the extent of exotic species infestation and a review of ongoing management efforts to control Eurasian watermilfoil (*Myriophyllum spicatum*).

Methods

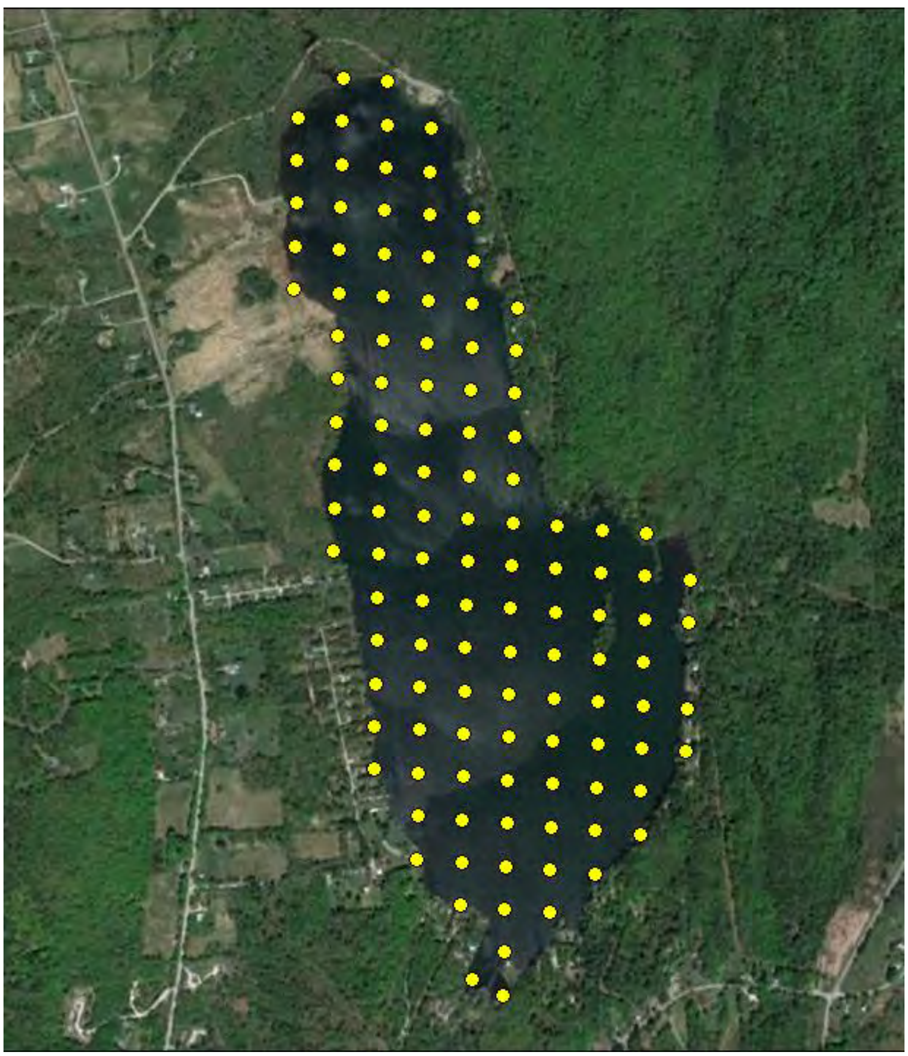
Survey Sites



Lake Iroquois. Lake Iroquois is located in Chittenden County, in the towns of Hinesburg, Richmond and Williston. The lake has a surface area of approximately 244 acres with a watershed area of 2198 acres. Lake Iroquois has a single outlet with a control structure, however no lake level control is possible. Maximum water depth is reported to be 37 ft with average water depth of 19 feet (VTDEC 2016a). Secchi disk transparency in 2015 averaged 12 ft (3.8 m; VT DEC 2015). Lake Iroquois is classified as eutrophic based on phosphorous and chlorophyll concentrations, indicating that nutrient levels are sufficient to support dense growth of planktonic algae and aquatic plants. Two aquatic invasive aquatic plant species are reported for Lake Iroquois, Eurasian watermilfoil (*Myriophyllum spicatum*) and Curly-leaf Pondweed (*Potamogeton crispus*) (VT DEC 2016b). VT DEC records indicate that Eurasian watermilfoil was first confirmed in 1991 while curly-leaf pondweed was present in 1984. An aquatic plant survey of Lake Iroquois in September of 2014 reported over 70 acres of dense Eurasian watermilfoil growth (Knoecklein 2015). A total of 45 aquatic plant species have been reported for Lake Iroquois in multiple surveys since 1984, however a 2014 survey only reported 23 species. Loss of native species is a commonly reported phenomenon in lakes with severe infestation by Eurasian watermilfoil and/or other invasive aquatic plant species (Madsen et al. 1991). In a survey conducted by the author in 2017, a total of 25 species of aquatic plants were observed in Lake Iroquois (Eichler 2017). The aquatic plant community included sixteen submersed species, two floating-leaved species, and seven emergent species. Duck celery (*Vallisneria americana*) and coontail (*Ceratophyllum demersum)* were the most common native plants. Eurasian watermilfoil (*Myriophyllum* *spicatum*) was present in 24% of survey points.

Hand harvesting efforts began on Lake Iroquois during 2008 to control the dense growth of Eurasian watermilfoil. The aquatic weevil (*Euhrychiopsis lecontei*) population of the lake was supplemented in 2008 and 2009 in an effort to provide a biocontrol agent for Eurasian watermilfoil. The extensive growth of Eurasian watermilfoil reported in 2014 suggested a more extensive management effort was necessary. In 2016, diver assisted suction harvesting (DASH) for Eurasian watermilfoil control was employed in the boat launch area and near the LIRD beach. Over a period of 2 weeks, divers harvested over 5000 gallons of Eurasian watermilfoil. Benthic barriers (mats) were installed in 2017 to maintain the areas harvested by DASH in 2016. In 2019, DASH collected approximately 2000 gallons of Eurasian watermilfoil, however this only represented a very small fraction of the Eurasian watermilfoil growth in the lake. Residents remained concerned that current Eurasian watermilfoil growth was exceeding the capacity of the existing management effort.

Figure 1. Map of Lake Iroquois with point intercept survey locations for 2019.



Species List and Herbarium Specimens. As the lakes were surveyed, the occurrence of each aquatic plant species observed in the lake was recorded and adequate herbarium specimens were collected. The herbarium specimens were returned to the Darrin Fresh Water Institute, where they were pressed, dried, and mounted (Hellquist 1993).

Point Intercept Surveys. The frequency and diversity of aquatic plant species were evaluated using a point intercept method (Madsen 1999). At each grid point intersection, all species located at that point were recorded, as well as water depth. Species were located by a visual inspection of the point and by deploying a rake to the bottom, and examining the plants retrieved. A total of 115 points were surveyed for Lake Iroquois, based on a 100 m grid. A global positioning system (GPS) was used to navigate to each point for the survey observation. Point intercept plant frequencies were surveyed on September 12, 2019 at a time of maximum aquatic plant abundance.

Relative abundance in the Point Intercept surveys. To characterize relative abundance of each of the species identified in the point intercept survey, a scale developed by Cornell University and the US Army Corps of Engineers was employed. For each rake toss, the relative abundance of each plant species collected was recorded based on a rating scale (see below). Maps of the distribution of each species by its relative abundance are included in Appendices A & B.

Relative abundance scale based on US Army Corp/Cornell methods.

Code	Rating	Abundance
0	no plants	
1	trace growth of plants	fingerful on rake
2	sparse growth of plants	handful on rake
3	medium growth of plants	rakeful of plants
4	dense growth of plants	difficult to bring into boat

Results and Discussion

Lake Iroquois Survey Results

In September of 2019, the aquatic plant community of Lake Iroquois included twenty-three submersed species, two floating-leaved species, one floating species and seven emergent species (Table 1) and included some species observed but not collected in the point intercept survey. Twenty five species were present in the point intercept portion of the 2019 surveys, slightly more than the 19 and 23 species reported in 2017 and 2014, respectively. Combining the results of all surveys, a total of 45 species of aquatic plants have been reported for Lake Iroquois, however many of these would be classified as wetland species not captured by the current survey techniques. This number of species greatly exceeds the 15 species typically reported for moderately productive lakes in our region and indicates good water quality and a variety of habitat types. Eurasian watermilfoil (*Myriophyllum spicatum)* and curly-leaf pondweed (*Potamogeton crispus*) were the only exotic species reported in Lake Iroquois. One of the species present in Lake Iroquois, Humped Bladderwort (*Utricularia gibba*) is found on Vermont's rare plant list (VT DEC 2012).

Table 1. Species lists for Lake Iroquois and Sunset Pond.
Species in red are invasive.

Species Name	Common Name	Lake Iroquois
Brasenia schreberi	Water shield	fl
Ceratophyllum demersum L.	coontail	s
Chara sp.	muskgrass, chara	s
Eleocharis acicularis (L.) Roemer & Schultes	needle spike-rush	e
Elodea canadensis Michx.	elodea	s
Isoetes echinospora Dur.	quillwort	e
Lemna minor L.	duckweed	f
Lemna trisulca L.	duckweed	s
Megalodonta (Bidens) beckii Torr.	water marigold	s
Myriophyllum spicatum L.	Eurasian watermilfoil	s
Najas flexilis (Willd.) Rostk. & Schmidt.	bushy pondweed	s
Najas guadalupensis L.	southern naiad	s
Nymphaea odorata Ait.	white waterlily	fl
Polygonum amphibium	smartweed	e
Pontederia cordata L.	pickerelweed	e
Potamogeton amplifolius Tuckerm.	large-leaf pondweed	s
Potamogeton crispus L.	curly-leaf pondweed	s
Potamogeton foliosus Raf.	pondweed	s
Potamogeton natans L.	floating-leaf pondweed	s
Potamogeton perfoliatus L.	clasping-leaf pondweed	s

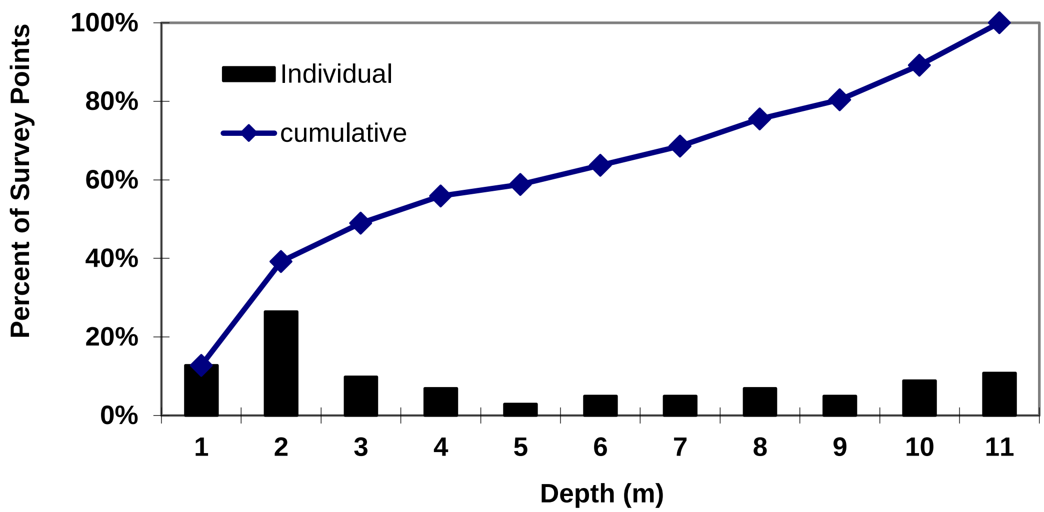
Species Name	Common Name	Lake Iroquois
Potamogeton praelongus Wulfen	white-stem pondweed	s
Potamogeton pusillus L.	small pondweed	s
Potamogeton richardsonii Oakes	Richardsons' pondweed	s
Potamogeton spirillus Tuckerm.	pondweed	s
Potamogeton zosteriformis Fern.	flat-stem pondweed	s
Ranunculus longirostris Godron	white water crowsfoot	s
Scirpus sp.	rush	e
Sparganium sp.	burreed	e
Typha sp.	cattail	e
Utricularia gibba L.	humped bladderwort	s
Utricularia vulgaris L.	great bladderwort	s
Vallisneria americana L.	wild celery	s
Zosterella dubia (Jacq.) Small	water stargrass	s

f=floating fl=floating leaved e=emergent s=submersed

Maximum Depth of Colonization

Maximum depth of rooted aquatic plant growth, termed the littoral zone, extended to a depth of approximately 5.0 meters (16 feet) in Lake Iroquois. The littoral zone is defined by the presence of rooted aquatic plants, for Lake Iroquois it extends from the lakeshore to a depth of 5 meters. The majority of survey points were in the littoral zone (Figure 2), providing a reasonable representation of the aquatic plant population of Lake Iroquois.

Figure 2. Depth Distribution of Lake Iroquois Sampling Points in 1 meter depth classes.



Species Lists

Maps of the distribution of aquatic plant species for Lake Iroquois are included in Appendix A. Frequency of occurrence results are presented in Table 2. Eurasian watermilfoil (*Myriophyllum spicatum*) was the most common species, present in 43% of survey points. This represents an increase from the 24% of survey points reported in 2017. A number of native species were also commonly observed, including Waterweed (*Elodea canadensis,* 30% of survey points), Water stargrass (*Zosterella dubia,* 24%), Duck celery (*Vallisneria americana,* 19%), White waterlily (*Nymphaea odorata,* 12%), and Muskgrass *(Chara spp,* 10%). In the 2017 survey, Duck celery (*Vallisneria americana*) and coontail (*Ceratophyllum demersum)* were the most common plants (28% of survey points). Other common native species in 2017 included, *Elodea canadensis* (23 % of survey points), *Zosterella dubia* (21%), *Chara/Nitella* (20%), *Najas flexilis* (15%), *Nymphaea odorata* (12%), and *Potamogeton praelongus* (10%). Slight declines in the frequency of occurrence of the majority of native species were observed (19 of 23 species) between 2017 and 2019.

Table 2. Lake Iroquois percent frequency of occurrence data.

Species Name	Common Name	2017	2019
Ceratophyllum demersum L.	coontail	27.5%	7.8%
Chara sp.	muskgrass, chara	19.6%	10.4%
Eleocharis acicularis (L.) Roemer & Schultes	needle spike-rush	4.9%	1.7%
Elodea canadensis Michx.	elodea	22.5%	30.4%
Isoetes echinospora Dur.	quillwort	1.0%	1.7%
Lemna minor L.	duckweed		0.9%
Lemna trisulca L.	duckweed	2.9%	0.9%
Myriophyllum spicatum L.	Eurasian watermilfoil	23.5%	42.6%
Najas flexilis (Willd.) Rostk. & Schmidt.	bushy pondweed	14.7%	4.3%
Najas guadalupensis L.	southern naiad	1.0%	
Nymphaea odorata Ait.	white waterlily	11.8%	12.2%
Polygonum amphibium	smartweed	1.0%	0.9%
Potamogeton amplifolius Tuckerm.	largeleaf pondweed	5.9%	6.1%
Potamogeton crispus L.	curlyleaf pondweed	2.0%	1.7%
Potamogeton foliosus Raf.	pondweed	6.9%	
Potamogeton perfoliatus L.	clasping-leaf pondweed	2.9%	1.7%
Potamogeton praelongus Wulfen	white-stem pondweed	9.8%	6.1%
Potamogeton pusillus L.	small pondweed	6.9%	4.3%
Potamogeton richardsonii Oakes	Richardsons' pondweed	4.9%	2.6%
Potamogeton spirillus Tuckerm.	pondweed	1.0%	
Potamogeton zosteriformis Fern.	flat-stem pondweed	6.9%	6.1%
Ranunculus longirostris Godron	white watercrowfoot	5.9%	4.3%
Scirpus sp.	bulrush		0.9%

Species Name	Common Name	2017	2019
Sparganium sp.	burreed	1.0%	0.9%
Typha sp.	cattail	1.0%	1.7%
Utricularia gibba L.	humped bladderwort	2.0%	
Utricularia vulgaris L.	great bladderwort	3.9%	0.9%
Vallisneria americana L.	wild celery	28.4%	19.1%
Zosterella dubia (Jacq.) Small	water stargrass	20.6%	23.5%

Forty-five percent of whole lake sampling points were vegetated by at least one native plant species, 91% of survey points with depths less than 5 m and 97% of survey points with depths less than 2 meters depth yielded native aquatic plants in 2019 (Figure 3). The expected relationship of greater frequency of occurrence of aquatic plants with shallower water depth is consistent with that reported by other regional studies. Littoral zone frequency of occurrence values were dominated by native species and similar to nearby lakes (Getsinger et al. 2002). In 2019, Eurasian watermilfoil was present in 43% of whole lake survey points, and 86% of survey points less than 5 m water depth, representing the littoral zone or zone of aquatic plant growth. This represents a substantial increase from the 24% of whole lake survey points and 42% of littoral zone survey points reported in 2017 (Figure 4).

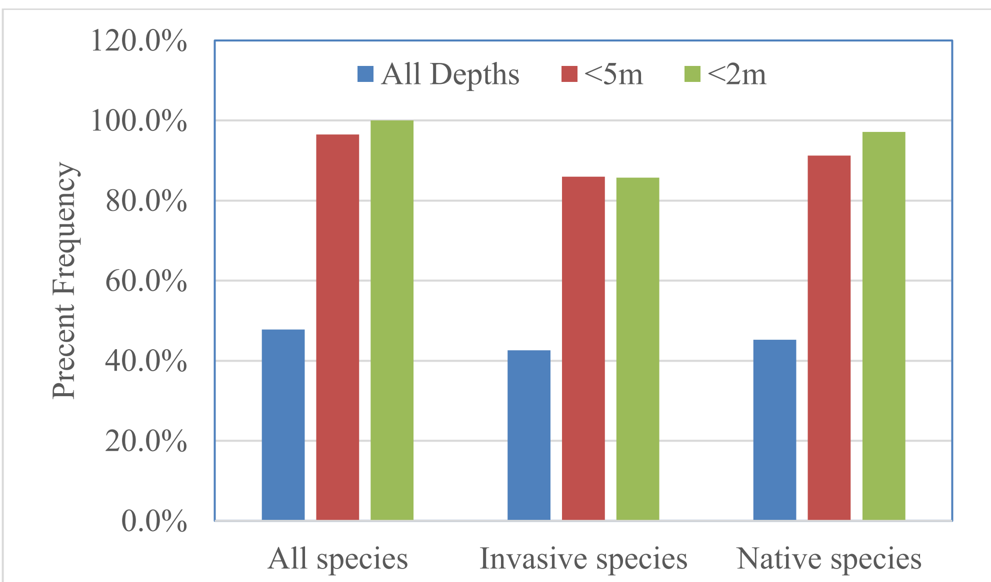


Figure 3. Lake Iroquois frequency of occurrence summaries.

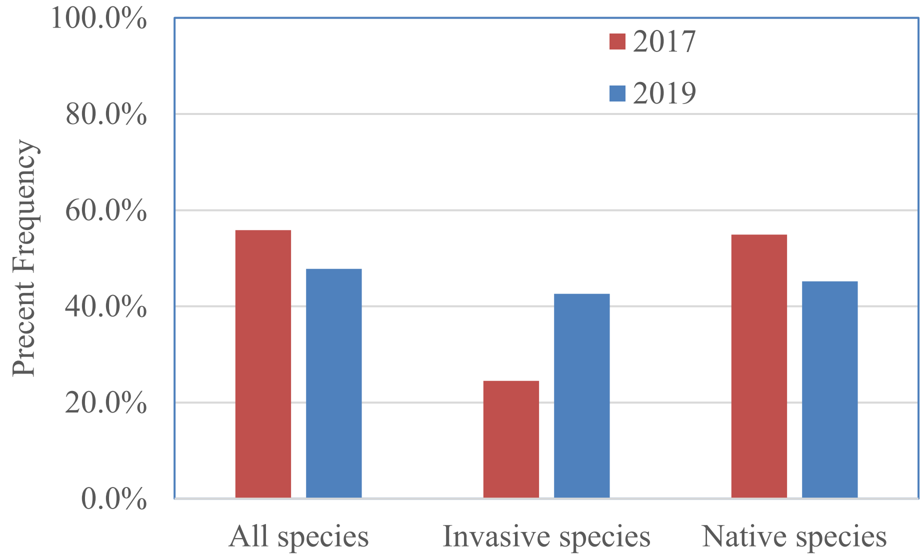


Figure 4. Lake Iroquois frequency of occurrence summaries for 2017 and 2019 surveys.

Species richness was quite high, with a number of species occurring in more than 5% of survey points. Species richness results are presented in Table 3 and Figure 5. Whole lake native species richness in 2017 was 2.13 ± 0.25 species per sample point and declined to 1.50 ± 0.12 species per sample point in 2019. Species richness in this range is comparable to other nearby lakes (Eichler 2016). For survey points exclusively within the littoral zone (depths less than 5 meters), native species richness was 3.62 ± 0.30 species per survey point in 2017 and declined to

Table 3. Lake Iroquois species richness comparison.

Plant Grouping	Water Depth Class	Summary Statistic	Survey Result	
			2017	2019
Native plant species	Whole Lake (all depths)	Mean	2.13	1.50
		N	102	115
		Std. Error	0.25	0.12
	Points with depths <5m	Mean	3.62	3.02
		N	60	57
		Std. Error	0.30	0.27
	Points with depths <2m	Mean	4.50	3.86
		N	50	35
		Std. Error	0.31	0.31
All plant species	Whole Lake (all depths)	Mean	2.40	1.94
		N	102	115
		Std. Error	0.27	0.15
	Points with depths <5m	Mean	4.08	3.91
		N	60	57
		Std. Error	0.30	0.28
	Points with depths <2m	Mean	4.90	4.74
		N	50	35
		Std. Error	0.31	0.32

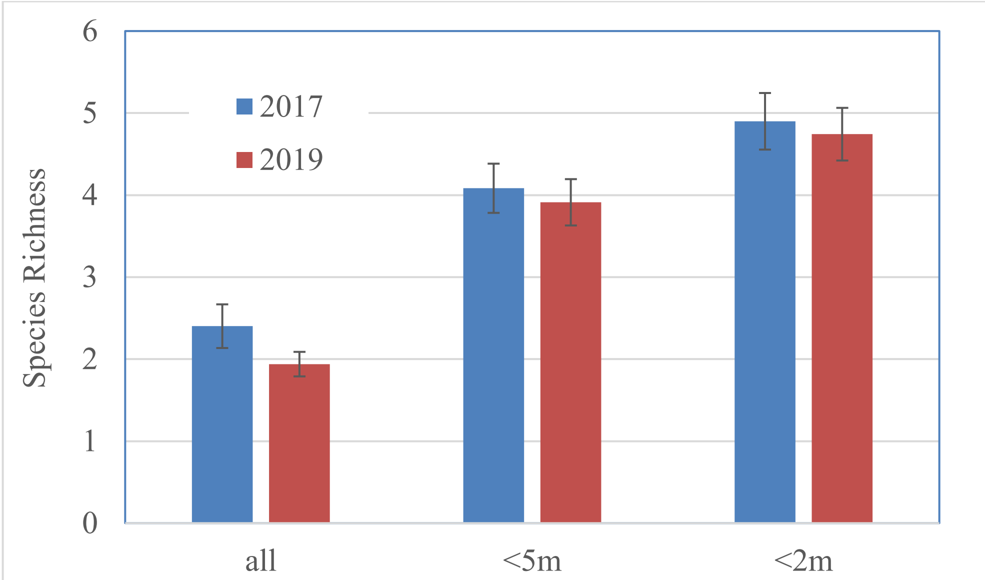


Figure 5. Lake Iroquois species richness.
Error bars are standard error of the mean.

3.02 ± 0.27 species per sample point. As expected, species richness in the littoral zone and its shallow fringe was higher than whole lake species richness. The expansion of Eurasian watermilfoil frequency of occurrence between 2017 and 2019 may account for the decline in total and native species richness. The negative impact of a canopy of Eurasian watermilfoil on species richness of native plants has been well documented (Madsen et al. 1991).

Summary

Quantitative aquatic plant surveys were undertaken for Lake Iroquois, Vermont, in September of 2019. Surveys were designed to obtain post-treatment data following aquatic plant management efforts employing diver assisted suction harvesting (DASH) for Eurasian watermilfoil control and be comparable to a prior survey by the author in 2017 (Eichler 2017). The frequency and distribution of aquatic plant species were evaluated using a point intercept method based on a differential global positioning system of grid points. The assessment generated the information necessary to: 1) evaluate the effectiveness of the aquatic plant management efforts, 2) determine the impact of the management efforts on non-target aquatic plant species, and 3) provide data for comparison of post-treatment conditions to prior survey information.

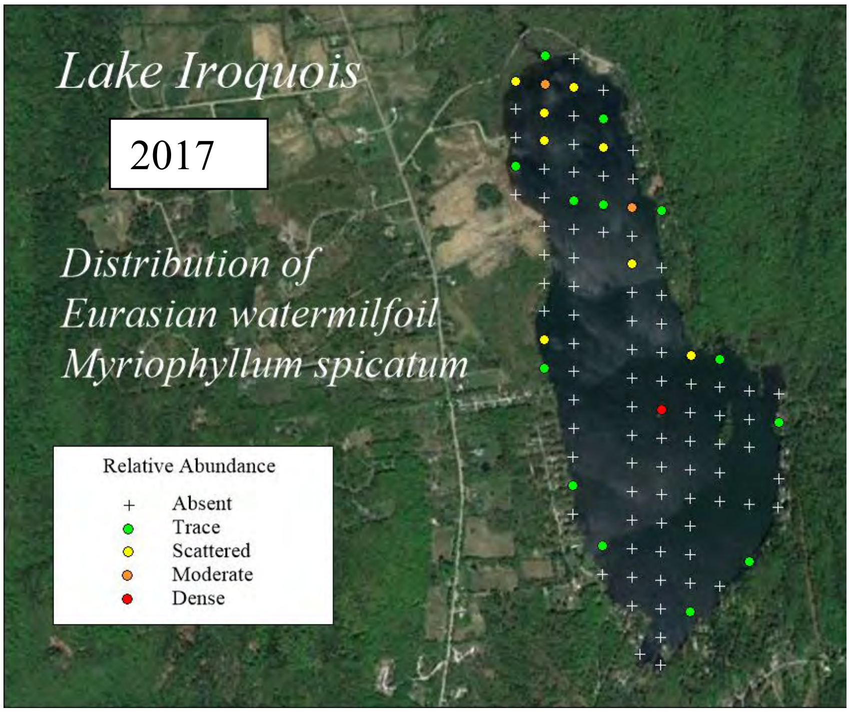
Eurasian watermilfoil (*Myriophyllum spicatum*) populations were first reported in 1990 in Lake Iroquois and confirmed in 1991. Hand harvesting by skin and SCUBA divers has been the basis of the program for most years since the formation of the lake association in 2007. The aquatic weevil (*Euhrychiopsis lecontei*) population of the lake was supplemented in 2008 and 2009 in an effort to provide a biocontrol agent for Eurasian watermilfoil. Approximately 70 acres of Lake Iroquois was reported to support dense growth of Eurasian watermilfoil in 2014. Diver assisted suction harvesting (DASH) in 2016 harvested over 5000 gallons of Eurasian watermilfoil from 2 locations. Benthic barriers (mats) were installed in 2017 to maintain the areas harvested by DASH. In 2019, DASH collected approximately 2000 gallons of Eurasian watermilfoil, however this only represented a very small fraction of the Eurasian watermilfoil growth in the lake. Residents remain concerned that current Eurasian watermilfoil growth is exceeding the capacity of the existing management effort.

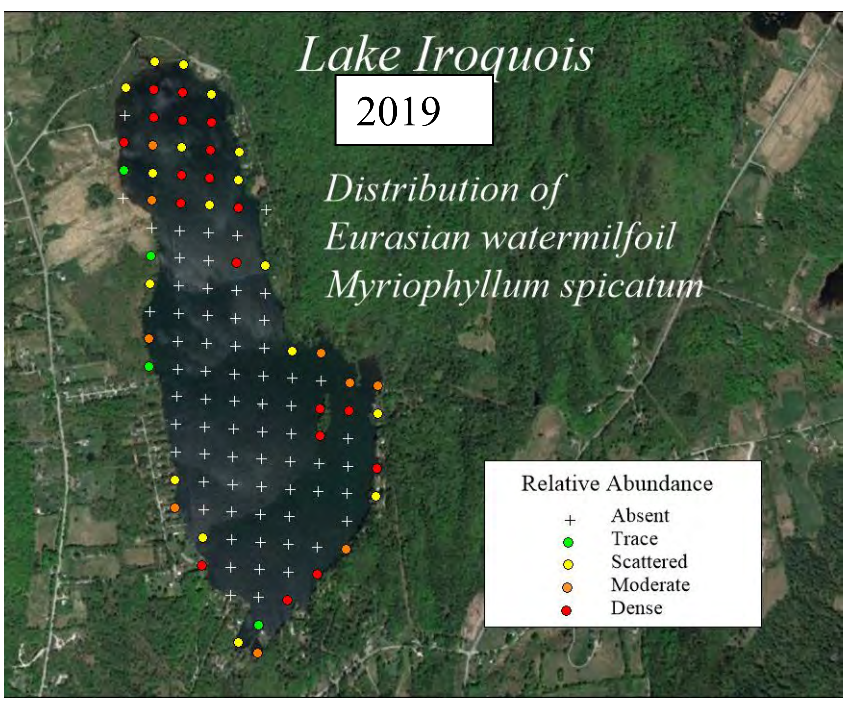
The aquatic plant community of Lake Iroquois includes twenty-three submersed species, two floating-leaved species, one free-floating species and seven emergent species, for a total of 33 species observed in 2019. Species numbers are similar to the 30 species and 23 species reported in 2017 and 2014, respectively. This number of species greatly exceeds the 15 species typically reported for moderately productive lakes in our region and indicates good water quality and a variety of habitat types. One of the species present in Lake Iroquois, Humped Bladderwort (*Utricularia gibba*) is found on Vermont's rare plant list (VT DEC 2012). Eurasian watermilfoil was present in 43% of survey points in 2019, an increase from the 24% of survey points in 2017 (Figure 6) and similar to results for 2014. The density of Eurasian watermilfoil growth also increased, with most points described as scattered growth in 2017 currently reported as moderate or dense growth.

A number of native species were commonly observed, including Waterweed (*Elodea canadensis,* 30% of survey points), Water stargrass (*Zosterella dubia,* 24%), Duck celery (*Vallisneria americana,* 19%), White waterlily (*Nymphaea odorata,* 12%), and Muskgrass *(Chara spp,* 10%). Native species results are generally comparable to those reported in 2017 with a few exceptions. In the 2017 survey, common native species for Lake Iroquois included wild celery (*Vallisneria americana,* 28% of survey points), coontail (*Ceratophyllum demersum,* 28%), waterweed (*Elodea canadensis,* 23%), water stargrass (*Zosterella dubia,* 21%), muskgrass (*Chara/Nitella,* 20%), bushy pondweed (*Najas flexilis,* 15%), white waterlily (*Nymphaea odorata,* 12%), and white-stem pondweed *(Potamogeton praelongus,* 10%). The majority of native species (19 of

23) declined in frequency of occurrence between 2017 and 2019, however declines were generally on the order of 1% to 2%. One exception was *Ceratophyllum echinatum,* one of the most abundant species in 2014, but absent in 2017 and 2019. A very similar, common native species, *Ceratophyllum demersum,* remains dominant in Lake Iroquois. Declines in most native species are observed as a result of invasion and canopy formation by Eurasian watermilfoil.

Figure 6. Distribution of Eurasian watermilfoil in Lake Iroquois.





Species richness in Lake Iroquois was quite high, with a number of species occurring in more than 5% of survey points. Forty-five percent of sampling points were vegetated by at least one native plant species and 91% of sampling points within the littoral zone supported native aquatic plants. The large number of points supporting native plant species suggests that Lake Iroquois is a prime candidate for recovery of its native plant population following management of Eurasian watermilfoil. Native species richness in the littoral zone was 3.62 species per sample in 2017, at the high end of species richness values for other regional lakes, which ranged from 1.79 to 4.00 species per sample. Native species richness declined slightly to 3.02 species per survey point in 2019, typical of lakes experiencing an expansion of Eurasian watermilfoil growth. Loss of native species is a commonly reported phenomenon in lakes with severe infestation by Eurasian watermilfoil and/or other invasive aquatic plant species (Madsen et al. 1991).

Eurasian watermilfoil in Lake Iroquois was present primarily as moderate and dense growth in September of 2019 (Figure 6), representing an increase from primarily scattered growth in 2017 and similar to the density of growth reported in 2014. Frequency of occurrence of Eurasian watermilfoil also increased from 24% of survey points in 2017 to 43% of survey points in 2019. While the native plant populations appear robust and similar to other regional lakes, declines in both frequency of occurrence and species richness were observed between 2019 and 2017. Several areas of dense growth of Eurasian watermilfoil for Lake Iroquois were observed, including the north and south ends of the lake, the eastern embayment and the area surrounding the mid-lake island. Eurasian watermilfoil growth has increased in Lake Iroquois, even with ongoing management efforts. Even though shifts in plant growth from year to year are common, particularly with new invaders like Eurasian watermilfoil, expanded management efforts are warranted given the density of Eurasian watermilfoil growth in Lake Iroquois.

Management Review

The Eurasian watermilfoil management effort at Lake Iroquois is an ongoing activity. Establishment of an effective lake association was a critical first step. The association appears to be effective, well organized, adequately funded and strongly motivated. An educated lake community is a valuable asset. Data collection to understand the options for management of invasive aquatic plants is well underway. With only a review of annual reports, brief discussions with program managers, and the results of the Fall plant surveys, I offer the following suggestions. Given the level of the current program, I anticipate that most if not all of these recommendations have been considered and many are currently being employed.

Prevention

1. Maintain or consider expanding the 'Greeter' program. Prevention is the most cost effective mechanism for invasive aquatic species (IAS) control. Enforce clean, drain and dry whenever possible.
2. Expand boat washing. Mandatory boat washing is becoming more common as regulatory agencies shoulder more of the costs for invasive species management. A quick review of the lakes visited by boaters prior to launching into central Vermont lakes includes sources for zebra mussels (Lake Champlain, Lake George, Glen Lake), asian clams (Lake George), and spiny waterfleas (Lake George, Lake Champlain). The larval stages of these species, and in some cases the adults, are too small for visual inspections to capture.
3. Discourage lake users from feeding waterfowl. Large collections of waterfowl increase the likelihood of nuisance plant and animal introductions via waterfowl transport. It also has other benefits, such as reducing the spread of swimmers itch, other forms of contact dermatitis, and additional public health concerns.

Education

1. Take full advantage of the educational materials available through the VT DEC, Lake Champlain Basin Program, Federation of Vermont Lakes and Ponds (FOVLAP) and others. Developing the support of residents and visitors greatly enhances prevention efforts and can provide additional inputs to monitoring activities.
2. Maximize community involvement through social media such as webpages, newsletters and others. Lake Iroquois Association has a well organized and frequently updated webpage.
3. Lake associations must band together to have the required political clout to maintain programs to manage lakes. Several excellent "umbrella" groups are the North American Lake Management Society (NALMS), the Aquatic Plant Management Society (APMS) and its Northeast Chapter (NEAPMS) and the Federation of Vermont Lakes and Ponds (FOVLAP). All publish informational

newsletters and brochures, and memberships are available both for lake associations and individuals.

Management

1. The current combination of physical and biological techniques employed by the Lake Iroquois Milfoil Management Program indicates an awareness of integrated milfoil management. Consider all available options for milfoil control, and combine the techniques chosen into an integrated management effort both lake-wide and on a site by site basis. Given the lake-wide growth of Eurasian watermilfoil, consideration of whole lake herbicide treatments is warranted.
2. Consider intensive efforts (i.e. herbicides, larger hand pulling crew sizes or more volunteer teams) to transition from a management to a maintenance condition. Once milfoil abundance is reduced through intense management efforts, levels can be maintained with limited annual efforts. Consider new ways to use existing resources. For example, some lakes have had success using larger dive teams with surface support (i.e. kayaks or canoes) to hand harvest areas of dense growth typically considered too large for this type of effort. Continued use of diver assisted suction harvesting (DASH) teams may be a viable option.
3. Prioritize harvest to manage sites most likely to produce fragments for in-lake dispersal (i.e. high traffic zones, high wave action areas, waterfowl areas).
4. Consider reducing visits to sites which produce very few milfoil plants to once every other season freeing divers to focus on areas of dense growth.
5. Consider benthic barrier for difficult to harvest sites, such as gravel or deep soft silty sediments. Sand bags can be substituted for stakes in very hard or very soft substrates to secure the barrier material.
6. Initial indications are that the weevil augmentation for Iroquois Lake has not controlled Eurasian watermilfoil growth nor resulted in an increase in the overall weevil population, however assessment of weevil density and the extent of weevil damage should be continued. This type of control effort may take several years to become established.

Monitoring and Assessment

1. Take advantage of volunteers to make visual inspections of the littoral zone for the presence of IAS. Judging by the number of volunteer hours and the description of milfoil mapping efforts, it appears that you are making use of volunteers.
2. Employ monitoring results to refine management efforts based on density of growth of IAS and site specific conditions. For example, use benthic barrier or ‘spot’ herbicide treatments for very dense growth or where site conditions make suction harvesting difficult. Benthic barrier has been demonstrated to kill milfoil

in about 6 weeks, so barrier can be recovered and used at another location in a single season, if needed. Employ suction harvesting on moderate to dense growth areas and use hand harvesting in scattered growth areas or as a “clean-up” of areas originally harvested by other means. Select dense sites with large fragmentation potential to be harvested first, with more remote sites with less milfoil growth saved for later in the season. Employ mechanical and physical techniques to extend the period between herbicide applications.

3. Conduct extensive surveys of the plant community periodically to confirm visual inspections, detect any additional invasive aquatic species, evaluate the effectiveness of current management efforts, and detect any unintended impacts to native (non-target) species.

References

Crow, G.E. and C.B. Hellquist. 2000. Aquatic and wetland plants of northeastern North America. 2 Volumes. University of Wisconsin Press, Madison, WI.

Eichler, L.W. 2017. Aquatic vegetation of Lake Iroquois and Sunset Pond, Chittenden County, Vermont - 2017. Prepared for Vermont DEC & the Lake Iroquois Association. DFWI Technical Report 2017-6. Darrin Fresh Water Institute, Bolton Landing, NY.

Eichler, L.W. 2016. Aquatic vegetation of Lake Dunmore and Fern Lake, Vermont - 2016. Prepared for Vermont DEC & the Lake Dunmore Association. DFWI Technical Report 2016-11. Darrin Fresh Water Institute, Bolton Landing, NY.

Getsinger et al., K.D., R.M. Stewart, J.D. Madsen, A.S. Way, C.S. Owens, H.A. Crosson, and A.J. Burns. 2002. Use of Whole-Lake Fluridone Treatments to Selectively Control Eurasian Watermilfoil in Burr Pond and Lake Hortonia, VT. US Army Corps of Engineers, Engineer Research and Development Ctr., Aquatic Plant Control Res. Program. ERDC/EL TR-02-39.

Hellquist, C.B. 1993. Taxonomic considerations in aquatic vegetation assessments. Lake and Reserv. Manage. 7:175-183.

Knoecklein, G. 2015. Lake Iroquois aquatic plant survey. Northeast Aquatic Research, LLC, Mansefield, CT. February 2015. http://www.lakeiroquois.org/home/announcements/milfoilreportnowavailable

Madsen, J.D. 1999. Point intercept and line intercept methods for aquatic plant management. US Army Engineer Waterways Experiment Station Aquatic Plant Control Research Program Technical Note CC-02, Vicksburg, MS.

Madsen, J.D., L.W. Eichler, and C.W. Boylen. 1988. Vegetative spread of Eurasian watermilfoil in Lake George, New York. J. Aquat. Plant Manage. 26, 47-50.

Madsen J.D., J.W. Sutherland, J.A. Bloomfield, L.W. Eichler and C.W. Boylen. 1991. Decline of native vegetation under a canopy of Eurasian watermilfoil. J. Aquatic Plant Manage. 29:94-99.

VT DEC. 2010. Vermont Department of Environmental Conservation – Lay Monitoring Program. www.anr.state.vt.us/dec/waterq/cfm/lakerep/lakerep_details.cfm

VT DEC. 2012. Rare and Uncommon Native Vascular Plants of Vermont. Vermont Natural Heritage Inventory. Vermont Fish & Wildlife Department. 21 November 2012. www.vtfishandwildlife.com/.../List_of_Rare_and_Uncommon_Native_Plants_of_Vermont.pdf

VT DEC. 2016. Vermont Department of Environmental Conservation – Lay Monitoring Program. Online, September 2017. www.anr.state.vt.us/dec/waterq/cfm/lakerep/lakerep_details.cfm

VT DEC. 2016a. Vermont Department of Environmental Conservation webpage. Depth charts for Vermont lakes. Online, December 2016. www.watershedmanagement.**vt**.gov/**lakes**/htm/lp_depthcharts.htm

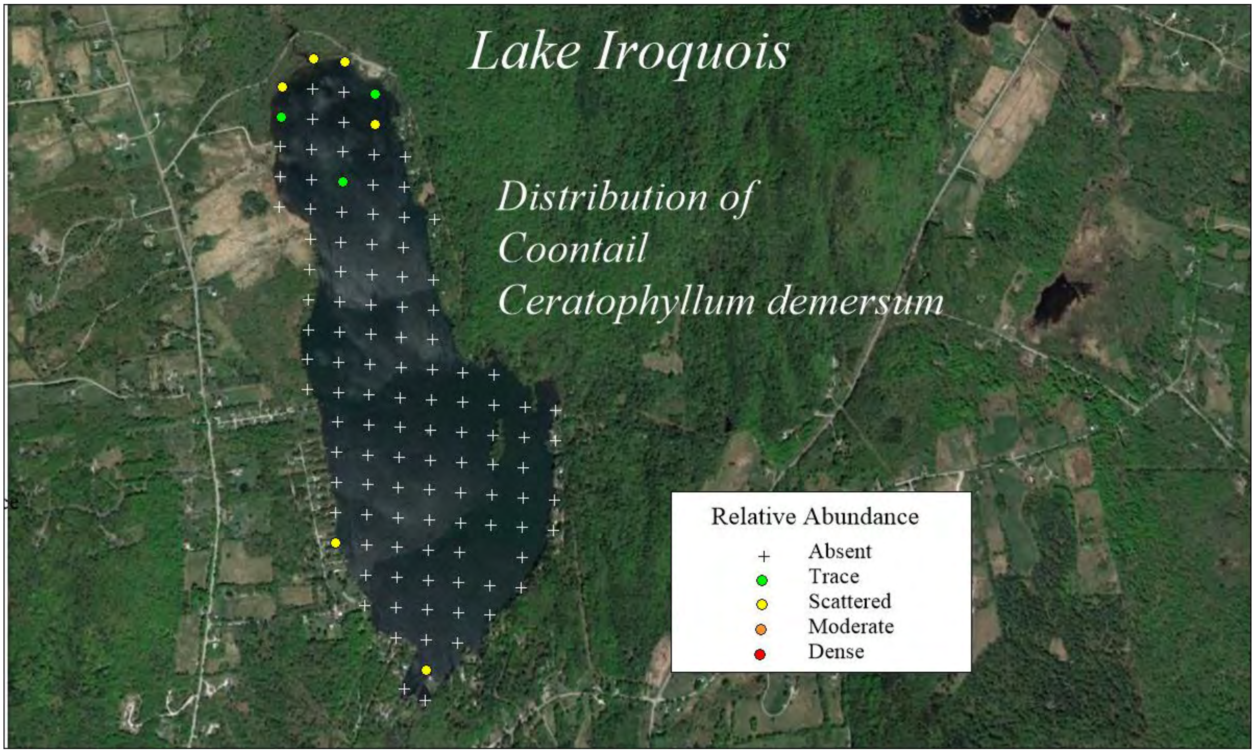
VT DEC. 2016b. Vermont Department of Environmental Conservation webpage. Waterbodies infested with aquatic invasive species. Online, December 2016. http://dec.vermont.gov/sites/dec/files/wsm/lakes/ans/docs/lp_InfestedWaterBodiesList2016.pdf

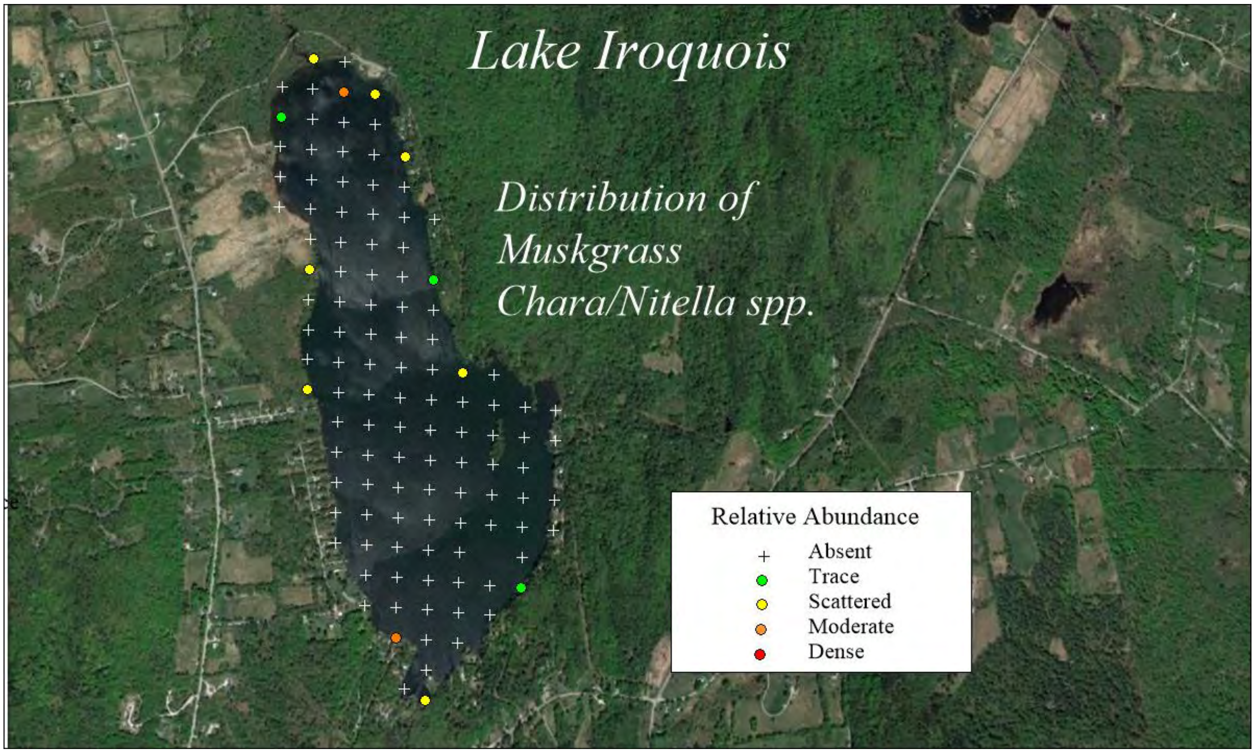
Acknowledgements

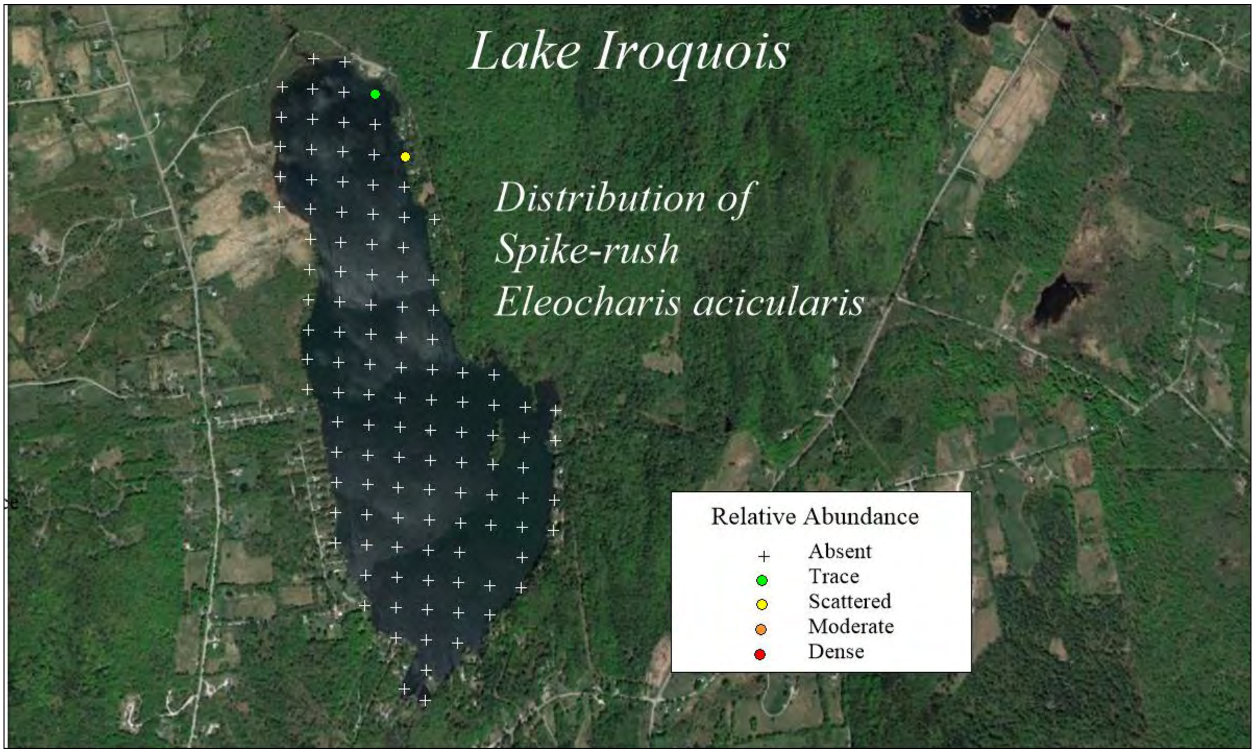
The authors would like to acknowledge Chris Conant and Jamie Carroll of the Lake Iroquois Association and the Town of Richmond Conservation Commission for their assistance in coordinating the current survey project. The author would also like to thank Laurie Ahrens for her assistance in the field component of the project.

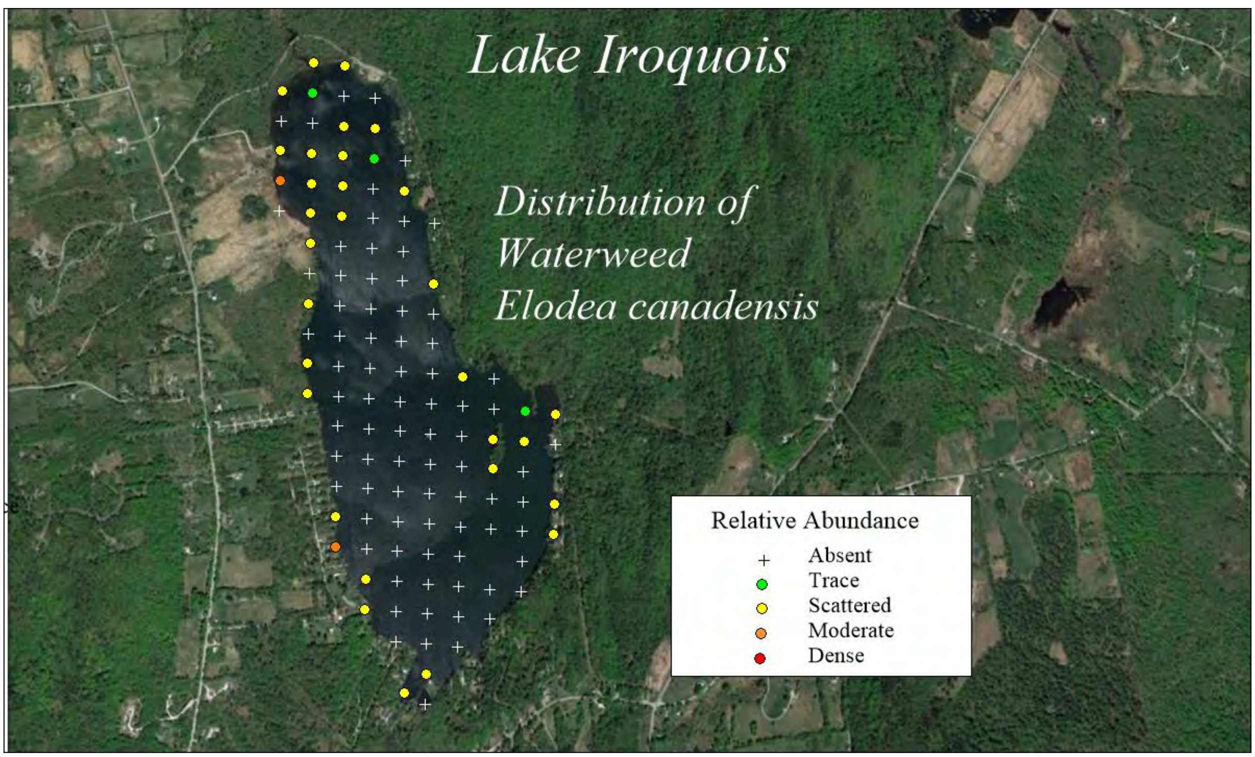
Appendix A

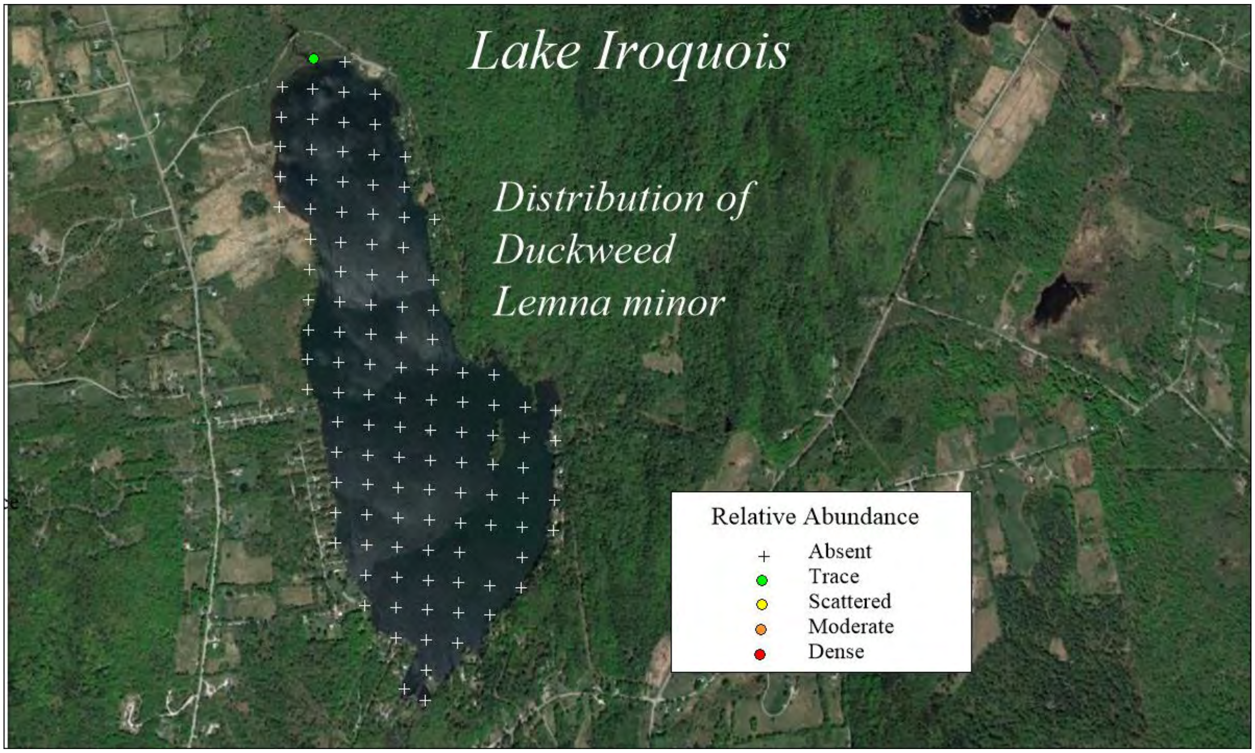
Lake Iroquois Aquatic Plant Distribution Maps

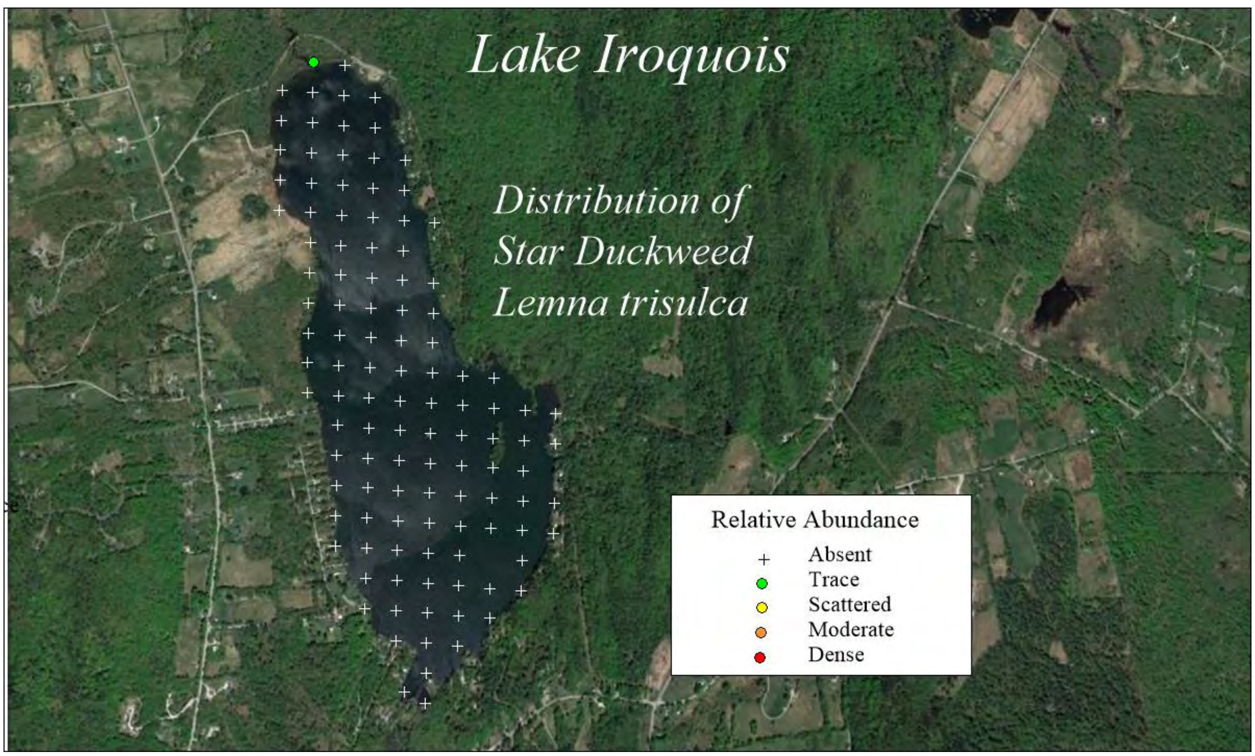

Lake Iroquois
Distribution of
Coontail
Ceratophyllum demersum
Relative Abundance
Absent
Trace
Scattered
Moderate
Dense

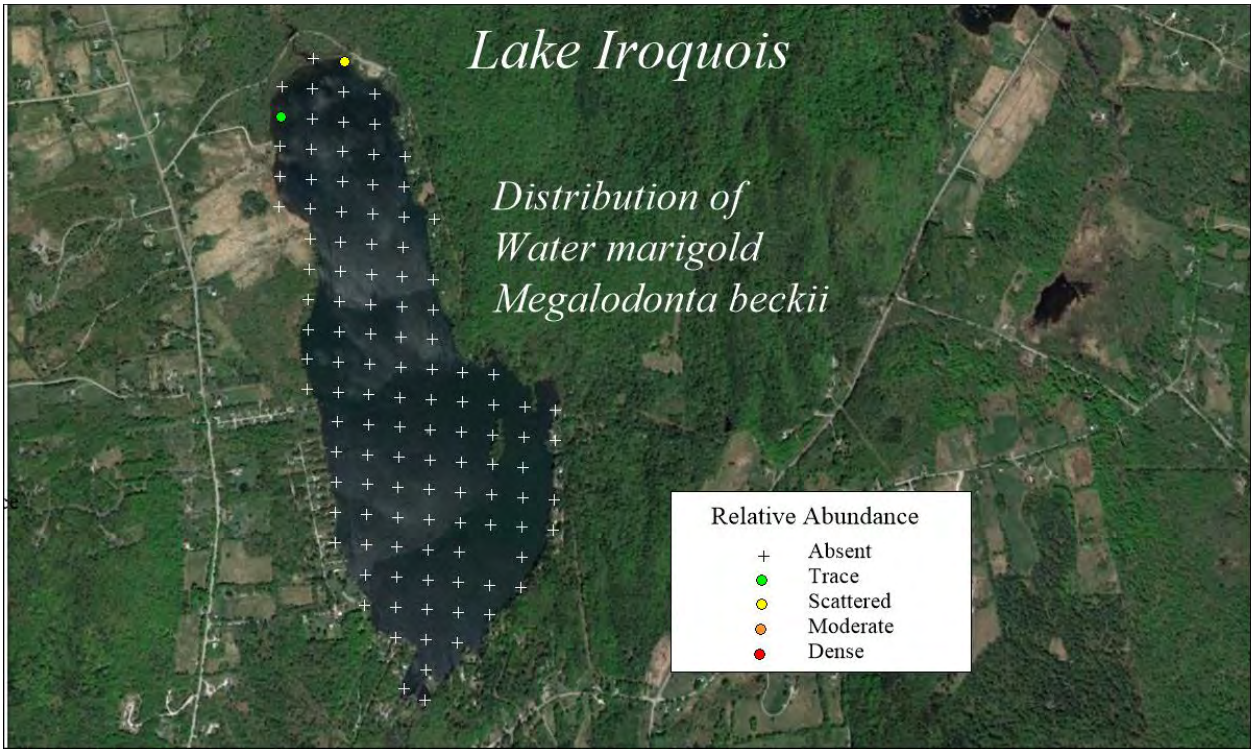

Lake Iroquois
Distribution of
Muskgrass
Chara/Nitella spp.
Relative Abundance
Absent
Trace
Scattered
Moderate
Dense

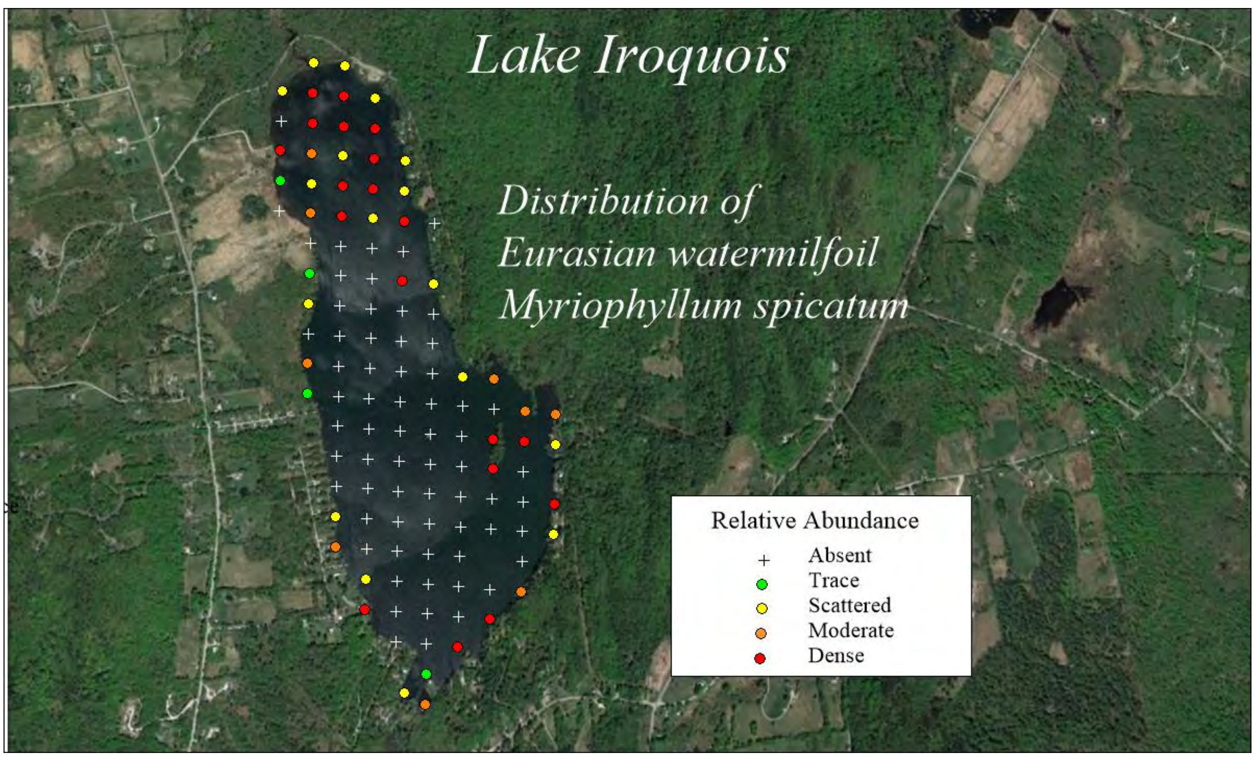

Lake Iroquois
Distribution of
Spike-rush
Eleocharis acicularis
Relative Abundance
Absent
Trace
Scattered
Moderate
Dense

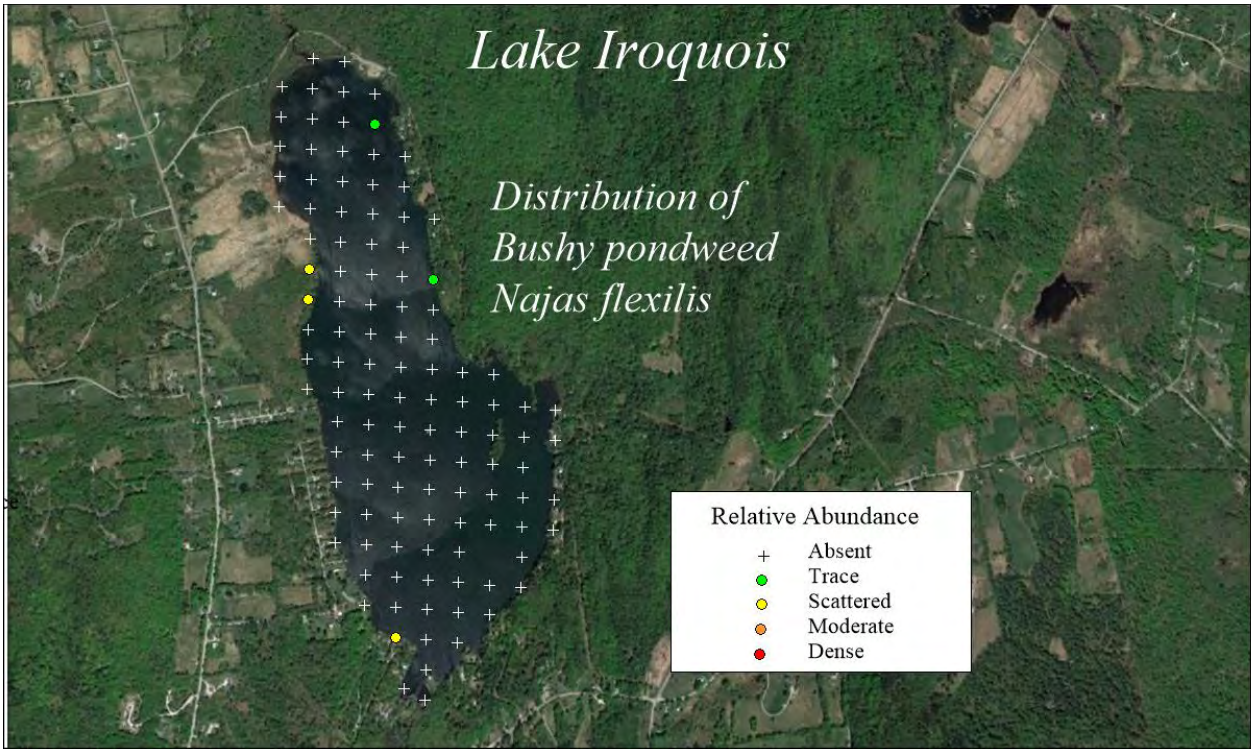

Lake Iroquois
Distribution of
Waterweed
Elodea canadensis
Relative Abundance
Absent
Trace
Scattered
Moderate
Dense

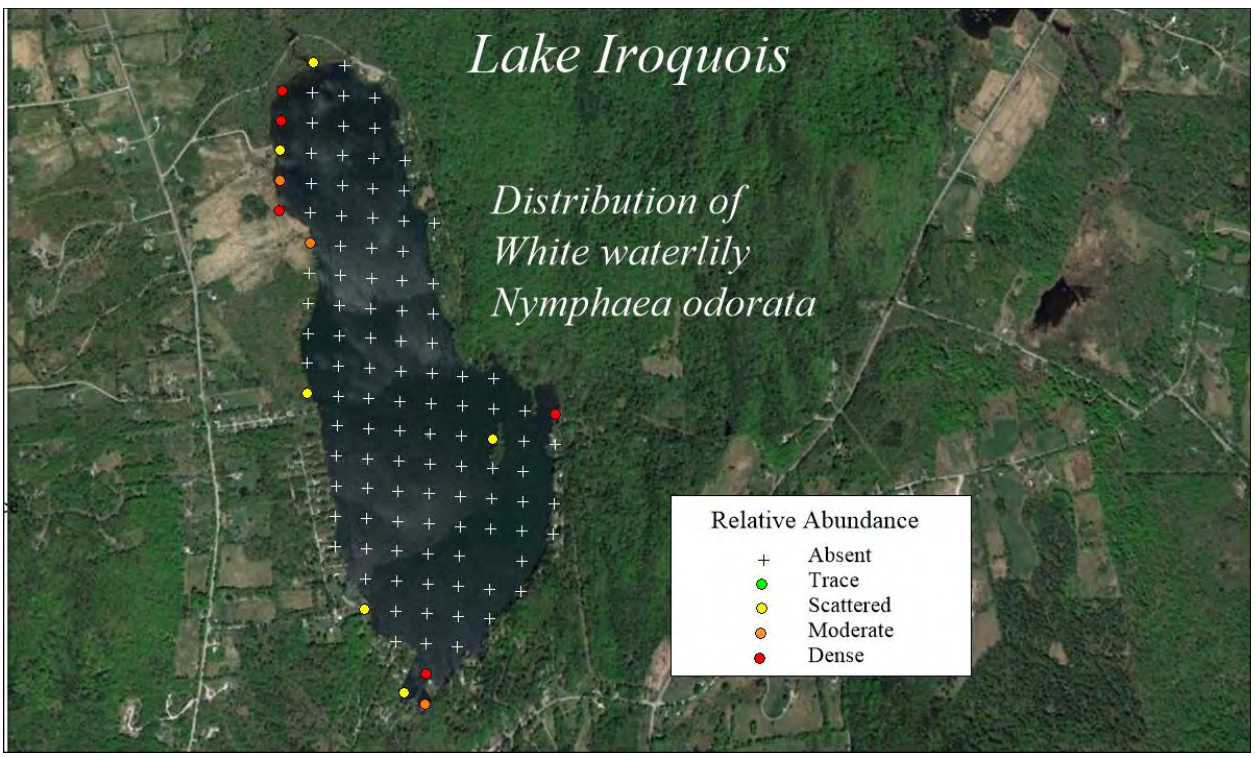

Lake Iroquois
Distribution of
Duckweed
Lemna minor
Relative Abundance
Absent
Trace
Scattered
Moderate
Dense

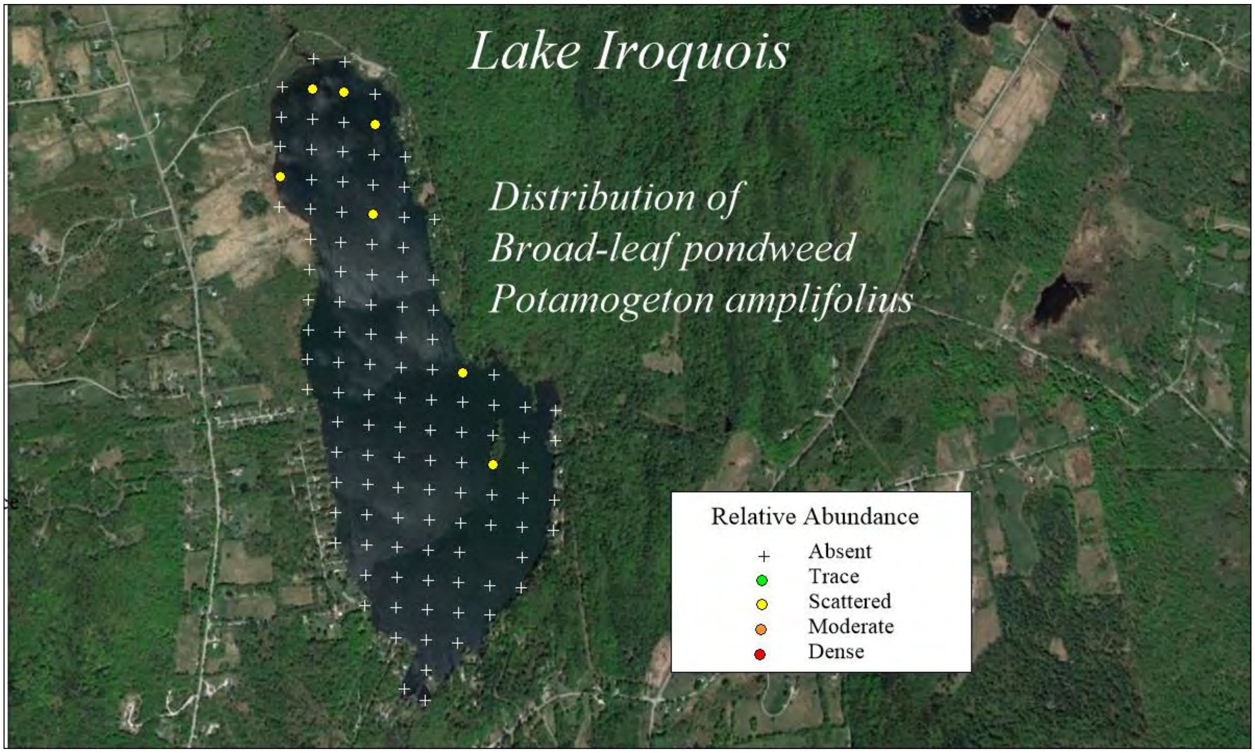

Lake Iroquois
Distribution of
Star Duckweed
Lemna trisulca
Relative Abundance
Absent
Trace
Scattered
Moderate
Dense

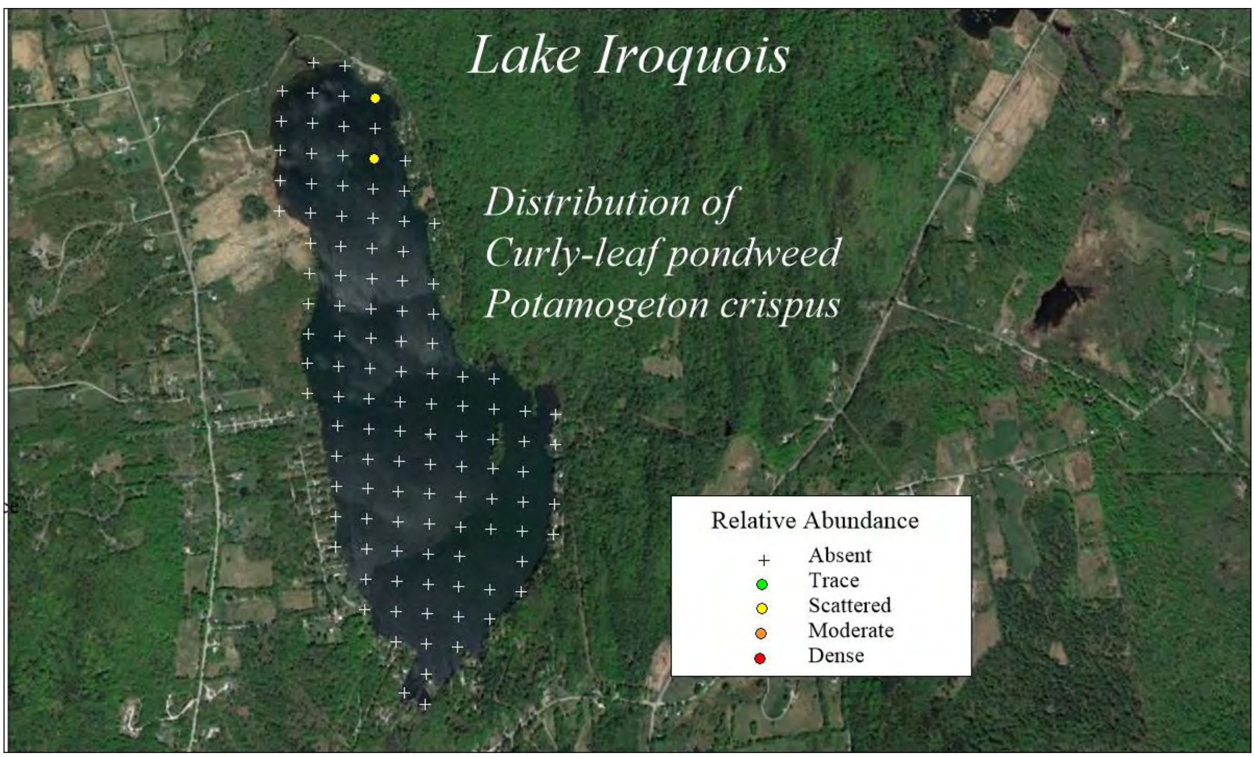

Lake Iroquois
Distribution of
Water marigold
Megalodonta beckii
Relative Abundance
Absent
Trace
Scattered
Moderate
Dense

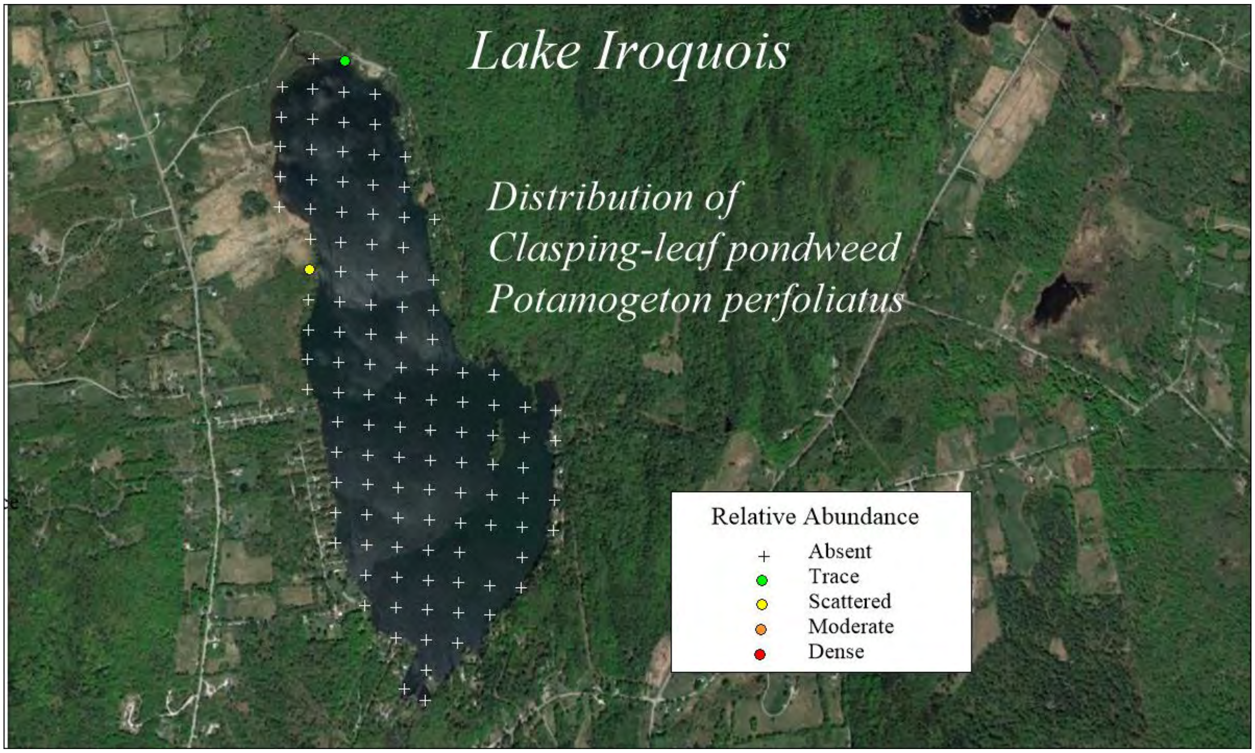

Lake Iroquois
Distribution of
Eurasian watermilfoil
Myriophyllum spicatum
Relative Abundance
Absent
Trace
Scattered
Moderate
Dense

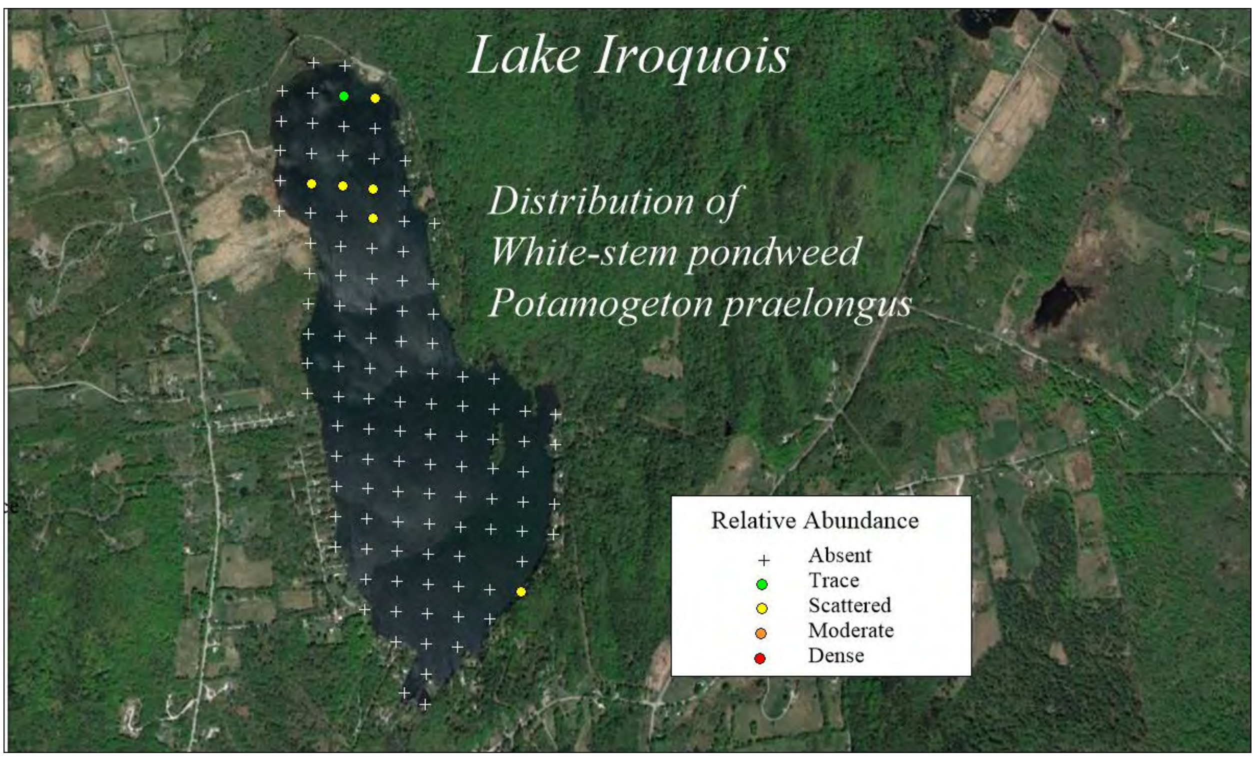

Lake Iroquois
Distribution of
Bushy pondweed
Najas flexilis
Relative Abundance
Absent
Trace
Scattered
Moderate
Dense

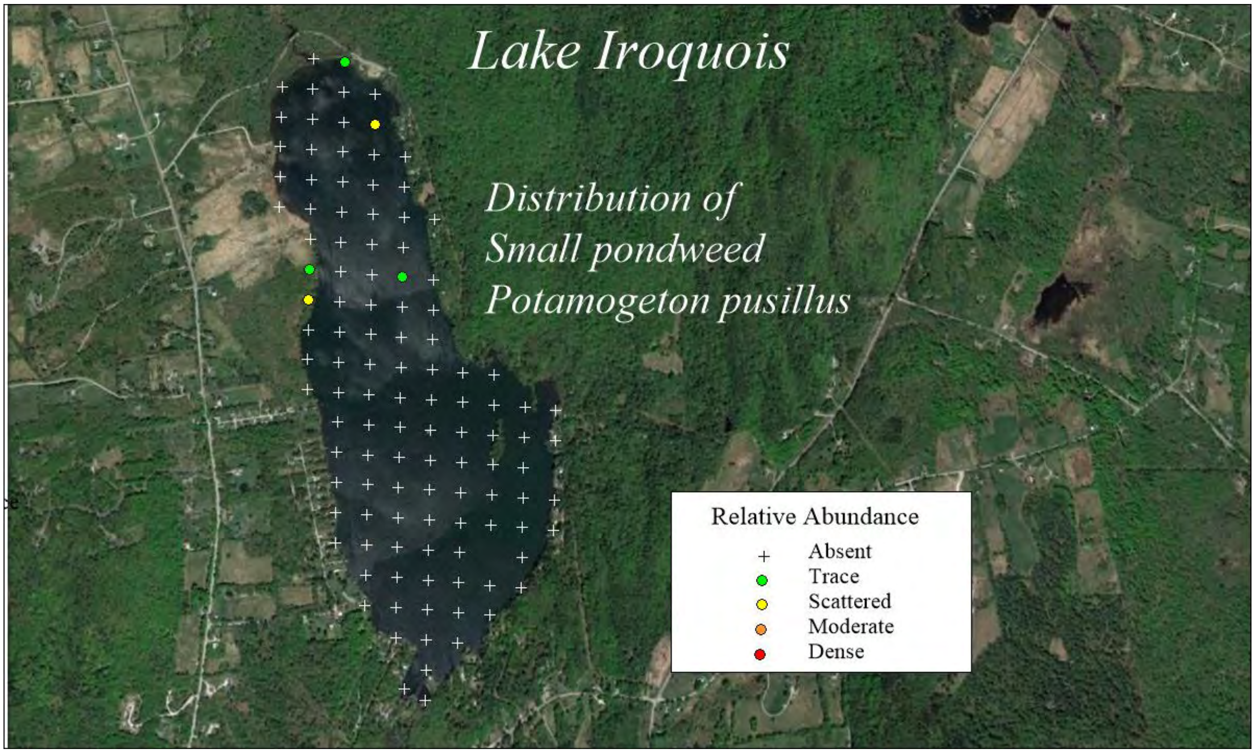

Lake Iroquois
Distribution of
White waterlily
Nymphaea odorata
Relative Abundance
Absent
Trace
Scattered
Moderate
Dense

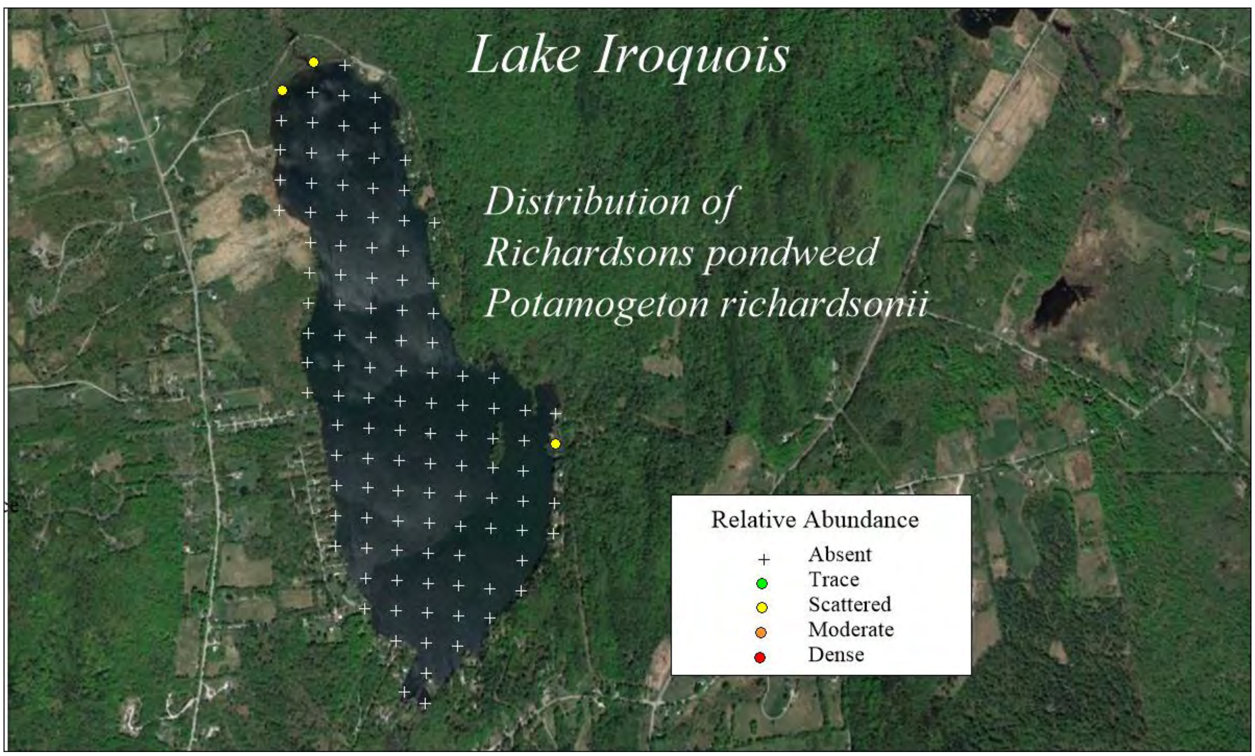

Lake Iroquois
Distribution of
Broad-leaf pondweed
Potamogeton amplifolius
Relative Abundance
Absent
Trace
Scattered
Moderate
Dense

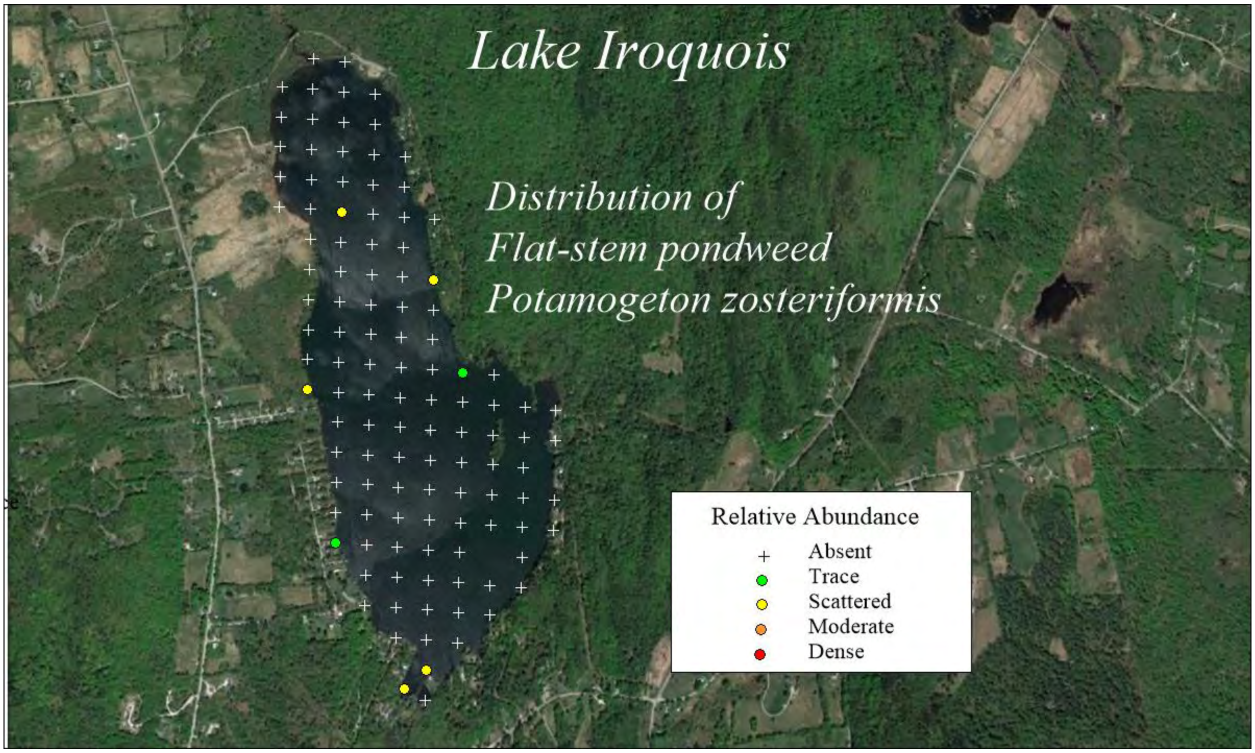

Lake Iroquois
Distribution of
Curly-leaf pondweed
Potamogeton crispus
Relative Abundance
Absent
Trace
Scattered
Moderate
Dense

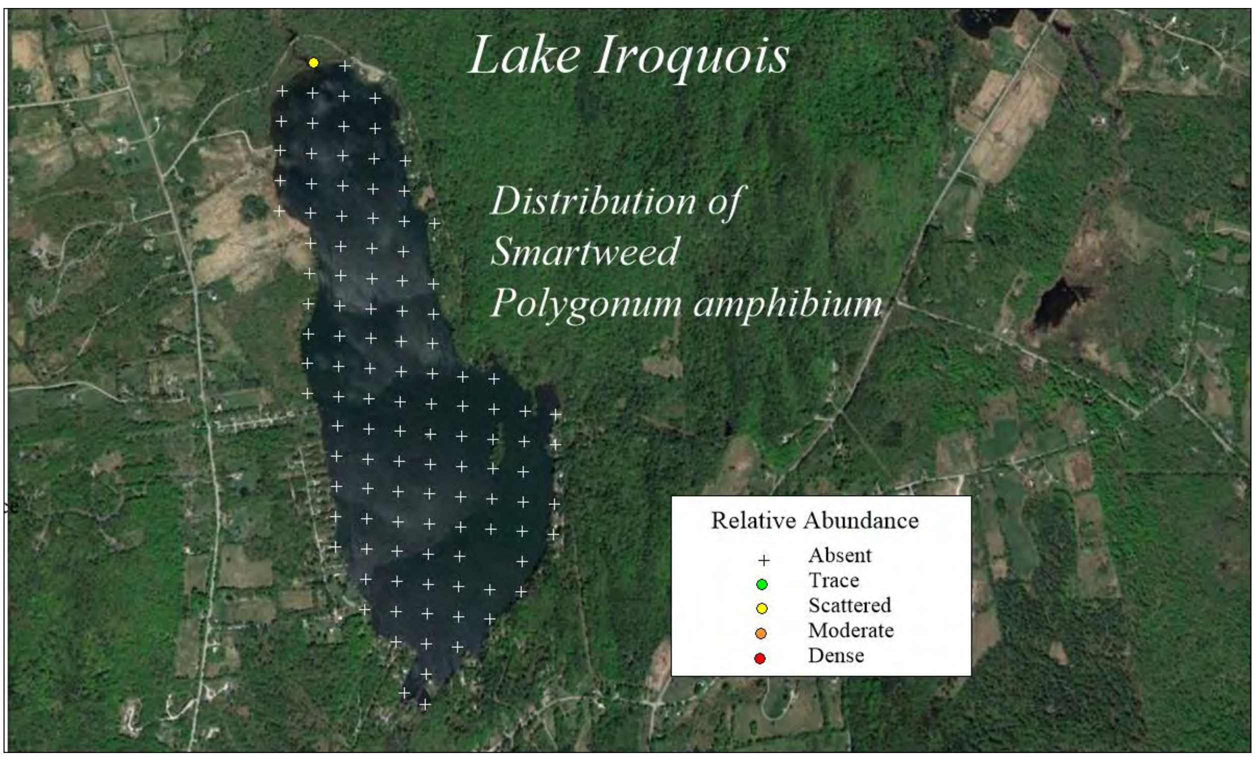

Lake Iroquois
Distribution of
Clasping-leaf pondweed
Potamogeton perfoliatus
Relative Abundance
Absent
Trace
Scattered
Moderate
Dense

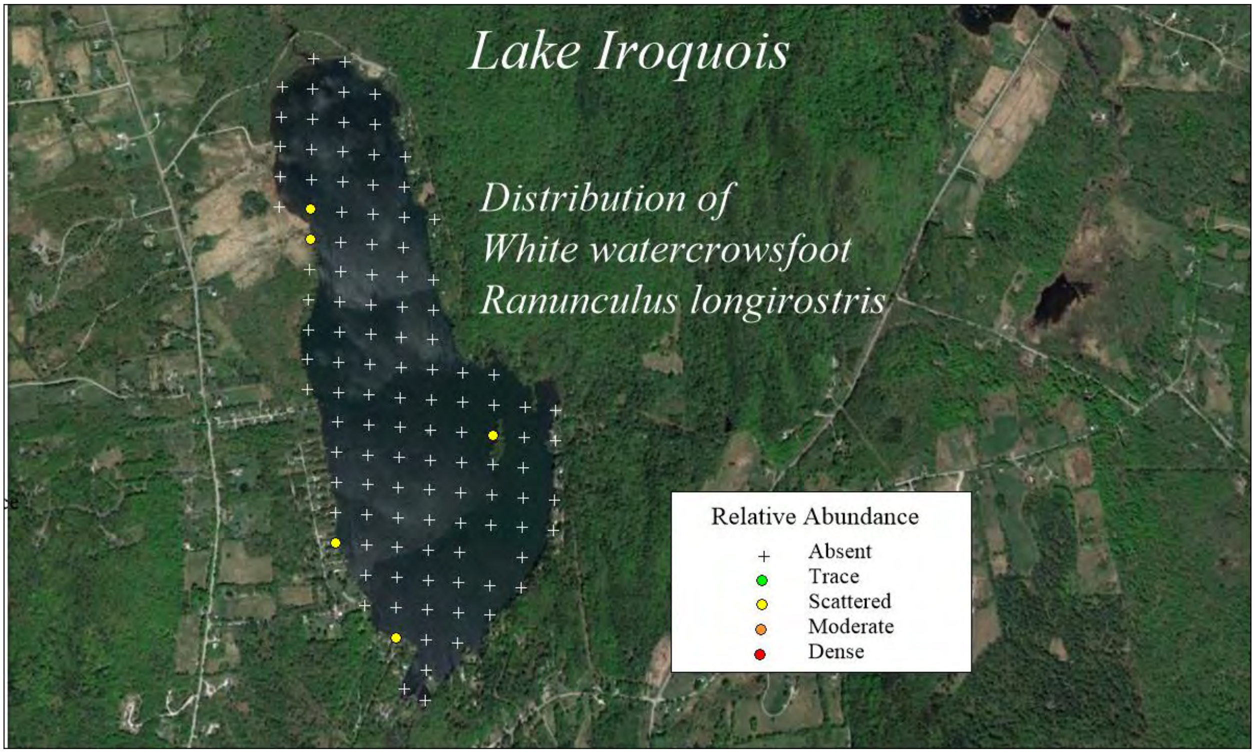

Lake Iroquois
Distribution of
White-stem pondweed
Potamogeton praelongus
Relative Abundance
Absent
Trace
Scattered
Moderate
Dense

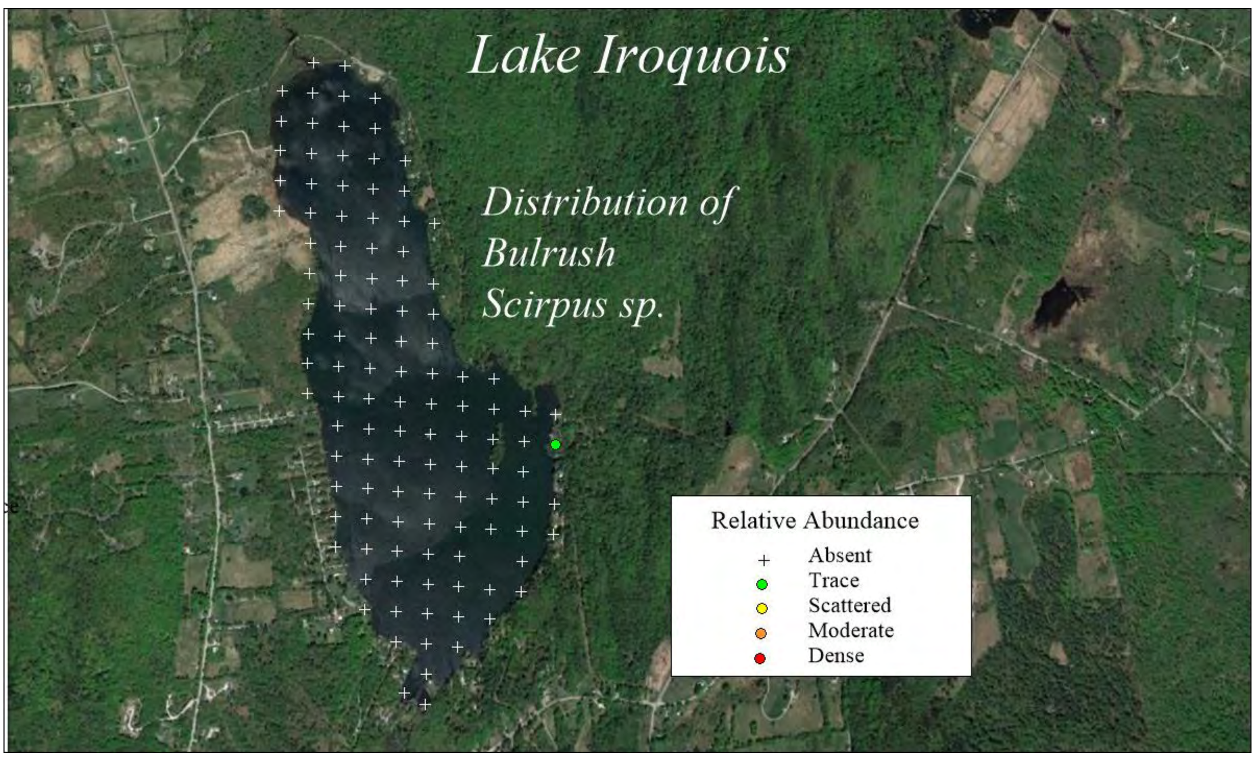

Lake Iroquois
Distribution of
Small pondweed
Potamogeton pusillus
Relative Abundance
Absent
Trace
Scattered
Moderate
Dense

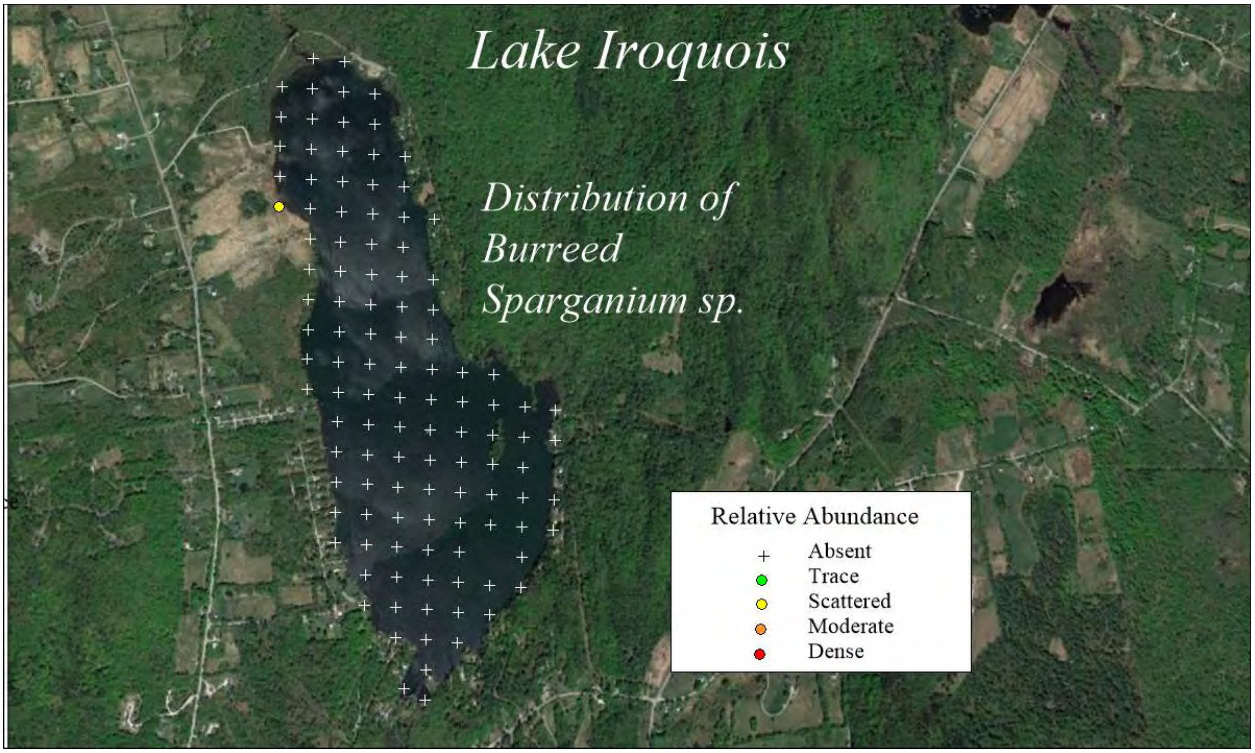

Lake Iroquois
Distribution of
Richardsons pondweed
Potamogeton richardsonii
Relative Abundance
Absent
Trace
Scattered
Moderate
Dense

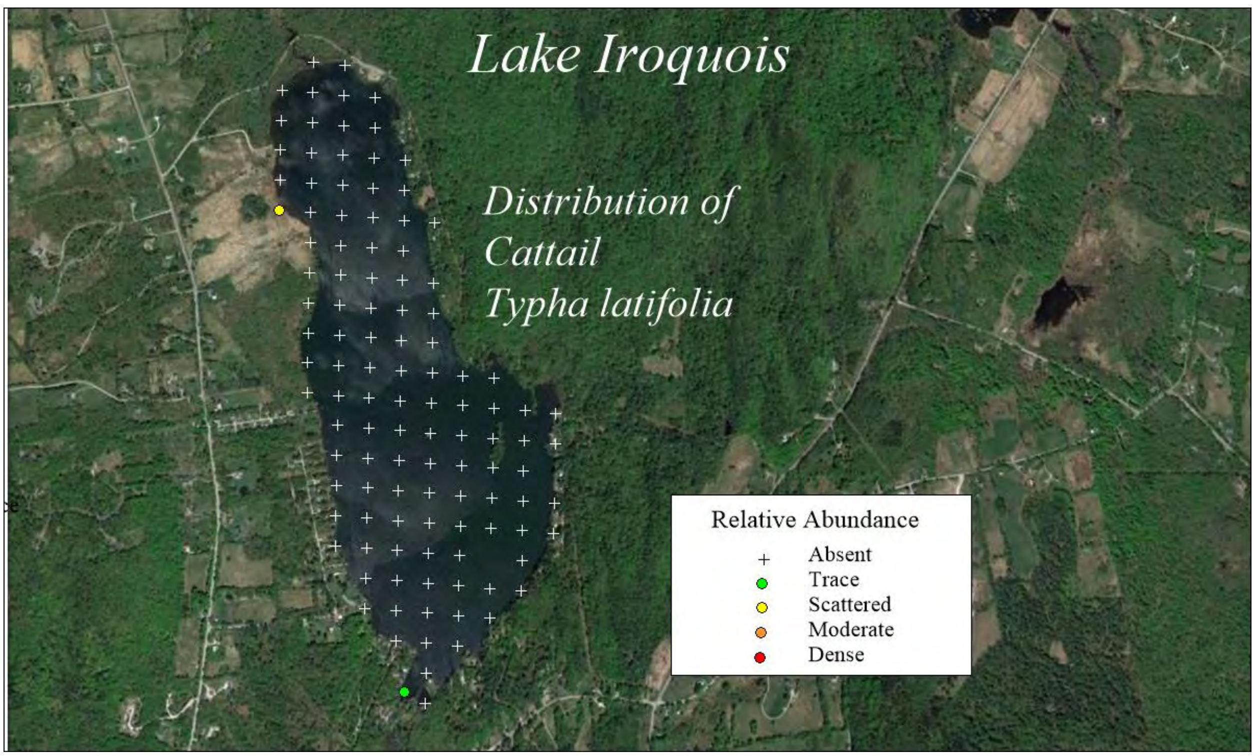

Lake Iroquois
Distribution of
Flat-stem pondweed
Potamogeton zosteriformis
Relative Abundance
Absent
Trace
Scattered
Moderate
Dense

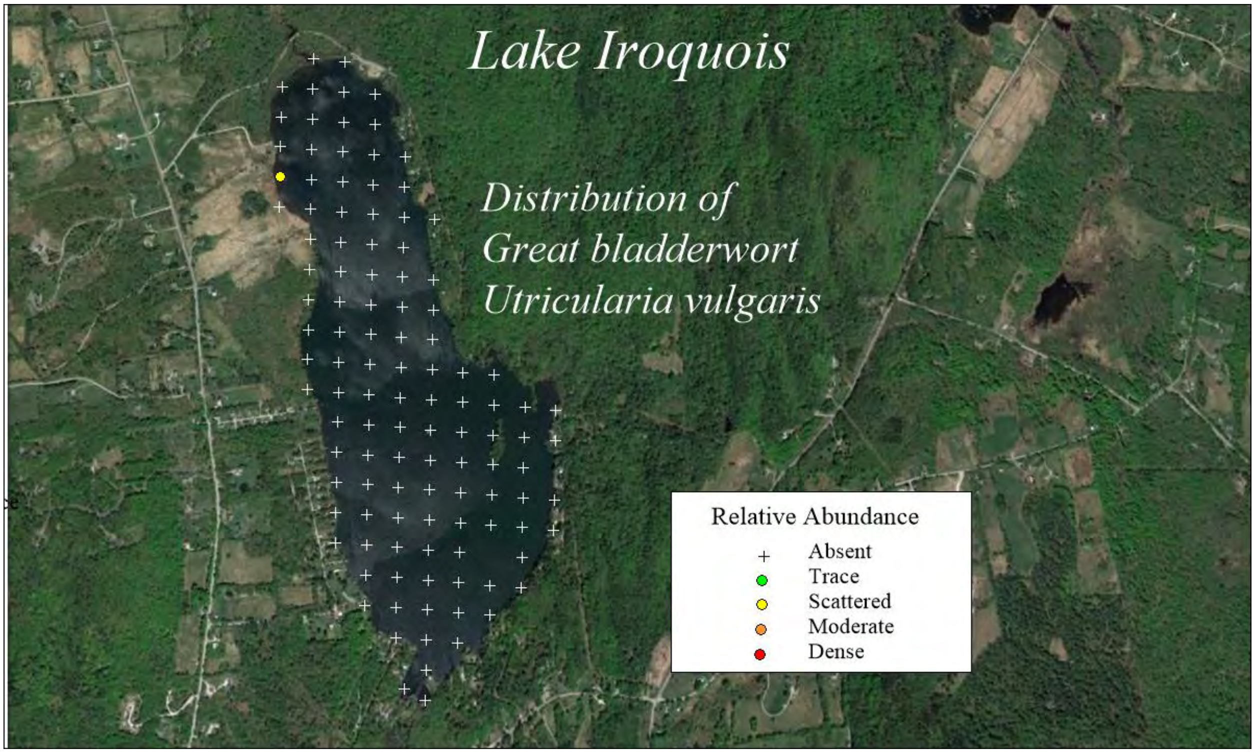

Lake Iroquois
Distribution of
Smartweed
Polygonum amphibium
Relative Abundance
Absent
Trace
Scattered
Moderate
Dense

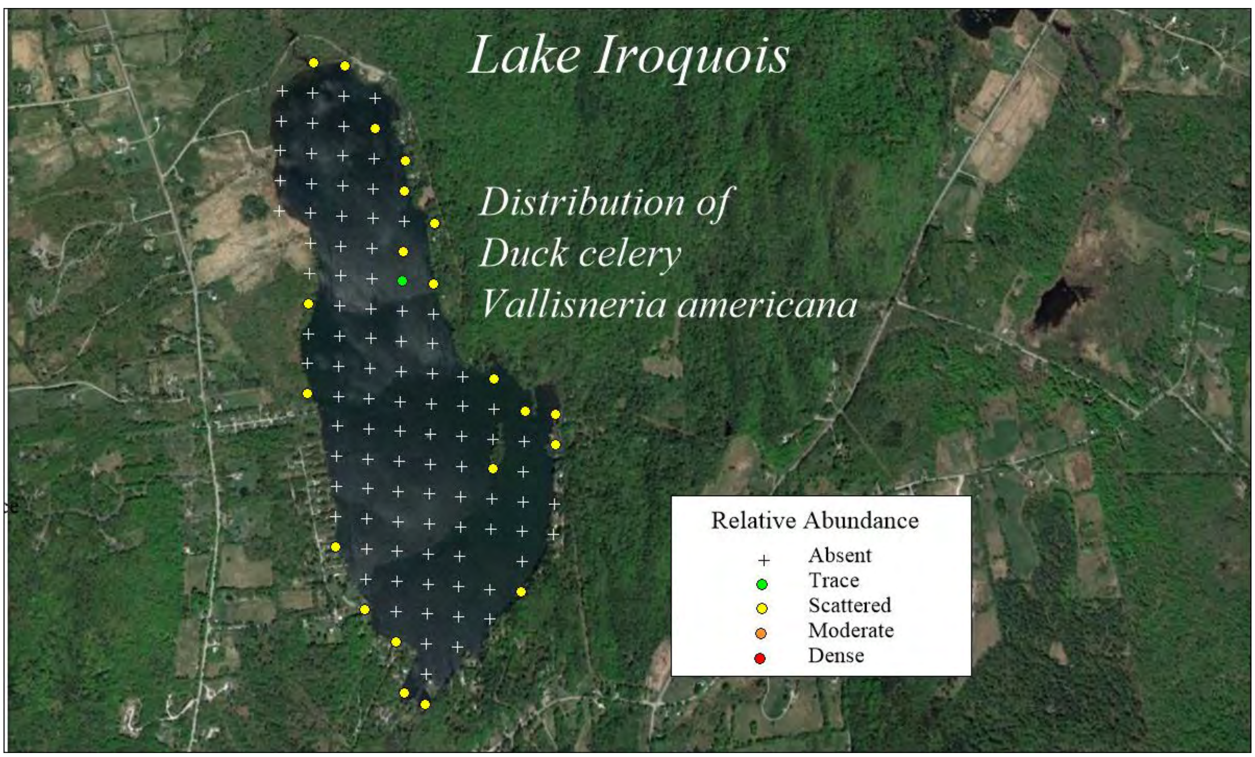

Lake Iroquois
Distribution of
White watercrowsfoot
Ranunculus longirostris
Relative Abundance
Absent
Trace
Scattered
Moderate
Dense

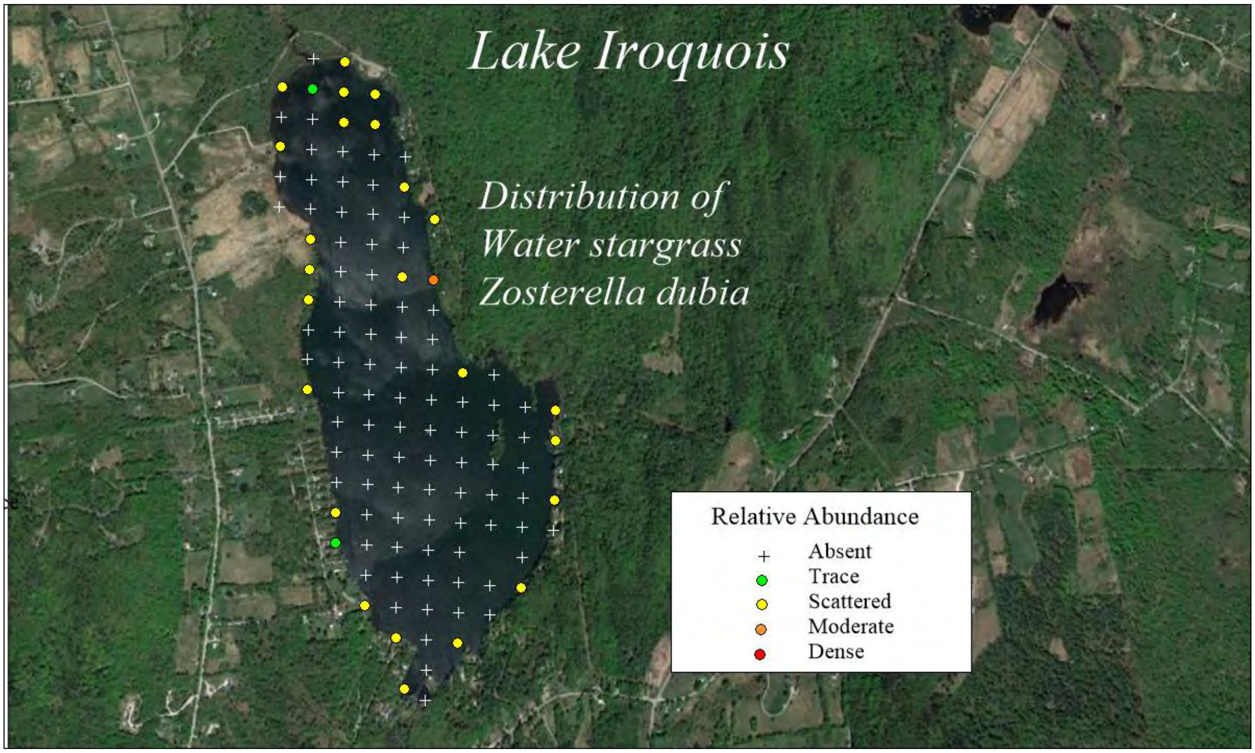

Lake Iroquois
Distribution of
Bulrush
Scirpus sp.
Relative Abundance
Absent
Trace
Scattered
Moderate
Dense


Lake Iroquois
Distribution of
Burreed
Sparganium sp.
Relative Abundance
Absent
Trace
Scattered
Moderate
Dense


Lake Iroquois
Distribution of
Cattail
Typha latifolia
Relative Abundance
Absent
Trace
Scattered
Moderate
Dense


Lake Iroquois
Distribution of
Great bladderwort
Utricularia vulgaris
Relative Abundance
Absent
Trace
Scattered
Moderate
Dense


Lake Iroquois
Distribution of
Duck celery
Vallisneria americana
Relative Abundance
Absent
Trace
Scattered
Moderate
Dense


Lake Iroquois
Distribution of
Water stargrass
Zosterella dubia
Relative Abundance
Absent
Trace
Scattered
Moderate
Dense

APPENDIX B

Maps

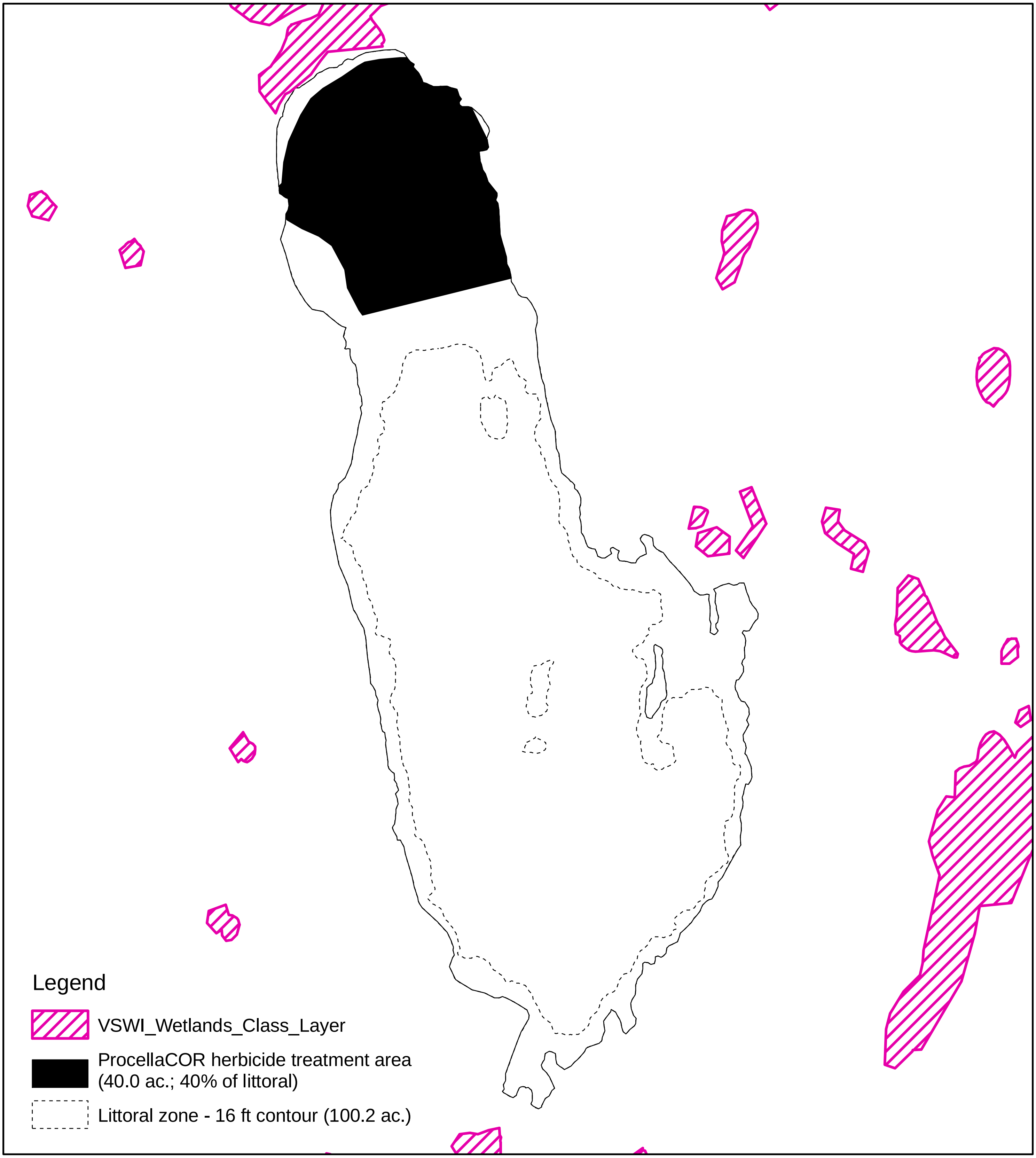
Site Locus

SOLITUDE LAKE MANAGEMENT
888.480.5253
solitudelakemanagement.com

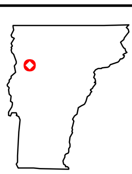
Lake Iroquois Williston / Hinesburg / Richmond, VT Chittenden County 44.3705° N, 73.0856° W	**Lake Iroquois** 0 2,000 4,000 Feet 1:24,000	Map Date: 02/14/20 Prepared by: KS Office: Shrewsbury, MA

Wetland Areas - Herbicide Treatment Areas

SOLITUDE LAKE MANAGEMENT
888.480.5253
solitudelakemanagement.com



Lake Iroquois
Williston / Hinesburg /
Richmond, VT
Chittenden County
44.3705° N, 73.0856° W



Lake Iroquois

0 850 1,700 Feet

1:10,500

N

Map Date: 02/14/20
Prepared by: KS
Office: Shrewsbury, MA

APPENDIX C

ProcellaCOR EC Product Label & MSDS

Washington State Dept. of Ecology – Evaluation of ProcellaCOR

SPECIMEN LABEL

ProcellaCOR™ EC

A selective systemic herbicide for management of freshwater aquatic vegetation in slow-moving/quiescent waters with little or no continuous outflow: ponds, lakes, reservoirs, freshwater marshes, wetlands, bayous, drainage ditches, and non-irrigation canals, including shoreline and riparian areas in or adjacent to these sites. Also for management of invasive freshwater aquatic vegetation in slow-moving/quiescent areas of rivers (coves, oxbows or similar sites).

FLORPYRAUXIFEN-BENZYL	GROUP	4	HERBICIDE

Produced for:
SePRO Corporation
11550 North Meridian Street, Suite 600
Carmel, IN 46032, U.S.A.

SePRO

EPA Reg. No. 67690-80
FPL20180226

Active Ingredient:
Florpyrauxifen-benzyl: 2-pyridinecarboxylic acid, 4-amino-3-chloro-6-(4-chloro-2-fluoro-3-methoxyphenyl)-5-fluoro-, phenyl methyl ester 2.7%
Other Ingredients: 97.3%
TOTAL: 100.0%

Contains 0.0052 lb florpyrauxifen-benzyl per Prescription Dose Unit™ (PDU™) or 0.21 lb florpyrauxifen-benzyl/gallon. 1 PDU is equal to 3.2 fl. oz. of product.

Keep Out of Reach of Children

CAUTION

Refer to the inside of label booklet for additional precautionary information including directions for use.

Notice: Read the entire label before using. Use only according to label directions. **Before buying or using this product, read *Warranty Disclaimer* and *Misuse* statements inside label booklet. If terms are not acceptable, return at once unopened.**

Agricultural Chemical: Do not ship or store with food, feeds, drugs or clothing.

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION. Causes moderate eye irritation. Avoid contact with eyes or clothing. Wash thoroughly with soap and water after handling and before eating, drinking, chewing gum, using tobacco or using the toilet. Remove and wash contaminated clothing before reuse.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Applicators and other handlers must wear:
- Long-sleeved shirt and long pants;
- Shoes plus socks;
- Protective eyewear; and
- Waterproof gloves.

Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables exist, use detergent and hot water. Keep and wash PPE separately from other laundry.

Engineering Controls: When handlers use closed systems or enclosed cabs in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides [40 CFR 170.240(d)(5)], the handler PPE requirements may be reduced or modified as specified in the WPS.

User Safety Recommendations
Users should:
- Wash hands before eating, drinking, chewing gum, using tobacco or using the toilet.
- Remove clothing/PPE immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing.
- Remove PPE immediately after handling this product. Wash the outside of gloves before removing. As soon as possible, wash thoroughly and change into clean clothing.

FIRST AID	
If in eyes	• Hold eye open and rinse slowly and gently with water for 15 to 20 minutes. • Remove contact lenses, if present, after the first 5 minutes; then continue rinsing eye. • Call a poison control center or doctor for treatment advice.
HOTLINE NUMBER	
Have the product container or label with you when calling a poison control center or doctor, or going for treatment. In case of emergency endangering health or the environment involving this product, call **INFOTRAC** at **1-800-535-5053.**	

Environmental Hazards
Under certain conditions, treatment of aquatic weeds can result in oxygen depletion or loss due to decomposition of dead plants, which may cause fish suffocation. Water bodies containing very high plant density should be treated in sections to prevent the potential suffocation of fish. Consult with the State agency for fish and game before applying to public waters to determine if a permit is needed.

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling. Read all Directions for Use carefully before applying.

Do not apply this product in a way that will contact workers or other persons, either directly or through drift. Only protected handlers may be in the area during application. For any requirements specific to your State or Tribe, consult the agency responsible for pesticide regulation.

Shake well before using.

PRODUCT INFORMATION

ProcellaCOR EC is a selective systemic herbicide for management of freshwater aquatic vegetation in slow-moving/quiescent waters with little or no continuous outflow: ponds, lakes, reservoirs, freshwater marshes, wetlands, bayous, drainage ditches, and non-irrigation canals, including shoreline and riparian areas in or adjacent to these sites. Also for management of invasive freshwater aquatic vegetation in slow-moving/quiescent areas of rivers (coves, oxbows or similar sites).

Apply ProcellaCOR EC directly into water or spray onto emergent foliage of aquatic plants. Depending upon method of application and target plant, ProcellaCOR EC is absorbed by aquatic vascular plants through emergent or floating leaves and from water through submersed plant shoots and leaves. In-water treatments are effective in spot and partial treatment designs with relatively short exposure times (hours to several days). Species susceptibility to ProcellaCOR EC may vary depending upon time of year, stage of growth, and water movement. For best results, apply to actively growing plants. However, effective control can be achieved over a broad range of growth stages and environmental conditions. Application to mature target plants may require higher application rates and longer exposure periods to achieve control.

Resistance Management
ProcellaCOR EC is classified as a WSSA Group 4 Herbicide (HRAC Group O). Weed populations may contain or develop biotypes that are resistant to ProcellaCOR EC and other Group 4 herbicides. If herbicides with the same mode of action are used repeatedly at the same site, resistant biotypes may eventually dominate the weed population and may not be controlled by these products. Unless ProcellaCOR EC is used as part of an eradication program or in a plant management system where weed escapes are aggressively controlled, do not use ProcellaCOR EC alone in the same treatment area for submersed and emergent plant control for more than 2 consecutive years, unless used in combination or rotated with an herbicide with an alternate mode of action.

To further delay herbicide resistance consider taking one or more of the following steps:

- Use tank mixtures with herbicides from a different group if such use is permitted; Consult your local extension service or SePRO Corporation if you are unsure as to which active ingredient is currently less prone to resistance.
- Adopt an integrated weed-management program for herbicide use that includes scouting and uses historical information related to herbicide use, and that considers other management practices.
- Scout after herbicide application to monitor weed populations for early signs of resistance development. Indicators of possible herbicide resistance include: (1) failure to control a weed species normally controlled by the herbicide at the dose applied, especially if control is achieved on adjacent weeds; (2) a spreading patch of non-controlled plants of a particular weed species; (3) surviving plants mixed with controlled individuals of the same species. If resistance is suspected, prevent weed seed production in the affected area by using an alternative herbicide from a different group or by a mechanical method that minimizes plant fragmentation.
- If a weed pest population continues to progress after treatment with this product, switch to another management strategy or herbicide with a different mode of action, if available.
- Contact your local extension specialist or SePRO Corporation for additional pesticide resistance-management and/or integrated weed-management recommendations for specific weed biotypes.

Stewardship Guidelines For Use

Apply this product in compliance with Best Management Practices (BMP) that include site assessment, prescription, and implementation. BMP have been developed to ensure accurate applications, minimize risk of resistance development, and monitor concentrations in water to document levels needed for optimal performance and manage potential irrigation use. SePRO Corporation will work with applicators and resource managers to implement BMP for application and monitoring to meet management objectives and ensure compatibility with potential water uses.

Use Precautions

- There are no restrictions for recreational purposes, including swimming and fishing.

Use Restrictions

- **Obtain Required Permits:** Consult with appropriate state or local water authorities before applying this product to public waters. State or local public agencies may require permits.
- **Chemigation:** Do not apply this product through any type of irrigation system.
- For in-water applications, the maximum single application rate is 25.0 Prescription Dose Units (PDU) per acre-foot of water with a limit of three applications per year.
- For aquatic foliar applications, do not exceed 10.0 PDU per acre for a single application, and do not apply more than 20.0 PDU total per acre per year.
- To minimize potential exposure in compost, do not allow livestock to drink treated water.
- Do not compost any plant material from treated area.
- Allow 14 days or greater between applications.
- Do not use water containing this product for hydroponic farming.
- Do not use treated water for any form of irrigation, except as described in the Application to *Water Used for Irrigation on Turf and Landscape Vegetation* section.
- Do not use for greenhouse or nursery irrigation.
- Make applications in a minimum of 10 gallons per acre (GPA) for ground and a minimum of 15 gallons per acre (GPA) for aerial applications.
- Do not apply to salt/brackish water.
- Do not apply ProcellaCOR EC directly to, or otherwise permit ProcellaCOR EC to come into contact during an application, with carrots, soybeans, grapes, tobacco, vegetable crops, flowers, ornamental shrubs or trees, or other desirable broadleaf plants, as serious injury may occur. Do not permit spray mists containing ProcellaCOR EC to drift onto desirable broadleaf plants. Further information on spray drift management is provided in the Spray Drift Management section of this label.
- For treatments out of water, do not permit spray mists containing this product to drift onto desirable broadleaf plants as injury may occur. Further information on spray drift management is provided in the *Spray Drift Management* section of this label.
- Do not allow tank mixes of ProcellaCOR EC to sit overnight. See additional tank mix restrictions below.
- Do not use organosilicone surfactants in spray mixtures of this product.
- Do not tank mix this product with malathion or methyl parathion.
- Do not make an application of malathion or methyl parathion within 7 days of an application of this product. See additional tank mix restrictions below.

Application to Water Used for Irrigation on Turf and Landscape Vegetation

To reduce the potential for injury to sensitive vegetation, follow the waiting periods (between application and irrigation) and restrictions below, and inform those who irrigate with water from the treated area. Follow local and state requirements for informing those who irrigate.

When monitoring ProcellaCOR EC concentrations, analyze water samples using an appropriate analytical method for both the active ingredient and the acid form. Use of HPLC (High-Performance Liquid Chromatography), which is also referenced as FasTEST®, is recommended.

Applications to invasive freshwater aquatic vegetation in slow-moving/quiescent areas of rivers (coves, oxbows or similar sites).

- Users must be aware of relevant downstream use of water for irrigation that may be affected by the treatment and must ensure all label restrictions are followed. All potential downstream water intakes with irrigation practices that may be affected by the treatment must be documented and affected irrigation users notified of the restrictions associated with such treatment.

Residential and other Non-Agricultural Irrigation (such as shoreline property use including irrigation of residential landscape plants and homeowner gardens, golf course irrigation, and non-residential property irrigation around business or industrial properties. Excludes greenhouse or nursery irrigation).

- Turf Irrigation: Turf may be irrigated immediately after treatment.
- For irrigation of landscape vegetation or other forms of non-agricultural irrigation not excluded above, conduct one of the following:

  o analytically verify that water contains less than 2 ppb (SePRO recommends use of FasTEST); or

  o if treated area(s) have the potential to dilute with untreated water, follow the precautionary waiting periods described in the tables 1 and 2 below for in-water or foliar application.

TABLE 1: Non-agricultural irrigation following in-water application

Waiting Period (Days) for Irrigation at Specific Target Treatment Rates (PDU per acre-foot)						
Percent Area of Waterbody Treated*	1-3 PDU	>3-5 PDU	>5.0 to 10.0 PDU	>10.0 to 15.0 PDU	>15.0 to 20.0 PDU	>20.0 to 25.0 PDU
2% or less	6 hours	1 day	1 day	2 days	2 days	3 days
3 - 10%	1 day	3 days	5 days	7 days	10 days	14 days
11 - 20%	3 days	7 days	10 days	10 days	14 days	21 days
21 - 30%	5 days	10 days	14 days	21 days	28 days	35 days
>30%	7 days	14 days	21 days	28 days	35 days	35 days

* Assumes treated area(s) have the potential to dilute with untreated water. If the treated area is not projected to dilute rapidly (example: confined cove area), utilize FasTEST to confirm below 2 ppb or verify vegetation tolerance before irrigation use. Consult a SePRO Aquatic Specialist for additional site-specific recommendations.

TABLE 2: Non-agricultural irrigation following foliar application

Waiting Period (days) for Irrigation at Specific Target Treatment Rates		
Percent Area of Waterbody Treated*	5.0 PDU / acre	>5.0 to 10.0 PDU / acre
10% or less	0.5 day	1 day
11 - 20%	1 day	2 days
>20%	2 days	3 days

* Assumes treated area(s) have the potential to dilute with untreated water. If the treated area is not projected to dilute rapidly (example: confined cove area), utilize FasTEST to confirm below 2 ppb or verify vegetation tolerance before irrigation use. Consult a SePRO Aquatic Specialist for additional site-specific recommendations.

Susceptible Plants

Do not apply where spray drift may occur to food, forage, or other plantings that might be damaged. Spray drift may damage or render crops unfit for sale, use or consumption. Small amounts of spray drift that may not be visible may injure susceptible broadleaf plants. **Before making a foliar or surface spray application, please refer to your state's sensitive crop registry (if available) to identify any commercial specialty or certified organic crops that may be located nearby. At the time of a foliar or surface spray application, the wind cannot be blowing toward adjacent cotton, carrots, soybeans, corn, grain sorghum, wheat, grapes, tobacco, vegetable crops, flowers, ornamental shrubs or trees, or other desirable broadleaf plants.**

Spray Drift Management
Avoiding spray drift at the application site is the responsibility of the applicator. The interaction of many equipment- and weather-related factors determines the potential for spray drift. The applicator is responsible for considering all these factors when making decisions.

The following drift management requirements must be followed to limit off-target drift movement from aerial applications:

Aerial Application:
- Aerial applicators must use a minimum finished spray volume of 15 gallons per acre.
- Drift potential is lowest between wind speeds of 2 to 10 mph. Do not apply below
2 mph due to variable wind direction and high potential for temperature inversion. Do not apply in wind speeds greater than 10 mph.
- To minimize spray drift from aerial application, apply with a nozzle class that ensures coarse or coarser spray (according to ASABE S572) at spray boom pressure no greater than 30 psi.
- The distance of the outer most operating nozzles on the boom must not exceed 70% of wingspan or 80% of rotor diameter.
- Nozzles must always point backward parallel with the air stream and never be pointed downwards more than 45 degrees.
- Do not apply under conditions of a low-level air temperature inversion.
- The maximum release height must be 10 feet from the top of the weed canopy, unless a greater application height is required for pilot safety.

Evaluate spray pattern and droplet size distribution by applying sprays containing a water-soluble dye marker or appropriate drift control agents over a paper tape (adding machine tape). Mechanical flagging devices may also be used. Do not apply under conditions of a low-level air temperature inversion. A temperature inversion is characterized by little or no wind and lower air temperature near the ground than at higher levels. The behavior of smoke generated by an aircraft-mounted device or continuous smoke column released at or near site of application will indicate the direction and velocity of air movement. A temperature inversion is indicated by layering of smoke at some level above the ground and little or no lateral movement.

Ground Application
- Ground applicators must use a minimum finished spray volume of 10 gallons per acre.
- To minimize spray drift from ground application, apply with a nozzle class that ensures coarse or coarser spray (according to ASABE S572).
- For boom spraying, the maximum release height is 36 inches from the soil for ground applications.
- Where states have more stringent regulations, they must be observed.

The applicator should be familiar with, and take into account the information covered in the following Aerial Drift Reduction Advisory (this information is advisory in nature and does not supersede mandatory label requirements.)

Aerial Drift Reduction Advisory
Information on Droplet Size: The most effective way to reduce drift potential is to apply large droplets. The best drift management strategy is to apply the largest droplets that provide sufficient coverage and control. Applying larger droplets reduces drift potential, but will not prevent drift if applications are made improperly, or under unfavorable environmental conditions (see Wind, Temperature and Humidity, and Temperature Inversions).

Controlling Droplet Size:
- **Volume** - Use high flow rate nozzles to apply the highest practical spray volume. Nozzles with higher rated flows produce larger droplets.
- **Pressure** - Do not exceed the nozzle manufacturer's specified pressures. For many nozzle types, lower pressure produces larger droplets. When higher flow rates are needed, use higher flow rate nozzles instead of increasing pressure.
- **Number of Nozzles** - Use the minimum number of nozzles that provide uniform coverage.
- **Nozzle Orientation** - Orienting nozzles so that the spray is released parallel to the air stream produces larger droplets than other orientations. Significant deflection from horizontal will reduce droplet size and increase drift potential.
- **Nozzle Type** - Use a nozzle type that is designed for the intended application. With most nozzle types, narrower spray angles produce larger droplets. Consider using low-drift nozzles. Solid stream nozzles oriented straight back produce the largest droplets and the lowest drift.

Boom Length: To further reduce drift without reducing swath width, boom must not exceed 70% of wingspan or 80% of rotor diameter.

Application Height: Do not make applications at a height greater than 10 feet above the top of the largest plants unless a greater height is required for aircraft safety. Making applications at the lowest height that is safe reduces exposure of droplets to evaporation and wind.

Swath Adjustment: When applications are made with a crosswind, the swath will be displaced downwind. Therefore, on the up and downwind edges of the field, the applicator must compensate for this displacement by adjusting the path of the aircraft upwind. Swath adjustment distance should increase with increasing drift potential (higher wind, smaller drops, etc.).

Wind: Drift potential is lowest between wind speeds of 2 to 10 mph. However, many factors, including droplet size and equipment type, determine drift potential at any given speed. Do not make applications below 2 mph due to variable wind direction and high inversion potential. Do not apply in wind speeds greater than 10 mph. Local terrain can influence wind patterns. Every applicator should be familiar with local wind patterns and how they affect spray drift.

Temperature and Humidity: When making applications in low relative humidity, set up equipment to produce larger droplets to compensate for evaporation. Droplet evaporation is most severe when conditions are both hot and dry.

Temperature Inversions: Do not apply during a local, low level temperature inversion because drift potential is high. Temperature inversions restrict vertical air mixing, which causes small suspended droplets to remain in a concentrated cloud. This cloud can move in unpredictable directions due to the light variable winds common during inversions. Temperature inversions are characterized by increasing temperatures with altitude and are common on nights with limited cloud cover and light to no wind. They begin to form as the sun sets and often continue into the morning. Their presence can be indicated by ground fog; however, if fog is not present, inversions can also be identified by the movement of the smoke from a ground source or an aircraft smoke generator. Smoke that layers and moves laterally in a concentrated cloud (under low wind conditions) indicates an inversion, while smoke that moves upward and rapidly dissipates indicates good vertical air mixing.

USE DIRECTIONS
ProcellaCOR EC performance and selectivity may depend on dosage, time of year, stage of growth, method of application, and water movement.

Aquatic Plants Controlled: In-Water Application
Table 3 lists the expected susceptible species under favorable treatment conditions for aquatic plant control. Use of lower rates will increase selectivity on some species listed. Consultation with SePRO Corporation is recommended before applying ProcellaCOR EC to determine best in-water treatment protocols for given target vegetation.

TABLE 3. Vascular aquatic plant control with in-water application

Vascular Aquatic Plants Controlled: In-Water Application	
Common name	**Scientific name**
Floating Plants	
Mosquito fern	*Azolla* spp.
Water hyacinth	*Eichhornia crassipes*
Emersed Plants	
Alligatorweed	*Alternanthera philoxeroides*
American lotus	*Nelumbo lutea*
Floating heart	*Nymphoides* spp.
Water pennywort	*Hydrocotyle umbellata*
Water primrose	*Ludwigia* spp.
Watershield	*Brasenia schreberi*
Submersed Plants	
Bacopa	*Bacopa* spp.
Coontail[1]	*Ceratophyllum demersum*
Hydrilla[1]	*Hydrilla verticillata*
Parrotfeather	*Myriophyllum aquaticum*
Water chestnut	*Trapa* spp.
Watermilfoil, Eurasian	*Myriophyllum spicatum*
Watermilfoil, Hybrid Eurasian	*Myriophyllum spicatum X M.* spp.
Watermilfoil, Variable	*Myriophyllum heterophyllum*

[1] Higher-rate applications within the specified range may be required to control less-sensitive weeds.

Aquatic Plants Controlled: Foliar Application
Table 4 lists the expected susceptible species using labeled foliar rates (5.0 – 10.0 PDU per acre) under favorable treatment conditions for aquatic plant control. Use higher rates in the rate range on more established, dense vegetation. Consultation with SePRO Corporation is recommended before applying ProcellaCOR EC to determine best foliar treatment protocols for given target vegetation.

TABLE 4. Vascular aquatic plant control with foliar application

Vascular Aquatic Plants Controlled: Foliar Application	
Common name	**Scientific name**
Floating Plants	
Mosquito fern	*Azolla* spp.
Water hyacinth	*Eichhornia crassipes*
Emersed Plants	
Alligatorweed	*Alternanthera philoxeroides*
American lotus	*Nelumbo lutea*
Floating heart	*Nymphoides* spp.
Parrotfeather (emersed)	*Myriophyllum aquaticum*
Water pennywort	*Hydrocotyle umbellata*
Water primrose	*Ludwigia spp.*
Watershield	*Brasenia schreberi*

APPLICATION INFORMATION

Mixing Instructions

In-Water Application to Submersed or Floating Aquatic Weeds

ProcellaCOR EC can be applied undiluted or diluted with water for in-water applications. To dilute with water, it is recommended to fill the spray tank to one-half full with water. Start agitation. Add correct quantity of ProcellaCOR EC. Continue agitation while filling spray tank to required volume and during application.

Foliar Application to Floating and Emergent Weeds

Dilute ProcellaCOR EC with water to achieve proper coverage of treated plants. To dilute with water, it is recommended to fill spray tank to one-half full with water. Start agitation. A surfactant must be used with all post-emergent foliar applications. Use only surfactants that are approved or appropriate for aquatic use. For best performance, a methylated seed oil (MSO) surfactant is recommended. Read and follow all use directions and precautions on aquatic surfactant label. After adding ProcellaCOR EC and surfactant, continue agitation while filling spray tank to required volume and during application.

TANK-CLEANOUT INSTRUCTIONS

ProcellaCOR EC should be fully cleaned from application equipment prior to use for other applications. Contact a SePRO Aquatic Specialist for guidance on methods for thorough cleaning of application equipment after use of the product.

APPLICATION METHODS

In-Water Application to Submersed or Floating Aquatic Weeds

ProcellaCOR EC can be applied via trailing hose, by sub-surface injection, or surface spray as an in-water application to control weeds such as hydrilla, floating heart, water hyacinth, and other susceptible weed species. This product has relatively short exposure requirements for in-water treatments (hours to days), but treatments with high exchange and short exposure periods should be carefully planned to achieve best results. Where greater plant selectivity is desired - such as when controlling hydrilla or other more susceptible species, choose a lower dose in the specified range. A SePRO Aquatic Specialist can provide site-specific prescriptions for optimal control based on target weed, management objectives, and site conditions.

Apply ProcellaCOR EC to the treatment area at a prescription dose unit (PDU) to achieve appropriate concentrations. A PDU is a unit of measure that facilitates the calculation of the amount of product required to control target plants in 1 acre-foot of water or 1 acre for foliar applications. Per Table 5 below, 1-25 PDU are needed to treat 1 acre-foot of water, depending on target species and the percent of waterbody to be treated.

Use Table 5 to select the dose needed to treat 1 acre-foot of water.

TABLE 5: Prescription Dose Units (PDU) per acre-foot of water***

Percent Area of Waterbody Treated	Target Species			
	Eurasian Watermilfoil	Hybrid Watermilfoil	Variable Leaf Watermilfoil	Other
≤ 2%	3 - 4	4 - 5	3 - 5	3 - 25
>2 - 10%	2 - 3	3 - 5	3 - 4	3 - 20
>10 - 20%	1 - 3	3 - 4	2 - 4	3 - 15
>20 - 30%	1 - 2	2 - 3	2 - 3	2 - 10
>30%	1 - 2	2 - 3	1 - 2	1 - 5

* In all cases, user may apply up to the maximum of 25 PDU per acre-foot. Consult your SePRO Aquatics Specialist for site-specific recommendations.

** 1 PDU contains 3.17 fl. oz. of product.

To calculate the amount of product needed in fluid ounces, use the formula below:

Number of acres X average depth (feet) X PDU* X 3.17 = fluid ounces
*: from Table 5

Example Calculation:
To control hybrid watermilfoil in 2 acres of a 5-acre lake (>30% treated) with an average depth of 2 feet:
2 acres X 2 feet X 3 PDU X 3.17 = 38.04 fl. oz.

For in-water applications, the maximum single application is 25.0 PDU / acre-foot, with a limit of three applications per year. Allow 14 days or greater between applications. Product may be applied as a concentrate or diluted with water prior to or during the application process. Use an appropriate application method that ensures sufficiently uniform application to the treated area.

Foliar Application to Floating and Emergent Weeds

Apply ProcellaCOR EC as a foliar application to control weeds such as water hyacinth, water primrose, and other susceptible floating and emergent species. Use an application method that maximizes spray interception by target weeds while minimizing the amount of overspray that inadvertently enters the water.

For all foliar applications, apply ProcellaCOR EC at 5.0 to 10.0 PDU per acre. Use of a surfactant is required for all foliar applications of ProcellaCOR EC. Use only surfactants that are approved or appropriate for aquatic use. Methylated seed soil (MSO) is a recommended surfactant and is typically applied at 1.0% volume/volume. Refer to the surfactant label for use directions. For best results, apply to actively growing weeds. ProcellaCOR EC may be applied more than once per growing season to meet management objectives. Do not exceed 10.0 PDU per acre during any individual application or 20.0 PDU total per acre, per year from all combined treatments.

Foliar Spot Treatment

To prepare the spray solutions, thoroughly mix ProcellaCOR EC in water at a ratio of 5.0 to 10.0 PDU per 100 gallons (0.12 to 0.24% product) plus an adjuvant. For best results, a methylated seed oil at 1% volume/volume is the recommended spray adjuvant. When making spot application, ensure spray coverage is sufficient to wet the leaves of the target vegetation but not to the point of runoff.

Aerial Foliar Application to Floating and Emergent Weeds

Apply ProcellaCOR EC in a spray volume of 15 gallons per acre (GPA) or more when making a post-emergence application by air. Apply with coarse to coarser droplet category per S-572 ASABE standard; see NAAA, USDA or nozzle manufacturer guidelines. Follow guidelines and restrictions in the *Spray Drift Management and Aerial Drift Reduction Advisory* sections to minimize potential drift to off-target vegetation. Aircraft should be patterned per Operation Safe/PAASS program for calibration and uniformity to provide sufficient coverage and control.

Boat or Ground Foliar Application to Floating and Emergent Weeds

When applying ProcellaCOR EC by boat or with ground equipment to emergent or floating-leaved vegetation, use boom-type, backpack or hydraulic handgun equipment. Apply ProcellaCOR EC in a sufficient spray volume (e.g. 20 to 100 gpa) to provide accurate and uniform distribution of spray particles over the treated vegetation while minimizing runoff. Use higher spray volumes for medium to high density vegetation. For boom spraying, use coarse or coarser nozzle spray quality per S-572 ASABE standard; see USDA literature or nozzle manufacturer guidelines. Follow nozzle manufacturer's recommendations for nozzle pressure, spacing and boom height to provide a uniform spray pattern. Follow appropriate spray drift management information where drift potential is a concern.

TANK MIXES WITH OTHER AQUATIC HERBICIDES

DO NOT TANK MIX ANY PESTICIDE PRODUCT WITH THIS PRODUCT without first referring to the following website for the specific product: www.3206tankmix.com. This website contains a list of active ingredients that are currently prohibited from use in tank mixture with this product.

Only use products in tank mixture with this product that: 1) are registered for the intended use site, application method and timing; 2) are not prohibited for tank mixing by the label of the tank mix product; and 3) do not contain one of the prohibited active ingredients listed on www.3206tankmix.com website.

Applicators and other handlers (mixers) who plan to tank-mix must access the website within one week prior to application in order to comply with the most up-to-date information on tank mix partners.

Do not exceed specified application rates for respective products or maximum allowable application rates for any active ingredient in the tank mix.

Read carefully and follow all applicable use directions, precautions, and limitations on the respective product labels. It is the pesticide user's responsibility to ensure that all products in the mixtures are registered for the intended use. Users must follow the most restrictive directions for use and precautionary statements of each product in the tank mixture.

Always perform a (jar) test to ensure the compatibility of products to be used in tank mixture.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.
Pesticide Storage: Store in original container only. Keep container closed when not in use. Do not store near food or feed. In case of spill or leak on floor or paved surfaces, soak up with vermiculite, earth, or synthetic absorbent.
Pesticide Disposal: Pesticide wastes are toxic. Improper disposal of excess pesticide, spray mixture, or rinsate is a violation of Federal law. If these wastes cannot be disposed of by use according to label instructions, contact your State Pesticide or Environmental Control Agency or the Hazardous Waste Representative at the nearest EPA Regional Office for guidance.

Container Handling

Non-refillable Container. DO NOT reuse or refill this container. Triple rinse or pressure rinse container (or equivalent) promptly after emptying; then offer for recycling, if available, or reconditioning, if appropriate, or puncture and dispose of in a sanitary landfill, or by incineration, or by other procedures approved by state and local authorities.
Triple rinse containers small enough to shake (capacity ≤ 5 gallons) as follows: Empty the remaining contents into application equipment or a mix tank and drain for 10 seconds after the flow begins to drip. Fill the container ¼ full with water and recap. Shake for 10 seconds. Pour rinsate into application equipment or a mix tank, or store rinsate for later use or disposal. Drain for 10 seconds after the flow begins to drip. Repeat this procedure two more times.
Triple rinse containers too large to shake (capacity > 5 gallons) as follows: Empty the remaining contents into application equipment or a mix tank. Fill the container ¼ full with water. Replace and tighten closures. Tip container on its side and roll it back and forth, ensuring at least one complete revolution, for 30 seconds. Stand the container on its end and tip it back and forth several times. Turn the container over onto its other end and tip it back and forth several times. Empty the rinsate into application equipment or a mix tank, or store rinsate for later use or disposal. Repeat this procedure two more times.
Pressure rinse as follows: Empty the remaining contents into application equipment or mix tank and continue to drain for 10 seconds after the flow begins to drip. Hold container upside down over application equipment or mix tank, or collect rinsate for later use or disposal. Insert pressure rinsing nozzle in the side of the container and rinse at about 40 PSI for at least 30 seconds. Drain for 10 seconds after the flow begins to drip.

Warranty Disclaimer: SePRO Corporation warrants that this product conforms to the chemical description on the product label. Testing and research have also determined that this product is reasonably fit for the uses described on the product label. To the extent consistent with applicable law, SePRO Corporation makes no other express or implied warranty of fitness or merchantability nor any other express or implied warranty and any such warranties are expressly disclaimed.

Misuse: Federal law prohibits the use of this product in a manner inconsistent with its label directions. To the extent consistent with applicable law, the buyer assumes responsibility for any adverse consequences if this product is not used according to its label directions. In no case shall SePRO Corporation be liable for any losses or damages resulting from the use, handling or application of this product in a manner inconsistent with its label.

For additional important labeling information regarding SePRO Corporation's Terms and Conditions of Use, Inherent Risks of Use and Limitation of Remedies, please visit *http://seprolabels.com/terms* or scan the image below.

SePRO Corporation
11550 North Meridian Street, Suite 600
Carmel, IN 46032, U.S.A.

Conforms to HazCom 2012/United States

SAFETY DATA SHEET

ProcellaCOR EC

Section 1. Identification

GHS product identifier : ProcellaCOR EC

Recommended use of the chemical and restrictions on use

Identified uses : End use herbicide product

EPA Registration No. : 67690-80

Supplier's details : SePRO Corporation
11550 North Meridian Street
Suite 600
Carmel, IN 46032 U.S.A.
Tel: 317-580-8282
Toll free: 1-800-419-7779
Fax: 317-580-8290
Monday - Friday, 8am to 5pm E.S.T.
www.sepro.com

Emergency telephone number (with hours of operation) **INFOTRAC - 24-hour service 1-800-535-5053**

The following recommendations for exposure controls and personal protection are intended for the manufacture, formulation and packaging of this product. For applications and/or use, consult the product label. The label directions supersede the text of this Safety Data Sheet for application and/or use.

Section 2. Hazards identification

Hazard classification: This material is not hazardous under the criteria of the Federal OSHA Hazard Communication Standard 29CFR 1910.1200.

Other hazards: No data available.

Section 3. Composition/information on ingredients

Chemical nature: This product is a mixture.

Component	CASRN	Concentration
Florpyrauxifen-benzyl	1390661-72-9	2.7%
Ethylhexanol	104-76-7	2.1%
Methanol	67-56-1	0.9%
Balance	Not available	94.3%

Section 4. First aid measures

Description of first aid measures

General advice: If potential for exposure exists refer to Section 8 for specific personal protective equipment.

Inhalation: Move person to fresh air. If person is not breathing, call an emergency responder or ambulance, then give artificial respiration; if by mouth to mouth use rescuer protection (pocket mask etc). Call a poison control center or doctor for treatment advice.

Skin contact: Take off contaminated clothing. Rinse skin immediately with plenty of water for 15-20 minutes. Call a poison control center or doctor for treatment advice.

Eye contact: Hold eyes open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eyes. Call a poison control center or doctor for treatment advice.

Ingestion: No emergency medical treatment necessary.

Most important symptoms and effects, both acute and delayed: Aside from the information found under Description of first aid measures (above) and Indication of immediate medical attention and special treatment needed (below), any additional important symptoms and effects are described in Section 11: Toxicology Information.

Indication of any immediate medical attention and special treatment needed

Notes to physician: No specific antidote. Treatment of exposure should be directed at the control of symptoms and the clinical condition of the patient. Have the Safety Data Sheet, and if available, the product container or label with you when calling a poison control center or doctor, or going for treatment.

Section 5. Fire-fighting measures

Suitable extinguishing media: Water fog or fine spray. Dry chemical fire extinguishers. Carbon dioxide fire extinguishers. Foam. Do not use direct water stream. May spread fire. General purpose synthetic foams (including AFFF type) or protein foams are preferred if available. Alcohol resistant foams (ATC type) may function.

Unsuitable extinguishing media: No data available

Special hazards arising from the substance or mixture

Hazardous combustion products: During a fire, smoke may contain the original material in addition to combustion products of varying composition which may be toxic and/or irritating. Combustion products may include and are not limited to: Nitrogen oxides. Hydrogen fluoride. Hydrogen chloride. Carbon monoxide. Carbon dioxide.

Unusual Fire and Explosion Hazards: Violent steam generation or eruption may occur upon application of direct water stream to hot liquids.

Advice for firefighters

Fire Fighting Procedures: Keep people away. Isolate fire and deny unnecessary entry. Consider feasibility of a controlled burn to minimize environment damage. Foam fire extinguishing system is preferred because uncontrolled water can spread possible contamination. Do not use direct water stream. May spread fire. Burning liquids may be moved by flushing with water to protect personnel and minimize property damage. Contain fire water run-off if possible. Fire water run-off, if not contained, may cause environmental damage. Review the "Accidental Release Measures" and the "Ecological Information" sections of this SDS.

Special protective equipment for firefighters: Wear positive-pressure self-contained breathing apparatus (SCBA) and protective fire fighting clothing (includes fire fighting helmet, coat, trousers, boots, and gloves). Avoid contact with this material during fire fighting operations. If contact is likely, change to full chemical resistant fire fighting clothing with self-contained breathing apparatus. If this is not available, wear full chemical resistant clothing with self-contained breathing apparatus and fight fire from a remote location. For protective equipment in post-fire or non-fire clean-up situations, refer to the relevant sections.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures: Isolate area. Keep unnecessary and unprotected personnel from entering the area. Refer to section 7, Handling, for additional precautionary measures. Use appropriate safety equipment. For additional information, refer to Section 8, Exposure Controls and Personal Protection.

Environmental precautions: Spills or discharges to natural waterways are likely to kill aquatic organisms. Prevent from entering into soil, ditches, sewers, waterways and/or groundwater. See Section 12, Ecological Information.

Methods and materials for containment and cleaning up: Contain spilled material if possible. Small spills: Absorb with materials such as: Clay. Dirt. Sand. Sweep up. Collect in suitable and properly labeled containers. Large spills: Contact SePRO Corporation for clean-up assistance. See Section 13, Disposal Considerations, for additional information.

Section 7. Handling and storage

Precautions for safe handling: Keep out of reach of children. Do not swallow. Avoid contact with eyes, skin, and clothing. Avoid breathing vapor or mist. Wash thoroughly after handling. Keep container closed. Use with adequate ventilation. See Section 8, EXPOSURE CONTROLS AND PERSONAL PROTECTION.

Conditions for safe storage: Store in a dry place. Store in original container. Keep container tightly closed when not in use. Do not store near food, foodstuffs, drugs or potable water supplies.

Section 8. Exposure controls/personal protection

Control parameters: Exposure limits are listed below, if they exist.

Component	Regulation	Type of Listing	Value/Notation
Ethylexanol	Dow IHG	TWA	2 ppm
	Dow IHG	TWA	SKIN
Methanol	ACGIH	TWA	200 ppm
	ACGIH	STEL	250 ppm
	OSHA Z-1	TWA	260 mg/m³ 200 ppm
	ACGIH	TWA	SKIN, BEI

ACGIH	STEL	SKIN, BEI
CAL PEL	C	1,000 ppm
CAL PEL	PEL	260 mg/m^3 200 ppm
CAL PEL	STEL	325 mg/m^3 250 ppm

RECOMMENDATIONS IN THIS SECTION ARE FOR MANUFACTURING, COMMERCIAL BLENDING AND PACKAGING WORKERS. APPLICATORS AND HANDLERS SHOULD SEE THE PRODUCT LABEL FOR PROPER PERSONAL PROTECTIVE EQUIPMENT AND CLOTHING.

Exposure controls

Engineering controls: Use local exhaust ventilation, or other engineering controls to maintain airborne levels below exposure limit requirements or guidelines. If there are no applicable exposure limit requirements or guidelines, general ventilation should be sufficient for most operations. Local exhaust ventilation may be necessary for some operations.

Individual protection measures

Eye/face protection: Use safety glasses (with side shields).

Skin protection

Hand protection: Use gloves chemically resistant to this material. Examples of preferred glove barrier materials include: Chlorinated polyethylene. Neoprene. Polyethylene. Ethyl vinyl alcohol laminate ("EVAL"). Polyvinyl chloride ("PVC" or "vinyl"). Viton. Examples of acceptable glove barrier materials include: Butyl rubber. Natural rubber ("latex"). Nitrile/butadiene rubber ("nitrile" or "NBR"). NOTICE: The selection of a specific glove for a particular application and duration of use in a workplace should also take into account all relevant workplace factors such as, but not limited to: Other chemicals which may be handled, physical requirements (cut/puncture protection, dexterity, thermal protection), potential body reactions to glove materials, as well as the instructions/specifications provided by the glove supplier.

Other protection: Use protective clothing chemically resistant to this material. Selection of specific items such as face shield, boots, apron, or full body suit will depend on the task.

Respiratory protection: Respiratory protection should be worn when there is a potential to exceed the exposure limit requirements or guidelines. If there are no applicable exposure limit requirements or guidelines, wear respiratory protection when adverse effects, such as respiratory irritation or discomfort have been experienced, or where indicated by your risk assessment process. For most conditions no respiratory protection should be needed; however, if discomfort is experienced, use an approved air-purifying respirator. The following should be effective types of air-purifying respirators: Organic vapor cartridge with a particulate pre-filter.

Section 9. Physical and chemical properties

Appearance	
Physical State	Liquid
Color	Amber
Odor	Solvent
Odor Threshold	No data available
pH	4.24 (1% aqueous suspension)
Melting point/range	Not applicable to liquids
Freezing point	No data available
Boiling point (760 mmHg)	No data available
Flash point	> 100 °C (> 212 °F)
Evaporation Rate (Butyl Acetate =1)	No data available
Flammability (solid, gas)	Not applicable
Lower explosion limit	No data available
Upper explosion limit	No data available
Vapor pressure	0.0000002 mmHg at 20°C (68°F)
Relative Vapor Density (air = 1)	No data available

Relative Density (water = 1)	0.93
Water solubility	0.015 mg/l at 20°C (68°F)
Partition coefficient:	
n-octanol/water	No data available
Auto-ignition temperature	260°C (500 °F)
Decomposition temperature	No data available
Dynamic Viscosity	15.4 mPa.s at 20°C (68°F) 8.90 mPa.s at 40°C (104°F)
Kinematic Viscosity	14.2 mm^2/s at 20°C (68°F) 7.91 mm^2/s at 40°C (104°F)
Explosive properties	Not explosive
Oxidizing properties	Not oxidizing
Liquid Density	0.9257 g/cm3 at 20 °C (68 °F) *Digital density meter*
Molecular weight	No data available

NOTE: The physical data presented above are typical values and should not be construed as a specification.

Section 10. Stability and reactivity

Reactivity: No dangerous reaction known under conditions of normal use.

Chemical stability: Thermally stable at typical use temperatures.

Possibility of hazardous reactions: Polymerization will not occur.

Conditions to avoid: Exposure to elevated temperatures can cause product to decompose.

Incompatible materials: None known.

Hazardous decomposition products: Decomposition products depend upon temperature, air supply and the presence of other materials. Decomposition products can include and are not limited to: Carbon monoxide. Carbon dioxide. Hydrogen chloride. Hydrogen fluoride. Nitrogen oxides.

Section 11. Toxicological information

Toxicological information appears in this section when such data is available.

Acute toxicity

Acute oral toxicity Very low toxicity if swallowed. Harmful effects not anticipated from swallowing small amounts. As product: LD50, Rat, female, > 5,000 mg/kg

Acute dermal toxicity Prolonged skin contact is unlikely to result in absorption of harmful amounts. As product: LD50, Rat, male and female, > 5,000 mg/kg

Acute inhalation toxicity No adverse effects are anticipated from single exposure to mist. Based on the available data, respiratory irritation was not observed. As product: LC50, Rat, male and female, 4 Hour, dust/mist, > 5.40 mg/l No deaths occurred at this concentration.

Skin corrosion/irritation Brief contact may cause slight skin irritation with local redness.

Serious eye damage/ eye irritation May cause slight eye irritation. Corneal injury is unlikely.

Sensitization Did not cause allergic skin reactions when tested in guinea pigs. For respiratory sensitization: No relevant data found.

Specific Target Organ Systemic Toxicity (Single Exposure)	Evaluation of available data suggests that this material is not an STOT-SE toxicant.
Specific Target Organ Systemic Toxicity (Repeated Exposure)	For the active ingredient(s): Based on available data, repeated exposures are not anticipated to cause significant adverse effects. For the major component(s): Based on available data, repeated exposures are not anticipated to cause significant adverse effects. For the minor component(s): In animals, effects have been reported on the following organs: Blood, kidney, liver, and spleen.
Carcinogenicity	For the active ingredient(s): Did not cause cancer in laboratory animals. For the major component(s): No relevant data found.
Teratogenicity	For the active ingredient(s): Did not cause birth defects or any other fetal effects in laboratory animals. For the major component(s): No relevant data found. For the minor component(s): Has caused birth defects in laboratory animals only at doses toxic to the mother. Has been toxic to the fetus in laboratory animals at doses toxic to the mother. These concentrations exceed relevant human dose levels.
Reproductive toxicity	For the active ingredient(s): In animal studies, did not interfere with reproduction. For the major component(s): In animal studies, did not interfere with reproduction. In animal studies, did not interfere with fertility.
Mutagenicity	In vitro genetic toxicity studies were negative. Animal genetic toxicity studies were negative.
Aspiration Hazard	Based on physical properties, not likely to be an aspiration hazard. No aspiration toxicity classification

Section 12. Ecological information

Ecotoxicological information appears in this section when such data is available.

Toxicity

Acute toxicity to fish	Material is practically non-toxic to fish on an acute basis (LC50 > 100 mg/L). EC50, *Cyprinus carpio* (Carp), static test, 96 Hour, > 120 mg/l, OECD Test Guideline 203 or Equivalent
Acute toxicity to aquatic invertebrates	Material is slightly toxic to aquatic invertebrates on an acute basis (LC50/EC50 between 10 and 100 mg/L). EC50, *Daphnia magna* (Water flea), 48 Hour, 49 mg/l, OECD Test Guideline 202
Acute toxicity to algae/aquatic plants	Material is very highly toxic to some aquatic vascular plant species. ErC50, *Pseudokirchneriella subcapitata* (green algae), 72 Hour, > 5.4 mg/l, OECD Test Guideline 201 ErC50, *Myriophyllum spicatum*, 14 d, 0.000919 mg/l NOEC, *Myriophyllum spicatum*, 14 d, 0.0000954 mg/l

Toxicity to Above Ground Organisms

Material is practically non-toxic to birds on an acute basis (LD50 > 2000 mg/kg).

oral LD50, *Colinus virginianus* (Bobwhite quail), > 2500mg/kg bodyweight.

oral LD50, *Apis mellifera* (bees), 48 Hour, > 212.2μg/bee

contact LD50, *Apis mellifera* (bees), 48 Hour, >200μg/bee

Toxicity to soil-dwelling organisms

LC50, *Eisenia fetida* (earthworms), 14 d, mortality, >2,500 mg/kg

Persistence and degradability

florpyrauxifen-benzyl

Biodegradability: Material is expected to biodegrade very slowly (in the environment). Fails to pass OECD/EEC tests for ready biodegradability.
10-day Window: Fail
Biodegradation: 14.6 %
Exposure time: 29 d
Method: OECD Test Guideline 301B

Stability in Water (1/2-life)
Hydrolysis, DT50, 913 d, pH 4, Half-life Temperature 25 °C
Hydrolysis, DT50, 111 d, pH 7, Half-life Temperature 25 °C
Hydrolysis, DT50, 1.3 d, pH 9, Half-life Temperature 25 °C

Ethylhexanol

Biodegradability: Material is readily biodegradable. Passes OECD test(s) for ready biodegradability. Material is ultimately biodegradable (reaches > 70% mineralization in OECD test(s) for inherent biodegradability).
10-day Window: Not applicable
Biodegradation: > 95 %
Exposure time: 5 d
Method: OECD Test Guideline 302B or Equivalent
10-day Window: Pass
Biodegradation: 68 %
Exposure time: 17 d
Method: OECD Test Guideline 301B or Equivalent

Theoretical Oxygen Demand: 2.95 mg/mg

Chemical Oxygen Demand: 2.70 mg/mg

Biological oxygen demand (BOD)

Incubation Time	BOD
5 d	26-70 %
10 d	75-81 %
20 d	86-87 %

Photodegradation
Test Type: Half-life (indirect photolysis)
Sensitizer: OH radicals
Atmospheric half-life: 9.7 Hour
Method: Estimated.

Methanol

Biodegradability: Material is readily biodegradable. Passes OECD test(s) for ready biodegradability.
10-day Window: Pass
Biodegradation: 99%
Exposure time: 28 d
Method: OECD Test Guideline 301D or Equivalent

Theoretical Oxygen Demand: 1.50 mg/mg

Chemical Oxygen Demand: 1.49 mg/mg Dichromate

Biological oxygen demand (BOD)

Incubation Time	BOD
5 d	72 %
20 d	79 %

Photodegradation
Test Type: Half-life (indirect photolysis)
Sensitizer: OH radicals
Atmospheric half-life: 8-18 d
Method: Estimated.

Balance

Biodegradability: No relevant data found.

Bioaccumulative potential

Florpyrauxifen-benzyl

Bioaccumulation: Bioconcentration potential is moderate (BCF between 100 and 3000 or Log Pow between 3 and 5).
Partition coefficient: n-octanol/water(log Pow): 5.5 at 20 °C
Bioconcentration factor (BCF): 356 *Lepomis macrochirus* (Bluegill sunfish) 30 d

Ethylhexanol

Bioaccumulation: Bioconcentration potential is moderate (BCF between 100 and 3000 or Log Pow between 3 and 5).
Partition coefficient: n-octanol/water(log Pow): 3.1 Measured

Methanol

Bioaccumulation: Bioconcentration potential is low (BCF < 100 or Log Pow < 3).
Partition coefficient: n-octanol/water(log Pow): -0.77 Measured
Bioconcentration factor (BCF): <10 Fish Measured

Balance

Bioaccumulation: No relevant data found.

Mobility in soil

Florpyrauxifen-benzyl

Expected to be relatively immobile in soil (Koc > 5000).
Partition coefficient (Koc): 34200

Ethylhexanol

Potential for mobility in soil is low (Koc between 500 and 2000).
Partition coefficient (Koc): 800 Estimated.

Methanol

Potential for mobility in soil is very high (Koc between 0 and 50).
Partition coefficient (Koc): 0.44 Estimated.

Balance

No relevant data found.

Section 13. Disposal considerations

Disposal methods: If wastes and/or containers cannot be disposed of according to the product label directions, disposal of this material must be in accordance with your local or area regulatory authorities. This information presented below only applies to the material as supplied. The identification based on characteristic(s) or listing may not apply if the material has been used or otherwise contaminated. It is the responsibility of the waste generator to determine the toxicity and physical properties of the material generated to determine the proper waste identification and disposal methods in compliance with applicable regulations. If the material as supplied becomes a waste, follow all applicable regional, national and local laws.

Section 14. Transport information

DOT Not regulated for transport

Classification for SEA transport (IMO-IMDG):

Proper shipping name	Environmentally hazardous substance, liquid, n.o.s. (Florpyrauxifen-benzyl)
UN number	UN 3082
Class	9
Packing group	III
Marine pollutant	Florpyrauxifen-benzyl
Transport in bulk according to Annex I or II of MARPOL 73/78 and the IBC or IGC Code	Consult IMO regulations before transporting ocean bulk

Classification for AIR transport (IATA/ICAO):

Proper shipping name	Environmentally hazardous substance, liquid, n.o.s. (Florpyrauxifen-benzyl)
UN number	UN 3082
Class	9
Packing group	III

This information is not intended to convey all specific regulatory or operational requirements/information relating to this product. Transportation classifications may vary by container volume and may be influenced by regional or country variations in regulations. Additional transportation system information can be obtained through an authorized sales or customer service representative. It is the responsibility of the transporting organization to follow all applicable laws, regulations and rules relating to the transportation of the material.

Section 15. Regulatory information

OSHA Hazard Communication Standard

This product is not a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

Superfund Amendments and Reauthorization Act of 1986 Title III (Emergency Planning and Community Right-to-Know Act of 1986) Sections 311 and 312

This product is not a hazardous chemical under 29CFR 1910.1200, and therefore is not covered by Title III of SARA.

Superfund Amendments and Reauthorization Act of 1986 Title III (Emergency Planning and Community Right-to-Know Act of 1986) Section 313

This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

Pennsylvania Worker and Community Right-To-Know Act:

The following chemicals are listed because of the additional requirements of Pennsylvania law:

Components	CASRN
Ethylhexanol	104-76-7

California Proposition 65 (Safe Drinking Water and Toxic Enforcement Act of 1986)

WARNING: This product contains a chemical(s) known to the State of California to cause birth defects or other reproductive harm.

United States TSCA Inventory (TSCA)

This product contains chemical substance(s) exempt from U.S. EPA TSCA Inventory requirements. It is regulated as a pesticide subject to Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) requirements.

Section 16. Other information

Hazard Rating System

National Fire Protection Association (U.S.A.)

Health: 1 Flammability: 1 Instability: 0

Legend

ACGIH	USA. ACGIH Threshold Limit Values (TLV)
C	Ceiling
CAL PEL	California permissible exposure limits for chemical contaminants (Title 8, Article 107)
Dow IHG	Dow Industrial Hygiene Guideline
OSHA Z-1	USA. Occupational Exposure Limits (OSHA) – Table Z-1 Limits for Air Contaminants
PEL	Permissible exposure limit
SKIN	Absorbed via skin
SKIN, BEI	Absorbed via Skin, Biological Exposure Indice
STEL	Short term exposure limit
TWA	Time weighted average

History

Date of issue mm/dd/yyyy : 10/09/2017

Version : 1.0

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein. Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

4.3 EVALUATION OF RINSKOR (PROCELLACOR™)

NOTE: GEI Consultants, Inc. executed a confidential non-disclosure agreement with SePRO Corporation to obtain and review proprietary studies and data. SePRO is working in partnership with Dow AgroSciences to develop this technology for aquatic weed control. In the absence of peer-reviewed journal articles or other scientific literature, these studies—many of which were performed in support of EPA's Office of Pesticide Programs (OPP) registration requirements—were used to prepare the evaluation of the candidate aquatic herbicide.

4.3.1 Registration Status

PROCELLACOR™ (Procellacor™) Aquatic Herbicide (active ingredient Rinskor™, or 2-pyridinecarboxylic acid, 4-amino-3-chloro-6-(4-chloro-2-fluoro-3-methoxyphenyl)-5-fluoro-, phenylmethyl ester; common name: florpyrauxifen-benzyl) has not yet been registered nationally by the EPA or in Washington State by the WSDA under 15.58 Revised Code of Washington (RCW). This SEIS provides technical, environmental, and other information required by Ecology to determine whether to add Procellacor™ to existing water quality NPDES permits, which will allow this herbicide to be discharged to the waters of the State as allowed under the Clean Water Act.

Procellacor™ (as the aquatic use of Rinksor)was granted Reduced Risk status by EPA under the Pesticide Registration Improvement Act (PRIA) Version 3 (https://www.epa.gov/pria-fees/pria-overview-and-history#pria3) in early 2016 (Denny, Breaux, 2016; also see notification letter at Attachment A) because of its promising environmental and toxicological profiles in comparison to currently registered herbicides utilized for partial treatment of hydrilla, invasive watermilfoils, and other noxious plant species. EPA concluded that the overall profile appeared more favorable when compared to the registered alternatives for the proposed use patterns for these noxious species, and that the reduction in risk pertaining to human health was the driving factor in this determination. As discussed later in the document, Procellacor™ shows excellent selectivity with few or limited impacts to native aquatic plants such as aquatic grasses, bulrush, cattail, pondweeds, naiads, and tapegrass. In its review, EPA also noted that the overall profile for the herbicide appears favorable when compared to currently registered alternative herbicides (e.g. 2,4-D, endothall, triclopyr) for this aquatic use pattern. Procellacor™ represents an alternative mode of chemical action which is more environmentally favorable than currently registered aquatic herbicides. Procellacor™ would be expected to offer improvements in IPM for control of noxious aquatic weeds. The alternative mode of action should also help to prolong the effectiveness of many aquatic herbicide solutions by offering a new rotation or combination alternative as part of herbicide resistance management strategies.

The new candidate aquatic herbicide is under expedited review from EPA under the PRIA per the Reduced Risk status designation discussed above, with an anticipated registration date of April 2017. As part of the review, EPA's OPP is also currently conducting human health and ecological risk assessments with an expected date of release in spring 2017. This SEIS document relies on information currently available at this time, much of which necessarily is limited to data provided by Dow AgroSciences and SePRO Corporation in developing and testing the herbicide. It can be revised with more updated information following the release of EPA review information as well as other peer-reviewed literature expected to be released later in 2017. Dow AgroSciences has also concurrently applied to EPA for registration of the Rinskor active ingredient for weed control in rice paddies. The initial Procellacor™ formulation is expected to be a 300 g TGAI/L suspension concentrate. Control of hydrilla and invasive watermilfoils can be achieved at in-water spot/partial treatment rates of 10 to 50 µg a.i./L with Procellacor™, as opposed to rates of 1,000 to 5,000 µg a.i./L for endothall, 2,4-D, and triclopyr (Getsinger 2016, Beets and Netherland 2017a *in review*, Netherland et al 2017 *in prep*).

This analysis considers Procellacor™'s mode of action, efficacy, and range of in-water treatment concentrations required to achieve control across different water exchange / exposure scenarios. The review discusses results of mesocosm and other field studies conducted in partial site and whole pond treatments, described in more detail below.

To help expedite development and future adoption of the technology, SePRO has been working with numerous partners and collaborators to conduct experimental applications to confirm field efficacy on a variety of target aquatic vegetation, as well as to document non-target effects or impacts. As an unregistered product that does not have a federal experimental use permit, EPA guidelines require that field testing be limited to one acre or less of application per target pest species and that uses of water potentially affected by this application such as swimming, fishing, and irrigation be restricted. The discussion below provides a summary of the herbicides' physical properties, mammalian and ecotoxicological information, environmental fate, and other requirements for EPA registration. Most of these studies have been conducted by Dow AgroSciences and SePRO Corporation in fulfillment of EPA's OPP pesticide registration requirements under FIFRA (as represented by Heilman 2016). As noted above, few peer-reviewed publications have yet been released, although more are expected later in 2017 and beyond.

4.3.2 Description

Procellacor™ is the aquatic trade name for use of a new active ingredient (Rinskor), which is one chemistry in a novel class of herbicides known as the arylpicolinates. The primary end-use formulation anticipated for in-water application at time of registration is a 300 g active ingredient/liter suspension concentrate, but other aquatic use formulations are being considered for registration shortly after the initial EPA decision.

Aquatic herbicides are grouped by contact (controls plant shoots only) vs. systemic (controls entire plant), and by aqueous concentration and exposure time (CET) requirements. In general, contact products are quicker acting with shorter CET requirements, while systemic herbicides are slower acting with longer CET requirements. In light of this, Procellacor™ is quick-acting, has relatively short CET requirements, is systemic, and requires low application rates compared to other currently registered herbicides. Moreover, it has shown short persistence in both water and sediment relative to currently registered herbicides such as endothall, 2,4-D, and triclopyr, is species-selective, and has minimal non-target effects to both plant and animal species. Its effective chemical mode of action and high selectivity for aquatic invasive and noxious plants provides a significant impetus for its development and eventual registration. Procellacor™ has demonstrated this selective, systemic activity with relatively short CET requirements on several major aquatic weed species, including hydrilla and invasive watermilfoils. Netherland and Richardson (2016) and Richardson *et al*. (2016) investigated the sensitivity of numerous aquatic plant species to the compound, and provided verification of Procellacor™'s activity on key invasives and greater tolerance by the majority of native aquatic plants tested to date. Additional government and university research has documented high activity and different selectivity patterns relative to possible impacts to non-target aquatic vegetation compared to other currently registered, well-documented herbicides such as triclopyr, endothall, and/or 2,4-D (Beets and Netherland 2017a *in review*, Beets and Netherland 2017b *in prep*, Haug and Richardson 2017 *in prep*).

4.3.2.1 Environmental Characteristics: Product Use and Chemistry

Procellacor™ shows excellent activity on several major US aquatic weeds including hydrilla (*H. verticillata*) and multiple problematic watermilfoils (*Myriophyllum spp.)*, including Eurasian (EWM) and hybrid Eurasian (*M. spicatum X M. sibiricum*), parrotsfeather (*M. aquaticum*), and variable-leaf milfoil (*M. heterophyllum*). Procellacor™ provides a new systemic mode of action for hydrilla control and a new class of auxin-mimic herbicide chemistry for selective management of invasive watermilfoils. It also has in-water or foliar herbicidal activity on a number of noxious emergent and floating aquatic plants such as water hyacinth and invasive floating hearts (*Nymphoides spp*.). Procellacor™ has low application rates (50 µg/L or less) for systemic activity with short CET requirements (12 – 72 hours depending on rate and target weed) allowing for spot and/or partial in-water applications. For such treatments, Procellacor™ provides selective control with several hundred times less herbicide use versus current in-water, spot treatment herbicides such as endothall (5,000 µg/L maximum use rate for dipotassium salt form) and 2,4-D (4,000 µg/L maximum use rate). Procellacor™ also appears to show high selectivity with few impacts to native aquatic plants such as aquatic grasses, bulrush, cattail, pondweeds, naiads, and tapegrass (see discussion on selectivity below).

Procellacor™ is effective in controlling hydrilla, and offers a new pattern of selectivity for removing hydrilla from mixed aquatic-plant communities. The strong activity of this new alternative mode of action supports its development for selective hydrilla control. Mesocosm studies summarized by Heilman (2016) and in preparation or under active review for peer-reviewed publication have shown that control of standing biomass of hydrilla and EWM can be achieved in two to three weeks, with high activity even on 2,4-D and triclopyr-tolerant stands of hybrid EWM (Beets and Netherland 2017a *in review*, Netherland et al. 2017 *in prep*). Multiple small-scale laboratory screening studies were conducted to support both target weed activity and regulatory consideration of potential effects of Procellacor™ on non-target aquatic vegetation. The test plant EC_{50} response (herbicide concentration having 50% effect) to static exposures of Procellacor™ was determined for 12 different plant species: the general EC_{50} range was approximately 0.11 µg/L to greater than 81 µg/L (Netherland and Richardson, 2016; Richardson *et al*., 2016). Similar small-scale comparative efficacy testing of Procellacor™ vs. 2,4-D and triclopyr on multiple invasive watermilfoils confirms orders of magnitude greater activity with Procellacor™ versus the older auxin herbicides, including activity on hybrid EWM with documented tolerance to the older herbicides (Beets and Netherland 2017b *in prep*). These findings are promising for Procellacor™, as they support significantly lower herbicide application rates combined with a favorable environmental profile, discussed in more detail below.

4.3.2.2 Environmental Mobility and Transport

Procellacor™/Rinskor is known to have low water solubility (laboratory assay of TGAI: 10 to 15 µg/L at pH 5 to 9, 20^{o}C), low volatility (vapor pressure approx. 10^{-7} mm Hg), with moderately high partition coefficients (log K_{ow} values of approximately 5.4 to 5.5), which describe an environmental profile of low solubility and relatively high affinity for sorption to organic substrates.

The environmental fate of the herbicide in soil and water has been characterized as part of the registration package and is well understood. The parent compound is not persistent and degrades via a number of pathways including photolysis, aerobic soil degradation, aerobic aquatic degradation, and/or hydrolysis to a number of hydroxyl, benzyl-ester, and acid metabolites. In aerobic soil, Procellacor™ degrades moderately quickly, with half-lives ranging from 2.5 to 34 days, with an average of 15 days. Anaerobic soil metabolism studies also show relatively rapid degradation rates, with half-lives ranging from 7 to 15 days, and an average of 9.8 days. The herbicide is short-lived, with half-lives ranging from 4 to 6 days and 2 days, respectively, in aerobic and anaerobic aquatic environments, and in total water-sediment systems such as mesocosms. These half-lives are consistently rapid compared to other currently registered herbicides such as 2,4-D, triclopyr, and endothall. Degradation in surface water is accelerated when exposed to sunlight, with a reported photolytic half- life in laboratory testing of 0.07 days.

In two outdoor aquatic dissipation studies, as summarized by Heilman (2016), the SC formulation of the herbicide was directly injected into outdoor ponds at nominal rates of 50 and 150 µg/L as the active ingredient. Water phase dissipation half-lives of 3.0 – 4.9 days were observed, which indicates that the material does not persist in the aquatic environment. With conditions similar to wetland and marsh habitat, results from another field dissipation study in rice paddies that incorporated appropriate water management practices for both wet-seeded and dry-seeded rice (also reported by Heilman 2016) resulted in aquatic-phase half-lives ranging from 0.15 to 0.79 days, and soil phase half-lives ranging from 0.0037 to 8.1 days These results do not indicate a tendency to persist in the aquatic environment. The herbicide can be classified as generally immobile based on soil log K_{oc} values in the order of 10^{-5}, and suggest that the potential for off-site transport is minimal. This is consistent with numerous observations that Procellacor™ undergoes rapid degradation in the soil and aqueous environments via a number of degradation mechanisms, summarized above.

4.3.2.3 Field Surveys and Investigations

A human health and ecological risk assessment is currently being conducted by EPA Office of Pesticide Programs. Results of this assessment are expected to be released during spring of 2017 (Denny, 2016), and these conclusions will either support or refute data already collected for Procellacor™. There are no preliminary findings to report, but based on the current understanding of available environmental fate, chemistry, toxicological, and other data, there is little to no cause for concern to human health or ecotoxicity for acute, chronic, or subchronic exposures to Procellacor™ formulations.

4.3.2.4 Bioconcentration and Bioaccumulation

A fish bioconcentration factor study and magnitude of residue studies for clam, crayfish, catfish, and bluegill support that, as anticipated from its physical chemistry and organic affinity, Procellacor™/Rinskor will temporarily bioaccumulate but is rapidly depurated and/or metabolized within freshwater organisms within 1 – 3 days after exposure to high concentrations (150 µg/L or higher). Based on these findings and the low acute and chronic toxicity to a wide variety of receptor organisms, summarized below, bioconcentration or bioaccumulation are not expected to be of concern for the

Procellacor™ aquatic use. EPA's forthcoming human health and ecological risk assessment will include exposure scenarios that will help to further clarify and refine the understanding of bioconcentration or bioaccumulation potential for Procellacor™.

4.3.2.5 Toxicological Profile

Mammalian and Human Toxicity

Extensive mammalian toxicity testing of Procellacor™ has been conducted by the proposed registrant, and results have shown little evidence of acute or chronic toxicity. Acute mammalian toxicity testing for Procellacor™ showed very low acute toxicity by oral or dermal routes (LD_{50} values greater than 5,000 mg/kg). Acute toxicity is also reported low via the inhalation route of exposure (LC_{50} value greater than 5.2 mg/L). Procellacor™ is reported not to be an irritant to eyes or skin and only demonstrated a weak dermal sensitization potential in a mouse local lymph node assay (EC_3 of 19.1%).

Absorption, distribution, metabolism, and elimination profiles have been developed for Procellacor™. In summary, Procellacor™ has demonstrated rapid absorption (T_{max} of 2 hours), with higher absorption rates at lower doses (36 to 42% of the administered dose), rapid hydrolysis, and rapid elimination via the feces (51 to 101%) and urine (8 to 42%) during the first 24 hours following administration to laboratory mammals. In general, the lower doses tested would be more representative of levels potentially encountered by people, mammals, or other organisms.

Based on laboratory testing, Procellacor™ is not genotoxic, and there was no treatment-related toxicity even up to the highest doses tested in the acute, short-term, two generation reproduction or developmental toxicity studies or in the acute or subchronic neurotoxicity studies. Chronic administration of the herbicide did not show any carcinogenicity potential and did not cause any adverse effects in mice, rats or dogs, at the highest doses tested. In summary, studies conducted in support of EPA registration indicate there is little or no concern for acute, short term, subchronic or chronic dietary risk to humans from Procellacor™ applications. Tests have shown no evidence of genotoxicity/carcinogenicity, immunotoxicity, neurotoxicity, subchronic or chronic toxicity, reproductive or developmental toxicity, and only showed evidence of low acute toxicity.

Several studies conducted on both mice and rats, over the course of 1-2 years have indicated no treatment-related (post-necropsy) clinical observations or gross histopathological lesions. An 18-month mouse study was conducted, and no chronic toxicity, carcinogenicity, or other adverse effects were observed, even in those male and female mice receiving the highest doses tested. A 1-year dog study is also ongoing; similar to the above mammalian toxicity tests, no treatment-related toxicity or pathology has yet been observed during this study. Reproductive, developmental, and endocrine toxicity (immunotoxicity) has also been tested, and results of all these tests showed no evidence of toxicity. Although no specific human testing has been conducted for Procellacor™, based on extensive laboratory testing on mammalian species, little to no acute or chronic toxicity would be expected in association with environmental exposures.

General Ecotoxicity

Procellacor™ has undergone extensive ecotoxicological testing and has been shown to be nearly non-toxic to birds in acute oral, dietary, and reproduction studies. Similar to the mammalian testing summarized above, no toxicity was observed for avian, fish, or other species exposed to the herbicide in acute and long-term studies, with endpoints set at the highest concentration tested, which are well above those actually released as part of label-specified application of Procellacor™. As would be expected for an herbicide, toxicity has been observed to certain sensitive terrestrial and aquatic plants (see plant discussion below).

As noted above, the TGAI of Procellacor™ exhibits low water solubility, and in laboratory aquatic ecotoxicity studies, the highest concentration of TGAI that could be dissolved in the test water (or functional solubility) was approximately 40-60 µg/L in freshwater. The acute and/or chronic endpoints for freshwater fish and invertebrates are generally at, or above, the limit of functional solubility. Additional evaluations indicate a lack of toxicity of the aquatic end-use product (greater functional solubility than the TGAI) and metabolites up to several orders of magnitude above the typical in-water use rates of Procellacor™ (50 µg/L or less).

Fish Ecotoxicity

A variety of fish tests have been conducted in cold and warm water fish species using the TGAI as well as the end-use formulation and various metabolites. Acute toxicity results using rainbow trout (*O. mykiss*, a standard cold water fish testing species) indicated LC_{50} values of greater than 49 µg/L, and greater than 41 µg/L for fathead minnow (*P. promelas*, a standard warm water species). The pure TGAI would not be expected to be released into the environment, and comparable acute ecotoxicity testing was performed for carp using an end-use formulation for Procellacor™. Results indicate an LC_{50} value of greater than 1,900 ug/L for carp (*C. carpio*), indicating much lower acute toxicity potential. A marine toxicity test was identified, where sheepshead minnows (*C. variegatus*) were tested for acute toxicity, and a LC_{50} value of greater than 40 µg/L was produced, which is comparable to freshwater species tested for acute toxicity. This value is indicative of slight acute toxicity potential if environmental concentrations were to be present at these levels, which is unlikely. Comparable acute ecotoxicity testing using various Procellacor™ metabolites indicated LC_{50} values uniformly greater than 1,000 µg/L, indicating a minimal potential for acute toxicity from metabolites. Salmonid toxicity data also indicated no overt toxicity to juvenile rainbow trout at limit of solubility for both the TGAI and end-use formulation at the maximum application rate (40 µg/L). If fish were to occupy a plant-infested littoral zone that was treated by Procellacor™, no toxic exposure would be expected to occur, as toxicity thresholds would not be exceeded by the concentrations predicted to be allowed for use by the FIFRA label.

Fish toxicity testing, in addition to that summarized above, has been planned and is currently under way for sensitive and ESA-listed aquatic species and habitat considerations in the Pacific Northwest, as reported by Grue (2016). The emphasis for this aquatic toxicity testing is on salmonid species (Chinook salmon, bull trout, coho salmon, etc.), which are the most frequently listed and probably the most representative fish species in the Northwest under ESA. The most commonly accepted surrogate fish test species for salmonids is the coldwater salmonid rainbow trout (*O. mykiss*), but to help alleviate additional uncertainty, this additional testing will use age- and species- appropriate salmon species, and is intended to replicate pre-registration toxicity tests with trout. Test endpoints will include acute mortality, growth, and other sublethal endpoints (e.g. erratic swimming, on-bottom gilling, etc.) to evaluate more subtle toxicological effects potentially associated with Procellacor™.

This testing will screen comparable treatments to the trout testing (0, 40 and 80 µg/L Procellacor™, with the latter being well in excess of anticipated maximum labeled use rate). Testing will follow standard guidelines (ASTM, 2002; EPA, 1996) as did the earlier testing (e.g. Breaux, 2015), to ensure comparability. Results from this additional testing are expected to become available by late spring 2017, and will be useful in expanding our understanding of the toxicological properties of Procellacor™ when used in salmon-bearing waters.

Avian Toxicity

As noted above, Procellacor™ has been shown to be of low acute and chronic toxicity to birds as shown in a series of acute oral, dietary, and reproduction studies (Breaux, 2015). Little to no toxicity was observed for avian species exposed to the herbicide in both acute and longer-term chronic studies, with the highest test concentrations exceeded expected labeled rates, a common practice in laboratory toxicology. Bird testing was conducted to include standard test species including mallard duck (*A. platyrhynchos*), the passerine (songbird) species zebra finch (*T. guttata*), and bobwhite quail (*C. virginianus*). Tests involved oral administration for acute and chronic testing and reproductive studies, eggshell thinning, life cycle testing, and other endpoints. In summary, acute oral testing using bobwhite quail and zebra finch yielded LD_{50} values of greater than 2,250 mg/kg-day for both species. Two five-day acute dietary tests were also conducted, which both yielded LC_{50} values of greater than 5,620 mg/kg-day. Subchronic reproductive tests were also conducted for bobwhite quail and mallard ducks both yielded NOEC values of 1,000 mg/kg in the feed. All of these results are highly indicative of little to no toxicity to each of the avian species tested.

No amphibian or reptile toxicity testing was required by EPA Office of Pesticide Programs registration requirements, or conducted as part of the testing regimen for Procellacor™. EPA guidelines generally assert that avian testing is an adequate surrogate for amphibian or reptile testing, and invertebrate and mammalian test results are available as well to support projection of minimal toxicity of Procellacor™ to amphibians or reptiles.

Invertebrate Ecotoxicity

Acute and chronic testing of Procellacor™ with honey bees, the only insect species tested, has indicated no evidence of ecotoxicity to this species (Breaux, 2015). Concerning aquatic invertebrates, acute testing was performed for both the daphnid *D. magna* and the midge *Chironomus* sp. Tests were conducted using both the TGAI and end-use formulation for Procellacor™, as well as various metabolites. Acute toxicity results for the TGAI using *D. magna* indicated LC_{50} values of greater than 62 µg/L, and greater than 60 µg/L for *Chironomus.* This is generally consistent with acute toxicity testing conducted for the freshwater amphipod *Gammarus* sp., for which a NOEC value of 42 µg/L was developed. These results are indicative of little to no acute toxicity to these species. Comparable acute ecotoxicity testing was performed for *D. magna* using a Procellacor™ end-use formulation, and results indicated an LC_{50} value of greater than 80,000 µg/L, also indicating negligible acute toxicity potential. Acute ecotoxicity testing using various metabolites of the herbicide indicated LC_{50} values uniformly greater than 980 µg/L, with most values exceeding 10,000 µg/L, indicating little to no potential for acute toxicity for the metabolites.

Life cycle testing was also completed for a freshwater (*D. magna*) for both the TGAI and metabolites, and results showed a Lowest Observable Adverse Effect Concentration (LOAEC) and an NOAEC of 38 µg/L (both endpoints) showing low toxicity potential for the TGAI in an artificial scenario of static exposure using a renewal protocol design. The spot/partial use pattern of the herbicide and instability of TGAI under natural conditions project to a lack of chronic exposure to aquatic fauna. Comparable testing with metabolites showed LOAEC/NOAEC values both exceeding 25,000 µg/L, indicating negligible levels of toxicity for metabolites. Whole sediment testing using the TGAI for a freshwater invertebrate (chironomid midge) was also conducted for acute (10 day) and chronic (28 day) duration. The chronic test spiked water overlying sediments to a target concentration as the means to initiate exposure. Results of the whole sediment testing indicated an acute 10-day LOAEC of 10.5 mg ai/kg sediment and 28-day NOEC level of 78.5 µg/L (overlying water target concentration), which would generally be indicative of very low to negligible aquatic ecotoxicity.

Additionally, acute screening was recently performed by North Carolina State University (Principal Investigator: Dr. Greg Cope, cited as Buczek *et al.* 2017) on the juvenile life stage of a representative freshwater mussel (*L. siliquoidea*) with the TGAI, a primary metabolite (acid metabolite), and two TEP / formulations (the SC above and a 25 g/L EC formulation). The study showed no toxicity to juvenile mussels in any test with formulated results showing No Effect Concentrations (NOEC) that were 25 – 50 times greater than anticipated maximum application rate for the new herbicide (Cope *et al.* 2017 *in prep*).

Although the proposed registration for Procellacor™ in Washington State will be for freshwater application, it is possible that Procellacor™ would be applied near marine or estuarine habitats for weed control. Acute toxicity testing, using TGAI, conducted on the eastern oyster (*C. gigas*) produced an NOEC of greater than 24 µg ai/L and a comparable NOEC value for mysid shrimp (*M. bahia*) of greater than 26 ug ai/L, both the highest rates tested due to solubility limits with assays. Comparable NOEC values developed for primary aquatic end-use formulation were greater than 1,100 and 1,350 µg/L as formulated product (>289 and >362 µg/L as active ingredient), respectively, for the oyster and shrimp.

Marine invertebrate life cycle testing was conducted using the TGAI on a mysid shrimp) and a chronic NOAEC of 7.8 µg/L (LOAEC of 13 µg/L) was developed, which is potentially indicative of chronic toxicity to marine or estuarine invertebrates if these sustained concentrations were attained in environmental settings. Acute NOECs for oyster and mysids tested with the TGAI were set at the highest mean measured rate of tested material. There were no adverse effects noted in those studies. There are potential unknowns with possible effects with acute exposures to concentrations greater than 24-26 µg/L, but range finding-finding toxicity testing demonstrated that this range of concentrations were the highest limits to maintain solubility of TGAI in the assays.

In practice, due to rapid degradation of the TGAI in the field, rapid dilution from spot applications (main use pattern), and not labelling for estuarine and marine sites will mitigate any chance of acute exposures to marine invertebrates above the range of mid-20 µg/L. Chronic toxicity results for mysid shrimp do suggest possible chronic effects at 7.8 µg/L, with extended exposures to the TGAI. Again, however, the use pattern is not intended for estuarine/marine application with the initial labelling. The use pattern in freshwater is spot/partial treatments with negligible chance of sustained TGAI concentrations migrating downstream to estuarine habitat even if the freshwater site was in close proximity to an estuarine area. In general, the labeled freshwater use for spot/partial applications (high dilution potential) to control noxious freshwater aquatic plants and the rapid degradation of the TGAI suggest minimal risk to marine and estuarine invertebrates following application to a nearby freshwater site. Metabolite testing with marine species yielded NOECs of greater than 25,000 µg/L, indicating negligible toxicity.

Data Gaps

No data gaps have been identified for the basic environmental profile, including environmental fate, product chemistry, toxicology and ecotoxicology, and field studies required by EPA for pesticide registration. However, a number of recent trials are currently in review (e.g., Beets and Netherland 2017a) or in preparation for publication (e.g. Beets and Netherland, 2017b, Netherland *et al.* 2017, Haug *et al.* 2017). These, along with the continued use of Procellacor™ under a variety of plant management scenarios, will add valuable information that can be incorporated into the product labels, improved treatment profiles and potentially required mitigation measures.

4.3.3 Environmental and Human Health Impacts

4.3.3.1 Earth

Soil and Sediments

Procellacor™ has moderately high measured K_{ow} and K_{oc} partition coefficients, with log K_{ow} and K_{oc} values of approximately 5.4 to 5.5, or about 10^{-5}, which supports low solubility and demonstrates a relatively high affinity for sorption to organically enriched substrates such as soils or sediments. However, as noted above, in aerobic soil Procellacor™ degrades quickly, with half-lives ranging from 2.5 to 34 days, with an average of 15 days. Anaerobic soil metabolism studies are similar, showing relatively rapid degradation rates with half-lives ranging from 7 to 15 days, and an average of 9.8 days. This rapid degradation in the soil and sediment environment strongly suggests low persistence in these media. Due to the low acute and chronic toxicity described below, low to negligible impacts are expected in soils and sediments adjoining Procellacor™ treatment areas. The herbicide can be classified as largely immobile based on soil log K_{oc} values in the order of 10^{-5}, and that potential for off-site transport would be minimal.

Agriculture

At anticipated use concentrations, irrigation or flooding of crops with water treated with Procellacor™ are not expected to damage crops or non-target wild plants, except under scenarios not addressed in the forthcoming EPA label.

Terrestrial Land Use

At anticipated use concentrations, water reentry or swimming in water treated with Procellacor™ is not expected to cause dermal, eye, or other irritation or toxicity to human or wildlife species.

4.3.3.2 Water

Surface Water and Runoff

Procellacor™ is known to have low water solubility (about 15 µg/L in lab testing) and the parent compound is not persistent and is known to quickly degrade via a number of well-established pathways.

As discussed above, the herbicide is short lived in aerobic and anaerobic aquatic environments in a total water-sediment system. When exposed to direct sunlight, degradation in surface water is even more accelerated, with a reported photolytic half-life as little as 0.1 days.

The two outdoor aquatic dissipation studies summarized above further support this rapid dissipation and low impact. Both studies show that when Procellacor™ was directly injected into outdoor freshwater ponds at nominal rates of 50 and 150 µg/L, very rapid water-phase dissipation half-lives (3 to 4.9 days) were observed. These characteristics strongly suggest that the potential for off-site transport or mobility is minimal. As noted above, Procellacor™ undergoes rapid degradation in both soil and aqueous-phase environments via a number of degradation mechanisms.

No use for aquatic vegetation management in marine or estuarine water using Procellacor™ will be labeled at this time in Washington State (Heilman, 2016).

No specific studies or exposure scenarios were identified where drift or runoff were specifically investigated, but the forthcoming EPA risk assessment for Procellacor™ is expected to address these scenarios. For drift, the low vapor pressure (approximately 10^{-7} mm Hg) indicates that the material is not prone to volatilize following application, thus minimizing drift potential, and the low water solubility, low acute and chronic toxicity, along with minimal potential for persistence suggest that potential hazards associated with surface water runoff would be minimal.

Groundwater and Public Water Supplies

Few studies have yet been completed for groundwater, but based on known environmental properties concerning mobility, solubility, and persistence, Procellacor™ is not expected to be associated with potential environmental impacts or problems in groundwater.

In laboratory aquatic ecotoxicity studies, the highest concentration of TGAI that could be dissolved in the test water (or functional solubility) was approximately 40-60 µg/L in freshwater and 20-40 µg/L in saltwater. This is due to the low water solubility of the active ingredient and limits the range for which these toxicity tests can be conducted. This finding suggests that the water chemistry of Procellacor™ would limit potential environmental impacts to groundwater or surface water.

Impacts to public water supplies are expected to be low to negligible based on the low solubility, low persistence, and low acute and chronic toxicity of Procellacor™. Section 4.3.4 discusses possible measures or best management practices (BMPs) that could be used to further reduce potential impacts to public water supplies. The Ecology permit has mitigation that requires permittees to obtain an approval letter for this treatment prior to obtaining coverage under the permit.

4.3.3.3 Wetlands

The habitat and aquatic structure found in rice paddies is similar to those in a wetland and marsh environments, making the studies reported by Heilman (2016a) and Netherland and Richardson (2016) important tools for this analysis. The wetland and marsh study, discussed above in Section 4.3.2.2., incorporated appropriate water management practices for both wet-seeded and dry-seeded rice, and reported rapid aquatic-phase half-lives ranging from 0.15 to 0.79 days, and soil phase half-lives were also rapid, ranging from less than 0.01 to 8.1 days.

4.3.3.4 Plants

Algae

Limited ecotoxicity testing using a growth endpoint was conducted for two species of freshwater algae, including a diatom and green algae. These tests showed EC_{50} values using the TGAI of greater than 40 and 34 µg/L, respectively (solubility limit of assays). These results indicate that Procellacor™ is generally not toxic to green algae, freshwater diatoms, or blue-green algae at the anticipated label rate. Metabolite testing showed little toxicity to these algae, with no EC_{50} value less than 450 µg/L. Comparable growth testing was also conducted using the end-use formulation for aquatic algal plant growth, and results showed an EC_{50} greater than 1,800 µg/L (480 µg/L as active), with a NOAEC of 420 µg/L of formulation (111 µg/L as active), again showing a lack of toxicity to algae within anticipated label use rates. A comparable test of the TGAI was performed for cyanobacteria (blue-green algae), and results showed an EC_{50} of greater than 45 µg/L, with a calculated NOAEC value of 23.3 µg/L, showing little evidence of toxicity for any of these species.

Higher Plants and Crops

Procellacor™ is known to have strong herbicidal activity on key target aquatic invasive species, and testing shows that many native plants are able to tolerate Procellacor™ at exposure rates greater than what is necessary to control key target invasives. Data collection is still underway for specific toxicity to non-target plant species. Initial results of a 2016 collaborative mesocosm study conducted in Texas, for which results will be formally available later in 2017 indicate favorable selectivity by Procellacor™ of multiple invasive watermilfoils in the presence of representative submersed aquatic native plants (Netherland *et al.* 2017 *in prep*). Aquatic native plants challenged in this study included tapegrass, Illinois pondweed, American pondweed, waterweed, and water stargrass. Using aboveground biomass as a response endpoint, no significant treatment effects were observed with tapegrass or American/Illinois pondweed. Similarly, no statistically significant treatment effects were observed with stargrass, although injuries were observed at higher rates and exposures, although it was much more tolerant than the two target milfoil species. Other mesocosm studies have shown similar responses in white water lily with other non-target species including Robbins pondweed, American pondweed, and multiple bladderwort species showing little or no discernible impact. Richardson *et al*. (2016) and Haug and Richardson (2017 *in prep*) report that Procellacor™ provides a new potential for selectivity for removing hydrilla from mixed aquatic-plant communities. They recommend that further research should be conducted to further characterize observed patterns of selectivity.

4.3.3.5 Habitat

Impacts to critical habitat for aquatic plant or animal species are expected to be minimal, and may benefit critical habitat overall by supporting plant selectivity. Procellacor™ is generally of a low order or acute and chronic toxicity to plants and animals and generally does not persist in the environment. Due to its documented selectivity, Procellacor™ would allow many native non-target plants to thrive and thus enhance quality habitat. Removing noxious aquatic plants creates open spaces in the littoral zone that may be recolonized by not only native plants but other invasive plant species.

For example, when left unchecked, dense stands of unwanted weeds such as watermilfoil, parrotsfeather, hydrilla, or numerous other noxious plant species can negatively impact critical salmonid or other habitat used at all life stages, as well as habitats to a wide variety of plant and animal species, including vulnerable life stages. Stands of invasive weeds can reduce water flow and circulation, thus impeding navigation for migrant salmonids. Such stands can also provide ambush cover for predatory species such as bass, which prey on critical juvenile and other salmonid life stages. Moreover, noxious plants may outcompete native plant species, thus reducing overall biodiversity and reducing overall habitat quality. Dense stands may also be conducive to creating warmer water (through reduced circulation and dissolved oxygen sags), and could become subject to wide fluctuations in water quality (e.g. temperature, dissolved oxygen (DO)) on a diurnal/seasonal basis.

4.3.4 Mitigation

4.3.4.1 Use Restrictions

Procellacor™ should only be used for the control of aquatic plants in accordance with label specifications. No data gaps have been identified for the basic environmental profile required by EPA for pesticide registration, although continued use of Procellacor™ under a variety of plant management scenarios will add valuable information that can be incorporated into improved treatment profiles and possible mitigation measures. For potential future irrigation with Procellacor™-treated water, final EPA labeling will include guidance on appropriate water use. Such restrictions can be refined once the human health and ecological risk assessment currently being conducted by EPA are released in spring 2017. The proposed label language is expected to reflect fewer application-related restrictions than other herbicides. Lower levels of personal protective equipment (PPE) for workers will be required, which is consistent with lower use rates, lower water use restrictions, and minimal effects to crops or other non-target species.

4.3.4.2 Swimming and Skiing

Recreation activities such as swimming, water skiing and boating are expected to be unaffected by applications or treatments using Procellacor™ herbicide formulations.

4.3.4.3 Irrigation, Drinking and other Domestic Water Uses

As a mitigation measure for experimental purposes, irrigation has been and will continue to be restricted until the herbicide has dissipated. In addition, Ecology's Aquatic Plant and Algae permit provides specific mitigation measures for irrigation water and water rights. Following registration, however, no water use restrictions are anticipated for the product use label except for some forms of irrigation. Any such restrictions will be specified on the final label language in collaboration with EPA. Procellacor™ is not expected to have any restrictions for watering turf. Before irrigation use on potentially sensitive crops or other plants, the final label language is anticipated to require concentrations to be analytically verified to less than 1 µg/L. Restrictions on irrigation use on sensitive plants may alternatively or additionally include times of post-application restrictions, depending on use rates and scale/locations of application. These options are currently being reviewed with EPA.

Drinking water is not expected to be affected by Procellacor™ applications.

4.3.4.4 Fisheries and Fish Consumption

Neither fisheries nor human fish consumption are expected to be affected by application of Procellacor™ herbicides. If there is potential to impact listed salmonid species (e.g. salmon, steelhead, bull trout, etc.) Ecology would enforce a fish timing window that would be protective of those species. Guidance for such timing windows are found at: http://www.ecy.wa.gov/programs/wq/pesticides/final_pesticide_permits/aquatic_plants/permitdocs/wdfwtiming.pdf.

4.3.4.5 Endangered Species

Data are limited for specific listed threatened or endangered species under the ESA, however, a number of carefully designed and relevant laboratory toxicity tests for endangered species are currently under way, as discussed above. These tests will increase available testing data and enhance our understanding of how to more effectively protect non-target listed and vulnerable species, with particular emphasis on ESA-listed salmonid species such as salmon species, steelhead, and bull trout.

4.3.4.6 Wetlands or Non-Target Plants

Ecology's APAM permit outlines specific restrictions on what can be treated in wetlands. For example, in identified wetlands, the APAM specifies that the permittee "may treat only *high use areas* to provide for safe *recreation* (e.g., *defined swimming corridors*) and boating (e.g., *defined navigation channels*) in *identified and/or emergent wetlands.* The permittee must also limit the treated area to protect native wetland vegetation. However, final mitigation measures and best management practices concerning potential effects to beneficial or desirable wetland plant species will be developed in conjunction with testing on higher plants, some of which may occur in wetlands.

In general, effects to wetlands are anticipated to be minimal. Toxicity to fish, invertebrates, wildlife, and non-target plants would not generally be expected, and persistence (and thus food chain effects) would also be minimal. No specific toxicity testing was required or conducted for amphibians or reptiles which are ubiquitous in wetlands, but test results from invertebrate, avian, mammalian and other test species would be expected to serve as representative surrogate species for amphibians and reptiles.

Regarding potential impacts to rare or endangered plants occurring in wetlands, Ecology uses the Washington Department of Natural Resources (WDNR) Natural Heritage Site guidelines to determine if rare plants are likely to occur in the treatment area. If rare plants may be present at the treatment site, Ecology would require a field survey, and if such plants are found mitigation would be required.

4.3.4.7 Post-treatment Monitoring

EPA, Ecology, and other agencies routinely require both short- and long-term post-treatment monitoring for the purpose of evaluating non-target effects from herbicides such as Procellacor™. For Ecology, this post-treatment monitoring would be required under the permit, and would be a permit condition requiring monitoring to determine potential non-target impacts. These requirements will be incorporated into both label and permit, as appropriate, in conjunction with pesticide registration prior to application.

4.3.5 References

American Society of Testing and Materials (ASTM). 2002. Standard Guide for Conducting Acute Toxicity Tests on Test Materials with Fish, Macroinvertebrates, and Amphibians. ASTM Designation E 729-96, reapproved 2002. [1]

Beets J., and M. Netherland. 2017a. Mesocosm Response of Crested Floating Heart, Hydrilla, and Two Native Emergent Plants to a New Arylpicolinate Herbicide. Journal of Aquatic Plant Management - in prep. [1]

Beets J., and M. Netherland. 2017b. Response of Eurasian and Hybrid Watermilfoils to Five Auxin-Mimic Herbicides. Journal of Aquatic Plant Management - in prep. [1]

Breaux, N.T. (Dow AgroSciences LLC). 2015. Laboratory Studies Performed in Support of EPA Requirements: Ecotoxicology (Study #49677885), Environmental Fate (Study #49677884), Toxicology, (Study #49677882), Ecotoxicology (Study #030093_49678019), Environmental Fate Study #030093_49678018), Residue Analysis (Study #030093_49678017), Toxicology (Study #030093_49678016), and Product Chemistry (Study #030093_49678014). [9]

Buczek, S., J. Archambault, and W. Cope. 2017. Evaluation of the Acute Toxicity of Multiple Forms of Procellacor™ Aquatic Herbicide to a Freshwater Mussel. In prep. [9]

Denny, D., Branch Chief, EPA Office of Chemical Safety and Pollution Prevention, to Breaux, Dr., Regulatory Leader for Dow AgroSciences. 2016. Reduced Risk Decision for Rinskor Aquatic Uses. February 8. [letter [10]]

Getsinger, K. 2016. Potential Procellacor™ Use Patterns for Controlling Submersed Invasive Plants in Pacific Northwest Waterbodies. UW-SAFS Herbicide Salmonid Presentation. October 25. [9]

Grue, C. 2016. Confirming the Safety of the New Herbicide for Salmon-Bearing Waters. UW-SAFS Herbicide Salmonid Presentation. October 25. [9]

Haug E. and R. Richardson. 2017. Mesocosm evaluation of the efficacy and selectivity of Procellacor for *monoecious hydrilla* control. Journal of Aquatic Plant Management in prep. [1]

Heilman, M. (SePRO/Dow AgroSciences LLC). 2016. Efficacy, Fate, and Toxicology Associated with Selective Control of Invasive Aquatic Weeds. UW-SAFS Herbicide Salmonid Presentation. October 25. [9]

Netherland, M., and R. Richardson. 2016. Evaluating Sensitivity of Five Aquatic Plants to a Novel Arylpicolinate Herbicide Utilizing an Organization for Economic Cooperation and Development Protocol. Weed Science. Volume 64: p. 181-190. [1]

Netherland M., M. Heilman, J. Beets, and B. Willis. 2017. Mesocosm Response of Multiple Invasive Watermilfoils and Representative Native Submersed Plants to several Concentration – Exposure Times of Procellacor Aquatic Herbicide. Journal of Aquatic Plant Mgt, in prep. [1]

Richardson, R., E. Haug, and M. Netherland. 2016. Response of Seven Aquatic Plants to a New Arylpicolinate Herbicide. Journal of the Aquatic Plant Management Society. Volume 54: p. 26-31. [1]

US Environmental Protection Agency (EPA). Office of Prevention, Pesticides, and Toxic Substances (OPPTS). 1996. Ecological Effects Test Guidelines: OPPTS 850.175, Fish Acute Toxicity Testing, Freshwater and Marine. EPA 712-C-96-118. April. [1]