INVASIVE SPECIES MANAGEMENT PLAN

European Frog-bit (*Hydrocharis morsus-ranae*) in Green Bay coastal areas

Adapted from 2022 Version

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INTRODUCTION

Need and Purpose

European frog-bit (EFB) remains an NR40 Prohibited species in all 72 Wisconsin counties. The NR40 Prohibited classification means it is only in a few places within the state, likely to cause environmental and/or economic harm, eradication and prevention is feasible, and control is required. As of Fall 2023, the Green Bay EFB Response Team has deemed that portions of the Green Bay population are beyond eradication and control actions to the extent originally planned are not practical or in the best interest of the resource given the limited knowledge available for this species. This document serves as the revised 3-year plan and is meant to be succinct for the sake of usability in order to effectively inform and implement management.

Summary of Adaptive Management Team Meeting

On October 18, 2023, the Team met for 2.5 hours at the Green Bay DNR office with a few individuals attending virtually. The meeting was held to accomplish the following: 1) share what was accomplished in 2023, 2) acknowledge what the Team has learned thus far in the response, and 3) sketch out how the Team would like to adapt the existing management plan. A majority of the meeting was centered around the prompting question, 'If you were Keeper of the Frog-bit for a day, how would you envision the next 3 years of this response effort?' After multiple rounds of discussion, the Team identified research, prevention, monitoring strategy, asset protection, and funding as areas to focus on in an adapted plan.

Key Highlights in Adapted Plan

- Prioritizes research as a top goal.
- Outreach goal includes location/pathways and objectives.
- Treatment planned only where asset protection is a priority.

The remainder of this document will provide a status report of what has been accomplished from 2021-2023, discuss what has been learned thus far in the response effort, how the Team has agreed to adapt, and a plan for implementation.

RESEARCH

Status Report

With significant knowledge gaps yet to be addressed by the EFB research community, the Team originally committed to and made progress in identifying research priorities, collecting literature, identifying collaborators, providing support, and participating in the EFB Collaborative research discussions. Of note, the University of Wisconsin - Green Bay has made significant progress with the National Estuary Research Reserve (GB NERR) designation process which will likely be a key partner in EFB research. WDNR staff also provided samples to the U.S. Army Corps of Engineers for a genetic analysis project. Lastly, the EFB Collaborative has been made aware of the AIS Research and Demonstration Grant through WDNR's Surface Water Grant Program.

Challenges, Successes, & Themes

- Little traction has been gained in terms of the key questions to be answered for BMP (Best Management Practice) establishment.
- Drone/mapping technology - more research needed for potential treatment.
- Noticed herbivory/wildlife damage to EFB -- Potential biocontrol opportunity? Potential wildlife pathway?
- Turion vitality and formation/life cycle/biology research is a priority.
- Overall, need to emphasize research and put research to action.

Adaptation Strategy

OLD
Goal = Expand knowledge base
NEW
Goal = Continue learning about this species. ➢ Objective: Contribute data and learning regarding EFB biology, ecology, spread, and control (from *EFB Collaborative Adaptive Management Framework*) o Measurement/Deliverable: List of contributions ➢ Contribute learning regarding EFB ecosystem impacts (from *EFB Collaborative Adaptive Management Framework*) o Measurement/Deliverable: List of contributions

Implementation

Response Team members, as applicable, will implement the Goals and Objectives by continuing to participate in research planning discussions hosted by the EFB Collaborative. This includes supporting the Collaborative's objectives where opportunity arises (see *EFB Collaborative Regional Strategy 2024 – 2026).* Members will also bring forth the EFB perspective, amongst other core work perspectives, when participate in GB NERR designation process such as public comment periods and plan development. WDNR staff will continue to promote the Surface Water Grant Program's Research & Demonstration Grant as a significant funding opportunity and provide guidance on any proposal scoping.

PREVENTION

Status Report

With the establishment of the statewide Lake Monitoring and Protection Network (LMPN), all 5 Bay area counties have a Local AIS Coordinator leading outreach efforts with a concerted focus on EFB awareness and prevention. Additionally, CISMAs (Cooperative Invasive Species Management Areas) such as WRISC (Marinette Co. et al.) and DCIST (Door Co.) have utilized their platform and resources to provide EFB specific outreach. Early outreach initiatives focused on points of access and high-risk users such as waterfowl hunters. In an effort to prevent the spread inland, outreach opportunities targeting partners and the public from across the state have occurred at conferences and community events alike.

Table 1. Outreach highlights.

2021	2022	2023
• Temporary signage • WDNR press release • Presentations and prompts at Learn to Hunt events • Lakes & Rivers Partnership presentation	• 1,696 watercraft inspected • Wisconsin Waterfowl Hunters Expo w/ live EFB specimens • Temporary signage • Presentations to Oconto Co. stakeholder groups by FLOW • 1 Snapshot Day hosted in Oconto Co. • Educational specimens distributed to all local AIS Coordinators in WI • EFB brochure drafted by FLOW • Group work days	• 1,491 watercraft inspected • Wisconsin Waterfowl Hunters Expo w/ live EFB specimens • 3 Snapshot Day events hosted in Brown, Oconto, and Kewaunee Counties • Poster at Wisconsin Wetland Science Conference; Lakes & Rivers Convention • Green Bay Press Gazette video • Wisconsin Land & Water article • Billboard sponsored by WRISC • FLOW Program now includes Marinette Co. • Group work days

Challenges, Successes, & Themes

- Measuring the efficacy and true impact of outreach was identified as a challenge and is not unique to this response effort.
- Ensuring that all of the Team is aware of outreach happenings was a challenge.

Adaptation Strategy

OLD

Goal = Comprehensively prevent the spread.

- Objective: Increase number of watercraft inspections by 25%.
  - Measurement: Number of watercraft inspections.

NEW

Goal = Prevent the spread to inland waters of Wisconsin and new locations within the Bay.

- Objective: Identify and target subpathways that are high-risk for spreading EFB.
  - Measurement: Number/list of subpathways addressed.
  - Measurement: Number of impressions made.
- Objective: Expand EFB education and outreach to volunteers and special interest

groups.
    - Measurement: Number of volunteers trained to monitor for EFB.
- Objective: Use shared Collaborative education and outreach materials across jurisdiction(s) (from *EFB Collaborative Adaptive Management Framework*).

Implementation

- ***Actions/Commitments for Fox-Wolf Watershed Alliance/Chris Acy***
    - The following actions would be covered under LMPN funding annually
        - EFB is highlighted during CLMN, Project RED, AIS Snapshot Day, and Adopt a Launch trainings. These trainings increase volunteers on the landscape knowledgeable in identifying EFB.
        - Planning on representing AIS at the WI Waterfowl Hunting Expo annually
        - Focus on EFB education during statewide AIS initiatives including Landing Blitz and Waterfowl Hunter Outreach
        - Include EFB ID focus when conducting AIS outreach and education at local schools, events, meetings in coverage area
        - Minimally share 2 EFB related posts through various Fox-Wolf social media accounts annually

- ***Actions/Commitments for Lumberjack RC&D FLOW AIS Program/Derek Thorn***
    - The following actions would be covered under LMPN funding annually
        - CLMN volunteer trainings and highlight EFB as a species of concern
        - CBCW trainings and highlight EFB as a species of concern
        - Feature EFB as a species of concern at education and outreach events of species
        - Highlight EFB updates in FLOW AIS newsletter at the end of the field season

- ***Actions/Commitments for Door County/Door County Invasive Species Team/Brooke Dreshek, Beau***
        - *CBCW trainings and highlight EFB as a species of concern*
        - *Share EFB related posts through Facebook annually*
        - *Highlight EFB treatments and progress in DCIST newsletter before the end of year*
        - *Provide brochures at Ducks Unlimited banquet and other waterfowl hunter outreach*

EARLY DETECTION

Status Report

Initial early detection efforts focused on Marinette and Oconto Counties. A comprehensive and prioritized list of suitable habitat sites was drafted and included in the 2022 version of the Management Plan which resulted in 31 new detects out of 96 surveys throughout all 5 Bay area counties. A near similar monitoring effort was implemented in 2023 where 6 new sites were detected. Of the 6 sites, at least two Brown County sites were widespread and 'patchy' or 'dense' where there had been no detect the previous year indicating that this is an extremely mobile and quickly establishing species.

Table 2. Early detection summary results.

	2021	2022	2023
Early Detection Surveys	42	96	114
New detects	19	31	6
Acres mapped	38	74	190

Challenges, Successes, & Themes

- Scale is a challenge - EFB is very small on a large landscape making it difficult to detect.
- EFB is a mobile and rapidly reproducing plant that can make a true 'early detection' near impossible if the conditions are right.
- Continue to struggle with determining management areas/sites; How do we define a "population."
- Access to a site and navigation/mobility within the sites themselves is extremely challenging.

Adaptation Strategy

-

OLD

Goal = Respond to new infestations

- Objective: Keep EFB cover of uninfested sites at 0% annually.
  - Measurement: Number of new detects.

NEW

Goal = Reduce risk of impact to **inland** and **high priority** sites and waterbodies by limiting range expansion.

- Objective: Identify additional high-risk and suitable habit and implement early detection monitoring.
  - Measurement: Number of early detection surveys.
  - Measurement: Number of new detects.
  - Measurement: Number of volunteers surveying for EFB.

Bay Sites

Sites that will receive early detection monitoring within the Bay either align with control priorities OR are in Door Co. where the distribution and establishment of EFB is currently limited. Of note, the Unnamed streams along the East shore of the Bay were not found to be suitable in previous years of monitoring and are therefore no longer early detection sites.

Table 3. Early detection plan for sites located along the Bayshore. These are sites that are either directly on the bay or are direct tributaries up until the first barrier such as a dam or suitable habitat ends.

County	***Property Unit Name, if applicable***	***EFB Response Site Name***	***Station ID***	***Who?***
Marinette Co.		Menominee River - South shore areas and islands before first dam	10057429	*LWCD or WRISC*
		Menominee River-S Channel-6th St to Ogden St	10057430	*LWCD or WRISC*
		Menominee River- Outlet to Lake Michigan	10051307	*LWCD or WRISC*
		Menekaunee Walking Trail wetlands	10056615	*LWCD or WRISC*
		Little River	10058323	*LWCD or WRISC*
Oconto Co.	Charles Pond Unit	Charles Pond SNA	10058508	*LWCD*
	Tibbert-Suamico Unit	Tibbert-Suamico Unit	10058509	*LWCD*
		Geano Beach Boat Landing	10057781	*LWCD*
		City Docks	10018631	*LWCD*
		Oconto Yacht Club	10058711	*LWCD*
		Hi Seas Marina	10058712	*LWCD*
		Breakwater Park Boat Landing	10019203	*LWCD*
		Tibbet Creek	10056082	*LWCD*
Brown Co.	Peats Lake Unit	Duck Creek Delta Wetland Complex	10052460	*WDNR/Brown Co./FWWA*
	Sensiba Unit	Sensiba Unit West Pond	10056607	*WDNR/Brown Co./FWWA*
	Sensiba Unit	Sensiba Unit Main Pond - East	10056606	*WDNR/Brown Co./FWWA*
		Point Sable	10058211	*WDNR/UWGB*
		East River	10058286	*WDNR*
		Fox River – 50 Portage	10001143	*WDNR*
Kewaunee Co.		Ahnapee River from Olson Park Ramp to mouth	10057518	*WDNR AIS*
		Kewaunee River	10058204	*WDNR AIS*
Door Co.		Plum Island	100493	*DCSWCD*
		Little Marsh	10058388	*DCSWCD*
		Unnamed No. 1 Canal	10058368	*DCSWCD*
		Kayes Creek Little Sturgeon	10058370	*DCSWCD*
		Sawyer Harbor	10058374	*DCSWCD*
		North Bay Park	10058375	*DCSWCD*

		Rowleys Bay	10058376	*DCSWCD*
		Moonlight Bay	10058360	*DCSWCD*
		Ephraim Creek	10058338	*DCSWCD*
		Europe Bay	10058339	*DCSWCD*
		Nicolet Bay	10058336	*DCSWCD*
		Detroit Harbor	10058341	*DCSWCD*
		Jackson Harbor	10058342	*DCSWCD*
		Murphy Park Launch	10058343	*DCSWCD*
		Mackaysee Lake Chambers Island	10058344	*DCSWCD*
		Bradley Lake	10058290	*DCSWCD*
		Mud Lake and Riebodlts Creek	10058345	*DCSWCD*
		High Cliff Park	10058346	*DCSWCD*
		Detroit Island north shore	10058340	*DCSWCD*
		Little Lake	10058385	*DCSWCD*
		Mink River	10058347	*DCSWCD*
		Big Creek Estuary	10058349	*DCSWCD*
		Renard Creek	10050560	*DCSWCD*
		Sugar Creek	10051278	*DCSWCD*
		Big Marsh	10058387	*DCSWCD*
		Unnamed Creek	10058351	*DCSWCD*
		Strawberry Creek	10055329	*DCSWCD*
		Spike Horn Bay	10058352	*DCSWCD*
		Stevenson Pier Rd unnamed creek	10058353	*DCSWCD*
		Rileys Point	10058354	*DCSWCD*
		Sand Bay Point	10058355	*DCSWCD*
		Unnamed Creek at Sand Bay	10058356	*DCSWCD*
		Larson Creek Estuary	10058357	*DCSWCD*
		Toft Point	10058358	*DCSWCD*
		Unnamed Creek	10058390	*DCSWCD*
		Snake Island	10058362	*DCSWCD*
		Little Harbor	10058386	*DCSWCD*
		Marshalls Point	10058365	*DCSWCD*
		Figenschau Harbor	10058363	*DCSWCD*
		West Harbor	10058364	*DCSWCD*
		Newport Bay	10058366	*DCSWCD*
		White Cliff Fen Creek	10058367	*DCSWCD*
	White Cedar Forest SNA	White Cedar Forest SNA wetland	10058647	*DCSWCD/NHC*

Inland Sites

Table 4. Early detection planning for sites located inland. These are suitable habitat sites that are not directly along or very near the Bay.

County	***Property Unit Name, if applicable***	***EFB Response Site Name***	***Station ID***	***Who?***
Marinette Co.	-	Bagley Flowage	10058206	*LWCD*
	-	Peshtigo Flowage	10007831	*LWCD*
	-	Trout Creek	10058653	*LWCD*
Oconto Co.	-	Machickanee Flowage	10058209	*LWCD*
	-	*Leigh Flowage	519500	*FLOW*
	-	*White Lake	447000	*FLOW*
	-	*Round Lake	446700	*FLOW*
	-	*Pecor Lake	447100	*FLOW*
	-	Kelly Lake	10004132	*LWCD*
	-	White Potato Lake	10004133	*LWCD*
	-	Townsend Flowage	10001372	*LWCD*
Brown Co.		Lilly Lake	10047646	*FWWA*
		Duck Creek from Pamperin Park to Cardinal Ln	10058713	*FWWA*
Kewaunee Co.	-	-	-	-
Door Co.		Kangaroo Lake – North	10058207	*WDNR*

**Tentative*

CONTROL

Status Report

With all but +/- 6 weeks remaining in the 2021 growing season, 38 acres were mapped and nearly ¼ of that was controlled in some manner. With funding, time, and a plan in hand the following year, the mapped acreage doubled with much of it being controlled, though contractor capacity and communication was limiting. In 2023, the mapped acreage went from 74 acres to nearly 200 with numerous sites going uncontrolled due to the unexpected increase in area and density. A majority of sites that were previously controlled had worsened.

Table 5. Control summary results.

	2021	**2022**	**2023**
Mapped (acres)	38	74	190
Chemically treated (acres)	10	36	40
Manual Removal (acres)	Unknown*	47	48
Manual Removal (lbs.)	2,112	5,288	15,232
SOGL (acres)	N/A	19	N/A
GLRI Focus Area 2 ('new' acres)	N/A	63	55
Total controlled (acres)**	10	83	88
Retreated/repulled (acres)	N/A	N/A	33

*Unknown due to lack of mapping tool available at the time of occurrence.

**Can be higher than Mapped acreage in some years due to integrative pest management actions within same acreage.

There is little variation in the averages of the overall plant community between 2022 and 2023. Total species and FQA decreased slightly while percent cover increased, but the analysis reinforces that these changes are non-significant. An argument can be made that these changes are largely from the transforming plant community structure, as lower average subplot water depths (37.7 cm in 2022 to 26.3 cm in 2023, a difference of almost 4.5 inches) promoted the explosion of advantageously growing, but lower quality emergent plants, while discouraging the growth of an array of submergent and floating plants more commonly found in 2022. It is also promising that there are no significant differences between treatment types on the overall plant community as total species, total cover, and FQA are comparable across each treatment. The early indication is that choosing between manual or chemical control is largely a choice of scale – the size of the patch vs. the size of your workforce – and less so on the efficacy of the treatment chosen. See *Appendix B. 2023 Data Report* for more information.

What is dismaying, however, is EFB's distribution in 2023. The disparity between survey effort and new detections (96 surveys with 31 detections in 2022 vs. 114 surveys with 6 detections in 2023) compared to acreage found (74 in 2022 vs. 190 in 2023), the increase in frequency and average percent cover in subplots (found at 27 subplots at an average 2.65% in 2022 vs. 28 subplots at an average 7.66% in 2023 – see Figure 8 in Appendix B), and even anecdotal observations at many other sites points to a substantial expansion of EFB beyond just sampled subplots and its previously mapped range. Further confounding the issue, it is still not well understood whether EFB's persistence is from a robust turion bank, if treatments are ineffective, some combination of the two, or another alternative not currently known (e.g., the plant is being spread by some vector such as wildlife or recreation that has not been documented). What is well-known is that current WDNR and partner capacity and resources are not substantial enough to feasibly control the known distribution of EFB.

Challenges, Successes, & Themes

- Continue to struggle with determining management areas/sites; How do we define a "population."
- Expect EFB acreage to continue to increase.
- Short season to control between growth and turion drop.
- Timing of growth - needed to keep checking sites throughout the summer.
- Low water levels/more muck caused difficulties with accessing a sites.
    - Made it difficult for EFB to grow in the same areas.
    - Made the work hard to accomplish after accessing a site.
- In some instances, manual removal completed right away (small patches) but it didn't make a difference - EFB was found later at those sites.
- Herbicide treatment is difficult to evaluate; Herbicide for patchy/sparse populations was not effective (suspect that herbicide is not being taken up by the plant because it gets washed off by wave action).
- Overall, we do not know enough about EFB or its management strategies.
- STIMP: no significant difference in FQA from 2022 to 2023, but there is a significant difference in EFB cover.

Adaptation Strategy

OLD

Goal = Manage existing infestations

- Objective: Populations of EFB at small sparse sites will decrease at a rate of 25% per year until eradicated by 2025.
- Objective: Populations of EFB at patchy sites will decrease at a rate of 25% per year until eradicated by 2025.
- Objective: Reduce cover of EFB at dense sites to 30% by 2027
- Objective: Reduce cover of EFB at large monoculture sites to 25% by 2027.
    - Measurement: % decrease

NEW

Goal = Minimize impact to native species and ecosystems within known distribution.

- Objective: Implement control actions only on priority sites until BMPs are established.
    - Measurement: Acres controlled
    - Measurement: FQA comparisons
- Objective: Establish holistic monitoring of pre/post- monitoring sites.
    - Measurement: % of STIMP sites with delimitation.
- Objective: Contribute pre- post-monitoring data following Collaborative protocols (from *EFB Collaborative Adaptive Management Framework*).
- Objective: Utilize Collaborative-developed tools when planning and implementing EFB control and Early Detection & Response (from *EFB Collaborative Adaptive Management Framework*).

Implementation

Pre/Post-Monitoring

WDNR AIS staff will continue to lead pre/post-monitoring (i.e. Standard Treatment Impact Monitoring Protocol; STIMP) at all 33 STIMP subplots including those where control actions are not prescribed (see *Appendix B. 2023 Data Report p.11-19* for subplot locations). While the Team indicated that ultimately more holistic monitoring is needed such as water quality and macroinvertebrate sampling, the monitoring scheme will largely remain the same for the near term in order to accomplish the goals of this revised plan and align with the EFB Collaborative STIMP. That said, the Team will attempt to delimit each site where STIMP subplots occur in an effort to continue capturing these population area and density over time.

Prioritization

In the original version of this plan (p. 15), all sites were considered for control. That said, the Team proactively created a prioritization scheme in the event that control could not occur at all sites. This scheme accounted for level of distribution, risk of invasion pathways, and habitat suitability and in. The following sites (Table 6) were identified as new priority sites that align with the revised Goals and Objectives for control work given their status as sensitive areas with a history of strong active management for native species and habitat protection and restoration or small, low density sites where eradication is still feasible through manual removal. Note – Door Co. sites will be approached to the fullest extent possible given the limited distribution.

Table 6. Priority Site List for control. Sites are listed in order of occurrence moving South along the Bayshore starting from Seagull Bar SNA (Marinette Co.).

County	Property Unit Name (DNR Program), if applicable	EFB Response Site Name	Station ID	Site has STIMP subplots?	Prescribed Control (Herbicide, Manual, Both, None)	Who
Marinette Co.	Seagull Bar SNA	*Seagull Bar SNA*	10056056	Yes	Both, 2x herbicide (?)	NHC Program + Workday
		Red Arrow Park	10019102	Yes	Both, 2x herbicide (?)	NHC Program + Workday
	Peshtigo Harbor Unit	*Winegar Pond Shoreline - Bay to Johnson Rd*	10057435	No	Manual	Marinette Co. LWCD
	Peshtigo Harbor Unit	*Winegar Pond - Barrier Wetlands - South of Johnson Rd*	10056047	No	Herbicide	Contractor
	Peshtigo Harbor Unit	*Peshtigo River Harbor Area*	10056084	No	Herbicide	Contractor
	Peshtigo Harbor Unit	*Harbor Rd – North of Canal Ln*	10056076	No	Herbicide	Contractor
	Peshtigo Harbor Unit	*Canal Lane – Harbor Rd to Dyers Slough*	10056075	No	Herbicide	Contractor
	Peshtigo River Delta Marshes SNA & Peshtigo Harbor Unit	*Dyers Slough – Lower – Public*	10056046	Yes	Herbicide (Drone or Argo)	Contractor
	Peshtigo River Delta Marshes SNA & Peshtigo Harbor Unit	*Dyers Slough – Upper – Private*	10056605	No	Herbicide (Drone or Argo)	Contractor
	Peshtigo River Delta Marshes SNA & Peshtigo Harbor Unit	*Birding Trail Canal*	10056061	Yes	Herbicide (ATV/foot, limited drone access)	Contractor
	Peshtigo River Delta Marshes	*Bay shore from Dyers Slough to*	10056617	Yes	Herbicide (Drone)	Contractor

	SNA & Peshtigo Harbor Unit	*Spitzmacher Rd*				
	Peshtigo River Delta Marshes SNA & Peshtigo Harbor Unit	*Spitzmacher Rd Ditches*	10056070	No	Both (ATV/foot)	Marinette Co. LWCD (ditch running West to East) + Contractor
	Peshtigo River Delta Marshes SNA & Peshtigo Harbor Unit	*Spitzmacher Rd – East Canal*	10056656	No	Herbicide (ATV/foot)	Contractor
	Peshtigo River Delta Marshes SNA & Peshtigo Harbor Unit	*Spitzmacher Rd – Middle Canal*	10056655	No	Herbicide (ATV/foot)	Contractor
Oconto Co.	-	*Hale Rd Ditches*	10056051	Yes	Manual	Oconto Co. LWCD
	-	*North Bayshore Park Landing*	10056073	No	Manual	Oconto Co. LWCD
	-	*Unnamed Stream 497700*			Manual	Oconto Co. LWCD
	-	*DE Hall Boat Landing*	10057767?	No	Manual	Oconto Co. LWCD
	Rush Point Unit	*Unnamed Stream 497500*	10057780	No	Both	Ditches – Contractor Stream - Oconto Co. LWCD
	Oconto Marsh Unit	*Oconto Marsh Unit – Exterior*	10056050	Yes	Herbicide (Drone)	Contractor
	Oconto Marsh Unit	*Oconto Marsh Unit - Interior*	10057769	No	Herbicide (Drone)	Contractor
	-	*Breakwater Park*	10056071	No	Manual	Oconto Co. LWCD
	-	*City Docks and Marinas*			Manual	Oconto Co. LWCD
	Pecor Point Unit	*Pecor Point*	10056066	No	Manual	Oconto Co. LWCD
	-	*Pensaukee River*	10056072	No	Manual	Oconto Co. LWCD
	Pensaukee Unit	*Drainage 9*	10057814	No	Manual	Oconto Co. LWCD
Brown Co.	Bayside Road Unit	*Little Tail Point Interior -*	10058228	No	Manual	AIS + Wildlife Programs + FWWA + Brown Co. LWCD

		Bayside Road Unit				
	Sensiba Unit	*Little Tail Point Interior - Coastal Wetlands S of Resort Rd*	10058226	No	Both (Drone)	West shore – contractor Open water – AIS + Wildlife Programs + FWWA + Brown Co. LWCD
	Sensiba Unit	*Sensiba Unit Exterior Ponds - South*	10056608	No	Herbicide	Contractor
	-	*Suamico River*		No	Manual	AIS Program
	-	*Unnamed Stream 3000552*	10052348	No	Manual	AIS Program
	Sensiba Unit	*Long Tail Point Interior – wetlands south of river*	10058225	No	Manual	AIS Program
	-	*Unnamed Stream 3000555*	10058214	No	Manual	AIS Program
Door Co.	-	*Wave Pointe Resort Little Sturgeon*	10058337	No	Manual	Door Co. LWCD/DCIST
	-	*Little Sturgeon Bay – West of Keyes Island*	10058372	Yes	Manual	Door Co. LWCD/DCIST
	Peninsula State Park	*Fish Creek Estuary*	10058348	Yes	Manual	Door Co. LWCD/DCIST + NHC

Treatment Logistics

CONCTRACTOR/PERMITTING - The Wetland Invasive Plant Specialist, Matt Puz, will coordinate obtaining permits and securing an herbicide contract. Matt will also submit all treatment records to the WisFIRS database for applications conducted by the contractor. NHC will submit their own treatment record(s).

MANUAL REMOVAL - County Land and Water Conservation Departments will implement assignments through the support of FA2 subawards to fund staff, mileage, and supplies; however, initial supply needs through June 30th will be purchased through the SOGL grant sponsored by Ducks Unlimited and the University of Wisconsin – Green Bay in an effort to assist them with grant closeout.

DNR STAFF - WDNR Wildlife and NHC Programs as well as the Wetland Invasive Plant Specialist will charge staff time, mileage, and supplies to the FA2 budget codes. Likewise, initial supply needs will be funded via SOGL through June 30th.

WORK DAY – The workday assigned for Red Arrow Park/Seagull Bar SNA will be coordinated by the AIS Biologist, Amanda Smith, and will likely occur in late July or early August depending on how the growing season progresses.

Similar to past years, natural resource professionals will be solicited to learn about EFB, the State Natural Area and participate in hands-on manual removal efforts.

HERBICIDE – In an effort to maximize chemical efficacy managers have identified certain sites that are to be treated by way of drone and/or an Argo. It is believed that this will reduce disturbance of the site which will allow for maximal adherence of the chemical. It is expected that efficiency and greater accessibility will be added benefits of this application technique. Sites where no drone or Argo are listed indicate that the site is appropriate for traditional backpack or boom sprayer via ATV.

FUNDING

The FA2 grant awarded by EPA GLRI goes through December 2025 and has an estimated remaining balance of $145,000 as of October 2023 (Total Project = $270,000). A majority of the early detection and control work is funded by the FA2 and the estimated total for spending in 2024 is ~$90,000. A second FA2 grant can be applied for in the next Focus Area grant cycle.

In an effort to assist Ducks Unlimited and the University of Wisconsin – Green Bay with the close out of their Sustain Our Great Lakes (SOGL) grant, all partners will purchase supplies through DU until June 30th when the project ends. It is acknowledged and supported that this may result in County LWCDs spending less than originally planned in the subawards.

All five Bay area counties continue to receive LMPN funding through the Surface Water Grant Program totaling $72,441.31 annually.

Table 7. Summary of utilized funding and future opportunities.

	Research	Outreach	Early Detection	Control
2021	-	- LMPN	- USFWS	- FA 2*
2022	-	- LMPN** - Early Detection & Response Grant	- FA 2* - USFWS - Early Detection & Response Grant	- FA 2 - SOGL
2023	-	- LMPN - CBCW Grant^ - Education Grant^ - Supplemental Prevention Grant^	- FA 2 - USFWS - Early Detection & Response Grant^	- FA 2 - Early Detection & Response Grant^
2024	- AIS Research & Demo. Grant^	- LMPN - CBCW Grant^ - Education Grant^ - Supplemental Prevention Grant^	- FA 2 - USFWS - Early Detection & Response Grant^	- FA 2 - Early Detection & Response Grant^ - SOGL
2025	- AIS Research & Demo. Grant^	- LMPN - CBCW Grant^ - Education Grant^ - Supplemental Prevention Grant^	- FA 2 - USFWS - Early Detection & Response Grant^	- FA 2 - Early Detection & Response Grant^
2026	- AIS Research & Demo. Grant^	- LMPN - CBCW Grant^ - Education Grant^ - Supplemental Prevention Grant^	- FA 2 - USFWS - Early Detection & Response Grant^	- FA 2 - Early Detection & Response Grant^

**Will also consist of funds from an existing federal grant expiring December 30, 2022.*
***Except Marinette County.*
^Available funding opportunity through the WDNR Surface Water Grant Program.

SUMMARY

Significant accomplishments were achieved in the first 2+ years of the Green Bay European frog-bit response. As of Fall 2023, the Green Bay EFB Response Team has deemed that portions of the Green Bay population are beyond eradication and control actions, to the extent originally planned, and are not practical or in the best interest of the resource given the limited knowledge available for this species. This document serves as the revised 3-year plan where adaptations are focused around research, asset protection, prevention, and funding.

The revised goals and objectives (below) will guide the Team's actions over the next 3 years though further adaptions are expected as the population continues to evolve. The Team will prioritize supporting the Collaborative as a way to address the top goal of continued learning about this species. Preventing the spread will have a large focus on inland waters by targeting subpathways that are especially high-risk for spreading EFB. By implementing early detection monitoring at high-risk, suitable inland sites and select Bay sites, the Team will minimize risk of range expansion. Lastly, control actions will occur only at sensitive areas with a history of strong active management for native species and habitat protection and restoration in order to minimize impacts to native species and ecosystems.

GOAL 1. Continue learning about this species.
➢ Objective: Contribute data and learning regarding EFB biology, ecology, spread, and control (from *EFB Collaborative Adaptive Management Framework*) o Measurement/Deliverable: List of contributions ➢ Contribute learning regarding EFB ecosystem impacts (from *EFB Collaborative Adaptive Management Framework*) o Measurement/Deliverable: List of contributions
GOAL 2. Prevent the spread to inland waters of Wisconsin and new locations within the Bay.
➢ Objective: Identify and target subpathways that are high-risk for spreading EFB. o Measurement: Number/list of subpathways addressed. o Measurement: Number of impressions made. ➢ Objective: Expand EFB education and outreach to volunteers and special interest groups. o Measurement: Number of volunteers trained to monitor for EFB. ➢ Objective: Use shared Collaborative education and outreach materials across jurisdiction(s) (from *EFB Collaborative Adaptive Management Framework*).
GOAL 3. Reduce risk of impact to **inland** and **high priority** sites waterbodies by limiting range expansion.
➢ Objective: Identify additional high-risk and suitable habit and implement early detection

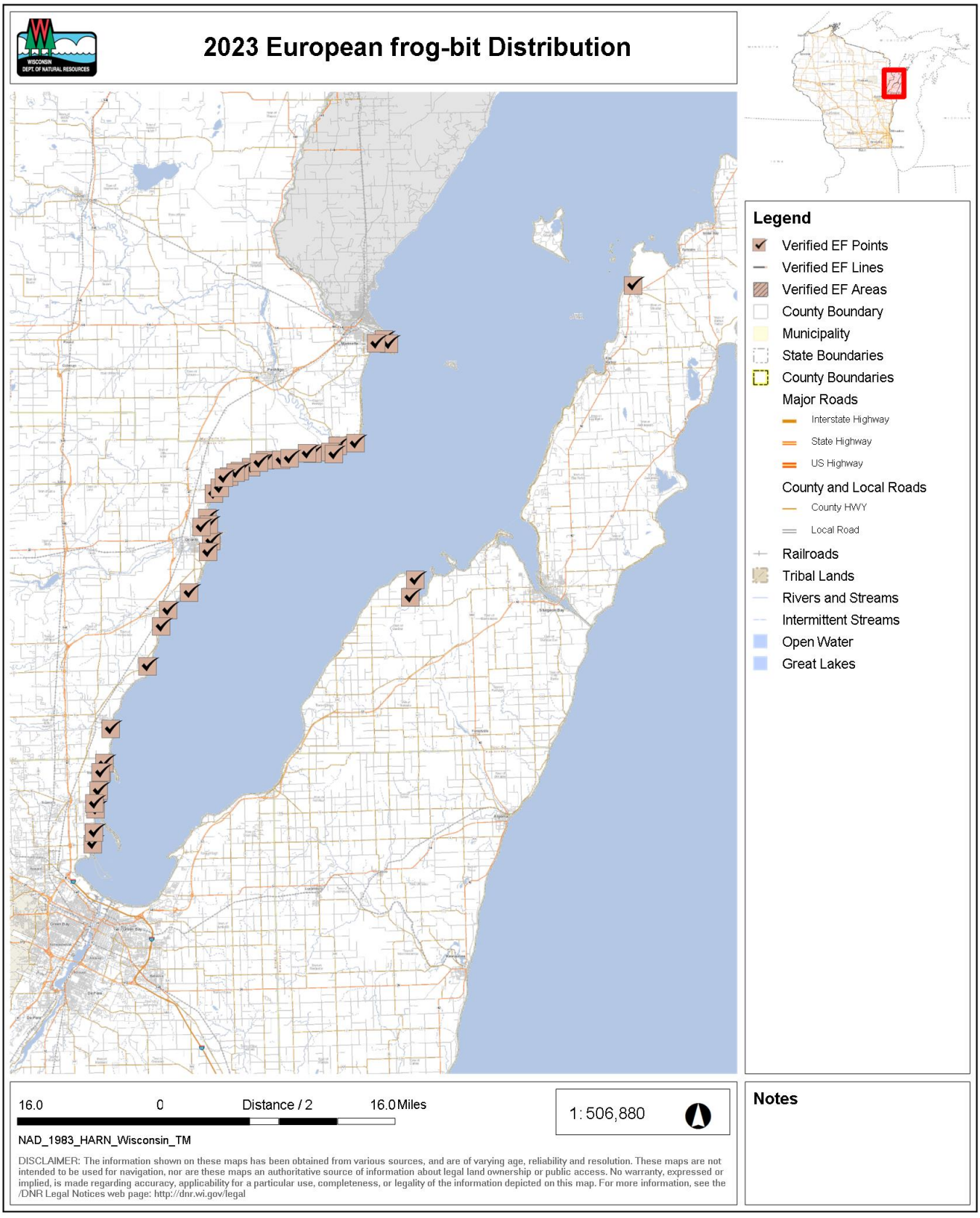
monitoring.

- Measurement: Number of early detection surveys.
- Measurement: Number of new detects.
- Measurement: Number of volunteers surveying for EFB.

GOAL 4. Minimize impact to native species and ecosystems within known distribution.

- Objective: Implement control actions only on priority sites until BMPs are established.
  - Measurement: Acres controlled
  - Measurement: FQA comparisons
- Objective: Establish holistic monitoring of pre/post- monitoring sites.
  - Measurement: % of STIMP sites with delimitation.
- Objective: Contribute pre- post-monitoring data following Collaborative protocols (from *EFB Collaborative Adaptive Management Framework*).
- Objective: Utilize Collaborative-developed tools when planning and implementing EFB control and Early Detection & Response (from *EFB Collaborative Adaptive Management Framework*).

Appendix A. 2023 Distribution Map



Appendix B. 2023 Data Report

European Frog-bit

2023 Data Report

Matt Puz
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Wisconsin Department of Natural Resources

Great Lakes RESTORATION

INTRODUCTION

Following Wisconsin's first verified observation of the prohibited aquatic invasive species, European frog-bit (*Hydrocharis morsus-ranae*; hereafter EFB), in the summer of 2021, the EFB Response Team, comprised of state and local agencies and partners, implemented an extensive response effort. Subsequent monitoring revealed a significant number of EFB populations along the coastal areas of Marinette and Oconto counties. Both herbicide treatments and manual removal were conducted on the handful of initial sites discovered in 2021. Following control efforts, the Response Team created the EFB Invasive Species Management Plan. The plan provides background information on initial response efforts, summarizes management strategies, and identifies and prioritizes specific actions needed to achieve the following goals:

Goal 1: comprehensively prevent the spread
Goal 2: respond to new infestations
Goal 3: manage existing infestations
Goal 4: expand knowledge base

Building off the previous year's work funded by the Great Lakes Restoration Initiative (GLRI), early detection monitoring, continued throughout Marinette, Oconto, Brown, and Door counties and the sites selected for chemical treatment greatly increased. Working with county, DNR, and other regional staff, sites were again prioritized, site-specific treatment plans were developed, and subplots were selected for post-treatment monitoring. Monitoring data was again collected using WDNR's adapted version of the Standard Treatment Impact Monitoring Protocol (STIMP) with the following objectives: 1) quantify the relative cover and abundance of EFB and the non-target plant community, 2) test the efficacies of different management techniques, 3) assess the impacts of herbicide treatment on the non-target plant community, 4) determine if outcomes aligned with expectations, and 5) use the data to adapt the management strategy, if necessary. This report details the methods and results of the data analysis, compares data collected in 2023 to data collected in 2022, and discusses potential next steps following two years of EFB management.

METHODS

Point data and track line and polygon density data were recorded using the FieldMaps app and displayed on the EFB Collaborative's ArcGIS Online map along with Wisconsin's 2021 and 2022 data. The online map, in conjunction with county and DNR staff input, provided the basis for selecting sites and subplots. Sites were selected for post-monitoring based on treatment type (manual or chemical), location, and population density. Subplots were selected within each site (see Appendix I for subplot locations). 33 subplots were selected and monitored in 2023, 25 of which were the same subplots from 2022. New subplots were added because a) they were at sites with new populations (especially in Brown and Door Counties) found in 2022 or b) to add parity to the analysis i.e., an overabundance of subplots receiving chemical treatment were monitored in 2022 so they were exchanged for manually removed subplots. No pre-treatment monitoring took place in 2023. Post-treatment monitoring took place 24 – 27 July, and 1, 9 – 10, 16 August 2023. Chemical treatment was initiated following reports from

county staff regarding EFB growth, with additional sites being added to the contractor's list if new or revisited sites were deemed too dense to manually remove.

DATA COLLECTION

Subplots were selected and created as outlined in the Wisconsin DNR's European Frog-bit Standard Treatment Impact Monitoring Protocol Standard Operating Procedures (EFB STIMP SOP) document drafted 13 December 2022 (See Appendix I for subplot location maps).

DATA ANALYSIS

Data analysis compared each subplots total species, percent cover, and floristic quality based on monitoring (pre (2022) vs. post (2023)), treatment type (chemical vs. manual vs. none, combined 2022 and 2023 data), and water depth. Weighted Floristic Quality Assessments (FQAs) were calculated using the Wisconsin Floristic Quality Assessment Calculator. Floristic quality metrics were calculated based on the Coefficient of Conservatism (C-Value) pre-assigned to each vascular plant species in the flora and their field estimated percent covers. Linear regressions were used to test for individual effects of monitoring, treatment on total species, percent cover, and floristic quality. All statistical tests, species frequencies, and relative abundance calculations were all performed in R version 4.0.5.

RESULTS

PRE-TREATMENT

2022 post-treatment data was used as pre-treatment data for 2023 (Table 1). A total of 122 species were recorded during pre-treatment monitoring. *Ceratophyllum demersum* occurred at the most sites (30), followed by *Lemna minor* and *Phalaris arundinacea* (29), and EFB (27). *Ceratophyllum demersum* also had the highest relative abundance (10.52) followed by *Wolffia columbiana* (7.88), and *Bidens cernua* (7.04). The most common species and their mean percent covers are detailed in Table 1. 2022's full report can be found here.

Table 1. Summary of the top 10 most common pre-treatment (post-treatment 2022) species, the number of sites where they were observed, their relative abundance (RA), and their structural type. Floating and submergent species (highlighted in green) are most likely to be impacted or replaced by European frog-bit (highlighted in orange).

Scientific Name	Common Name	Frequency	RA	Plant Type
Ceratophyllum demersum	Coontail	30	10.52	submergent
Lemna minor	Common duckweed	29	5.19	floating
Phalaris arundinacea	Reed canary grass	29	4.46	emergent
Hydrocharis morsus-ranae	European frog-bit	27	2.65	floating
Sagittaria latifolia	Broadleaf arrowhead	26	0.95	emergent
Sparganium eurycarpum	Giant bur-reed	24	1.88	emergent
Pilea pumila	Canadian clearweed	23	0.95	emergent
Spirodela polyrhiza	Greater duckweed	23	6.61	floating
Cicuta bulbifera	Bulblet water-hemlock	21	0.51	emergent
Impatiens capensis	Jewelweed	20	1.07	emergent

POST-TREATMENT

A total of 110 species were recording during post-treatment monitoring. EFB and *Sagittaria latifolia* occurred at the most sites (28), followed by *Sparganium eurycarpum* (25), and *Ceratophyllum demersum* (23). *Ceratophyllum demersum* had the highest relative abundance (11.97) followed by *Phalaris arundinacea* (8.28) and *Lemna minor* (8.23). The most common species and their mean percent covers are detailed in Table 2.

Table 2. Summary of the most common post-treatment species, the number of sites where they were observed, their relative abundance (RA), and their structural type. Floating and submergent species (highlighted in green) are most likely to be impacted or replaced by European frog-bit (highlighted in orange).

Scientific Name	Common Name	Frequency	RA	Plant Type
Hydrocharis morsus-ranae	European frog-bit	28	7.66	floating
Sagittaria latifolia	Broadleaf arrowhead	28	3.76	emergent
Sparganium eurycarpum	Giant bur-reed	25	5.44	emergent
Ceratophyllum demersum	Coontail	23	11.97	submergent
Bidens cernua	Nodding beggarticks	22	6.60	emergent
Phalaris arundinacea	Reed canary grass	22	8.28	emergent
Lemna minor	Common duckweed	21	8.23	floating
Pilea sp.	Clearweed	21	1.91	emergent
Schoenoplectus tabernaemontani	Soft stem bulrush	21	1.63	emergent
Cicuta bulbifera	Bulblet water-hemlock	20	.87	emergent

PRE/POST COMPARISON (2022 v. 2023)

While total species was lower in 2023 than 2022, percent cover was higher post-treatment as compared to pre-treatment (Figures 1 and 2). The mean total species for post-treatment subplots was 22.7 while the mean total species for pre-treatment subplots was 25.6. Mean post-treatment percent cover was 96.1 while mean pre-treatment percent cover was 80.4. There was no significant difference between total species or percent cover across years.

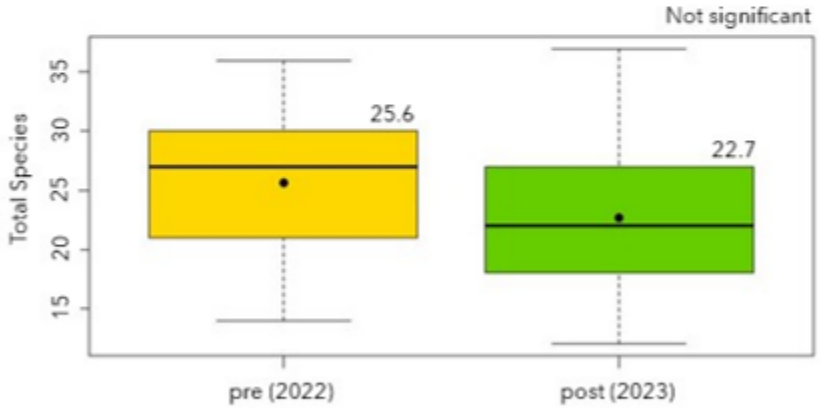


Figure 1. Comparison of total species in pre-treatment (2022) vs. post-treatment (2023) monitoring subplots. For each boxplot the top and bottom of the box represent the 75% quantile and the 25% quantile respectively, the line in the box is the median value, the whiskers represent the highest and lowest values, with outliers represented as dots. The black dot within each box represents the mean values which are also listed on the top right of each box.

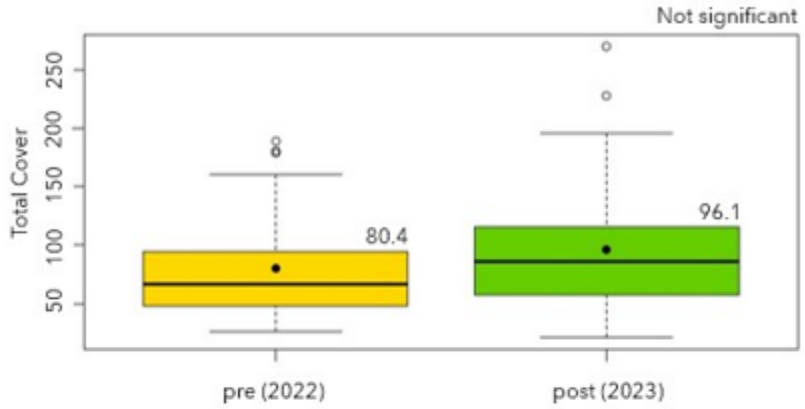


Figure 2. Comparison of percent cover in pre-treatment (2022) vs. post-treatment (2023) monitoring subplots. There was no significant difference between pre- and post-treatment percent cover.

There was also no significant difference between FQAs of pre- and post-treatment subplots but there was a drop in mean FQA from 2022 to 2023. Post-treatment subplots had a mean FQA of 3.1 while pre-treatment subplots had a mean FQA of 3.5.

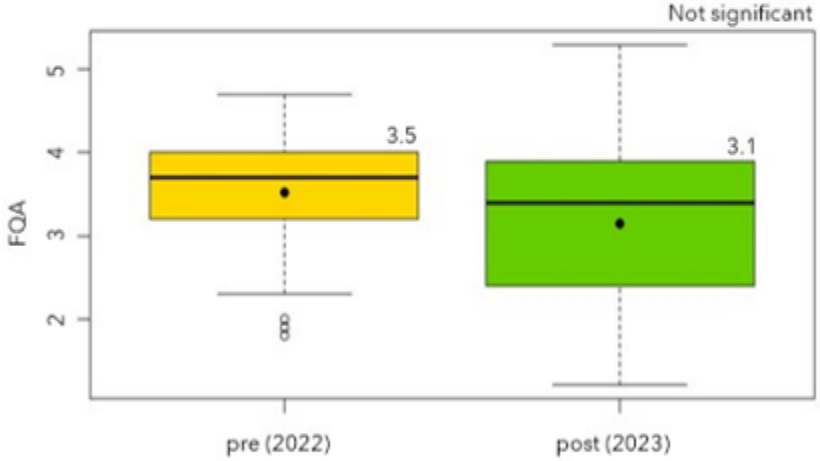


Figure 3. Comparison of FQA in pre-treatment (2022) vs. post-treatment (2023) monitoring subplots. FQA was not significantly different between pre- and post-treatment.

TREATMENT COMPARISON

For the combined years, there were no significant differences between post-treatment total species, percent cover, or FQA when subplots were compared by treatment (Figures 4, 5, and 6). Of the 66 total subjects for 2022 -2023, 37 subplots had planned chemical treatment, 20 were slated for manual removal, and the remaining 9 received no treatment. While not significantly different, total species and FQA was highest in the chemically treated subplots,

and total cover was marginally highest in the manually removed subplots. Subplots with no treatment had the second highest total species, but the lowest percent cover and FQA.

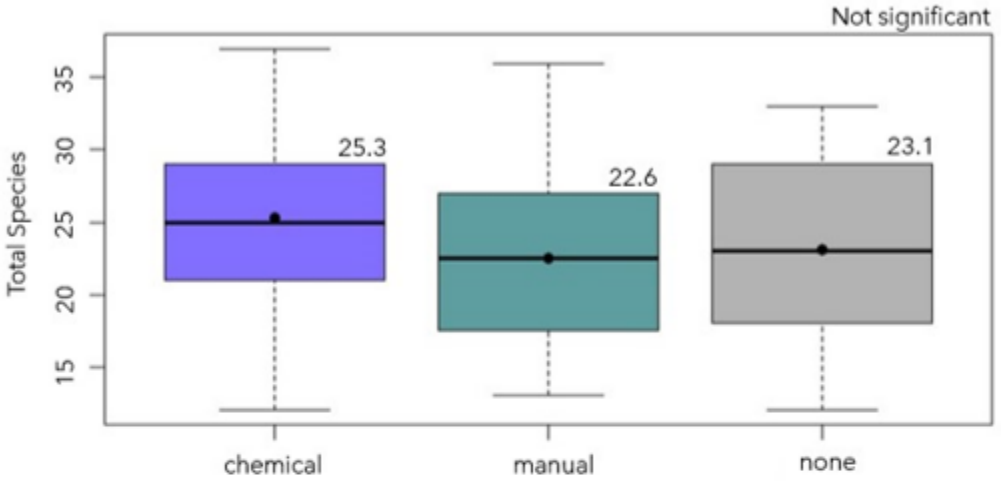


Figure 4. Comparison of total species in chemically treated, manually removed, and no treatment (none) subplots. Total species was not significantly different between treatment types. Based on combined data from 2022 - 2023.

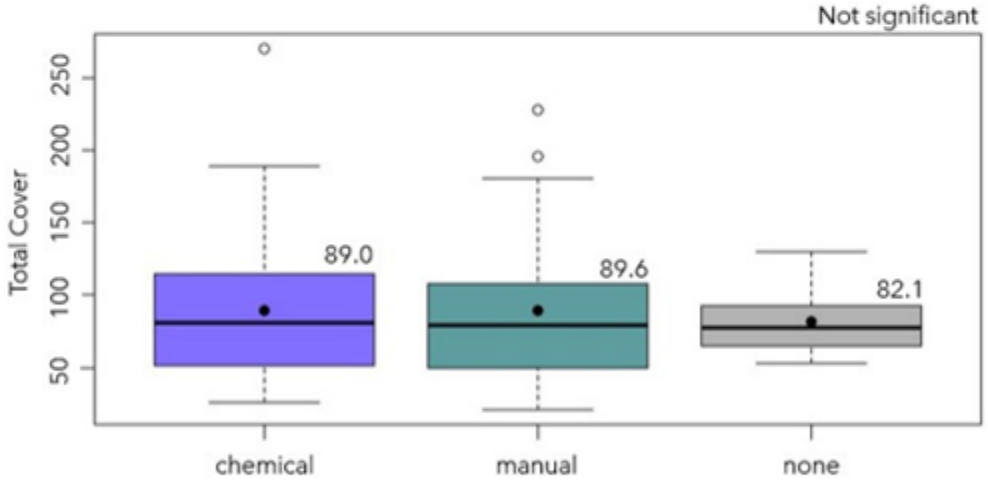


Figure 5. Comparison of total cover in chemically treated. manually removed, and no treatment (none) subplots. Percent cover was not significantly different between treatment types. Based on combined data from 2022 - 2023.

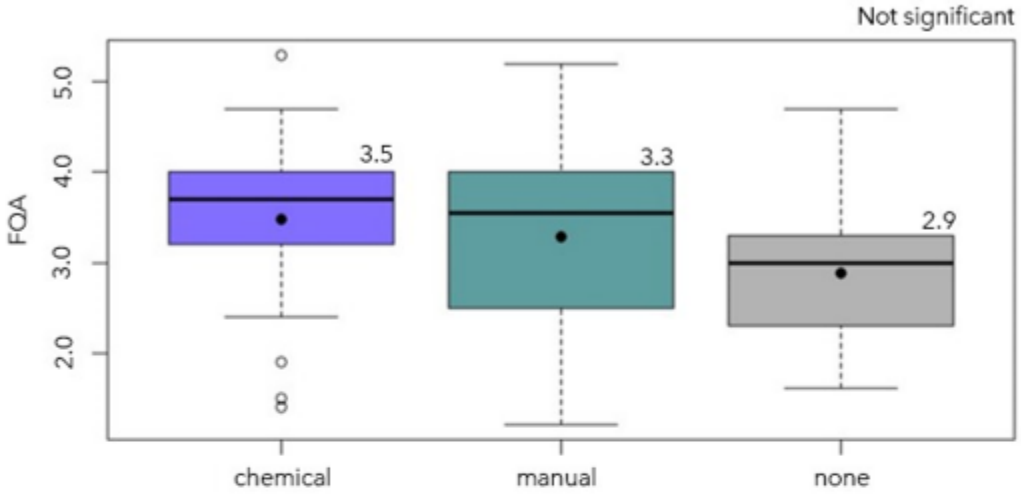


Figure 6. Comparison of FQA in chemically treated, manually removed, and no treatment (none) subplots. FQA was not significantly different between treatment types. Based on combined data from 2022 - 2023.

In most instances, all the subplots were prescribed either chemical or manual treatments. However, the 9 subplots prescribed no treatment (none) were prescribed as such either because a) no observed EFB was found at that site at the time of control, b) the subplots were located at sites with a large distribution and density of EFB and, due to budgetary constraints, only a portion of the site was controlled, or c) a site had never been monitored and the distribution of EFB at that site was unknown until much later in the field season.

EFB RESULTS

From 2022 - 2023, EFB was found at 55 of the 66 subplots, representing 83.3% of total subplots as compared to 81.8% for 2022 alone (27 of 33 subplots). In 2023 where EFB was observed (Table 3), percent cover ranged from 0.1% to 30%, with a relative abundance of 7.61%, an increase from 2022 where EFB percent cover ranged from 0.1% to 20% with a relative abundance of 2.65%. Of the 25 sites that were revisited in 2023, cover decreased at 6 sites (mean decrease = 5.8%), stayed the same at 5 sites, and was greater at 14 sites (mean increase = 9.1%). While water depth was significantly different between 2022 and 2023 (mean = 42 cm in 2022 vs mean = 29 cm in 2023), it had no significant effect on EFB cover. There was also no significant difference in EFB cover when compared by treatment type (Figure 8). However, EFB percent cover was significantly different in 2023 compared to 2022 (Figure 9). When all these factors (monitoring year, treatment type, and water depth) were combined into a multiple regression, monitoring year remained the only significant factor affecting EFB cover.

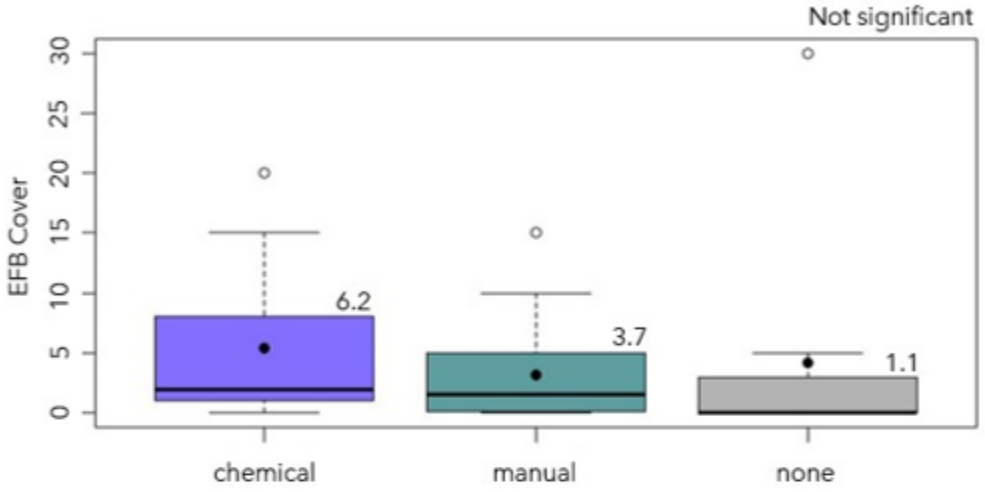


Figure 7. Comparison of EFB cover chemically treated, manually removed, and no treatment (none) subplots. EFB cover was not significantly different between treatment types.

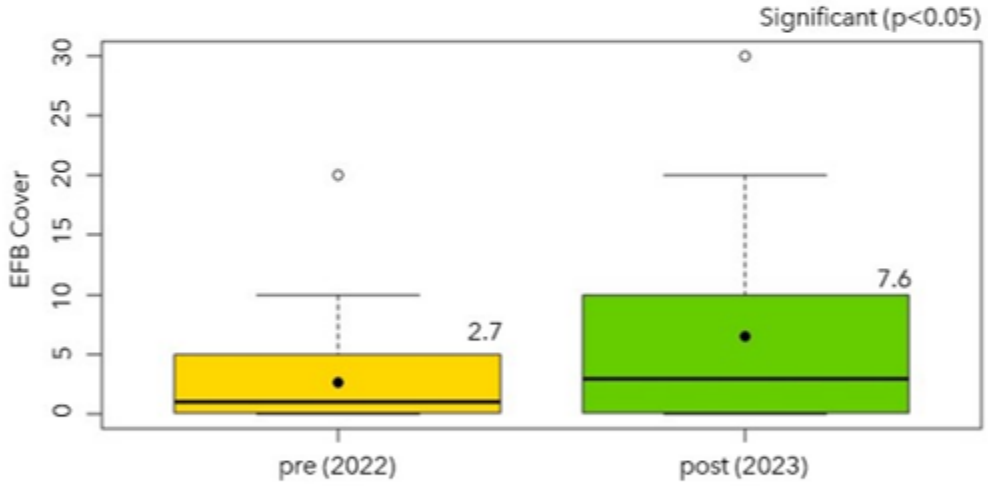


Figure 8. Comparison of EFB cover in pre-treatment (2022) vs. post-treatment (2023) monitoring subplots. EFB cover was significantly different between pre- and post-treatment (p=0.016)

Table 3. Summary of 25 subplots revisited in 2023 following initial monitoring in 2022 and the percent cover changes in EFB between the two years. In 2023, 14 sites had increased EFB cover (orange), 6 sites had decreased EFB cover (green), and 5 sites remained the same (blue). Bolded values represent the subplot(s) that had the largest increase or decrease in cover.

Site Name	Subplot #	EFB cover 2022	EFB cover 2023
Unnamed Stream 5011370 & Wetland Complex	4	1	10
	6	1	1
Oconto Marsh Unit	7	2	20
	8	**1**	**20**
	9	2	10
	11	0.1	1
Oconto Sportsmen's Club	14	8	5
	15	0.1	3
Thomas Slough	16	5	10
	18	3	20
Unnamed Stream 497700	19	1	0.1
Unnamed Stream 497800	20	5	15
	21	5	10
	22	1	15
Canal between Bay Rd & Spitzmacher Rd	25	5	20
Seagull Bar	26	1	1
	27	0	0
Birding Trail	28	5	2
	29	1	0.1
Dyer's Slough	31	0	1
	32	**20**	**0.1**
Bay Rd from Hale Rd to North Bay Shore Park	33	0	0
Short canal off of Bay Rd	34	10	3
Hale Rd Bay to Bay Rd	36	0	0.1
	37	0	0

DISCUSSION

MONITORING COMPARISON

There is little variation in the averages of the overall plant community between 2022 and 2023. Total species and FQA decreased slightly while percent cover increased, but the analysis reinforces that these changes are non-significant. An argument can be made that these changes are largely from the transforming plant community structure, as lower average subplot water depths (37.7 cm in 2022 to 26.3 cm in 2023, a difference of almost 4.5 inches) promoted the explosion of advantageously growing, but lower quality emergent plants, while discouraging the growth of an array of submergent and floating plants more commonly found in 2022. It is also promising that there are no significant differences between treatment types on the overall plant community as total species, total cover, and FQA are comparable across each treatment. The early indication is that choosing between manual or chemical control is largely a choice of scale – the size of the patch vs. the size of your workforce – and less so on the efficacy of the treatment chosen.

What is dismaying, however, is EFB's distribution in 2023. The disparity between survey effort and new detections (96 surveys with 31 detections in 2022 vs. 114 surveys with 6 detections in 2023) compared to acreage found (74 in 2022 vs. 190 in 2023), the increase in frequency and average percent cover in subplots (found at 27 subplots at an average 2.65% in 2022 vs. 28 subplots at an average 7.66% in 2023 – see Figure 9), and even anecdotal observations at many other sites points to a substantial expansion of EFB beyond just sampled subplots and its previously mapped range. Further confounding the issue, it is still not well understood whether EFB's persistence is from a robust turion bank, if treatments are ineffective, some combination of the two, or another alternative not currently known (e.g., the plant is being spread by some vector such as wildlife or recreation that has not been documented). What is well-known is that current WDNR and partner capacity and resources are not substantial enough to feasibly control the known distribution of EFB.

RECOMMMENDATION
During WNDR and partner planning for the 2024 field season, identify priority sites where resources, partner and contractor capacities, and outreach should be directed. The aim is two-fold: to limit the impact of EFB in high quality areas (of which there are many along the shore of the Bay of Green Bay), and to prevent the spread of EFB into any inland waters of Wisconsin, where it has currently never been observed.

WDNR has reached the halfway point of the 4-year GLRI grant funding for the initial 'response' phase following EFB's first observation in Wisconsin. WDNR and partners should determine if more resources and capacity are necessary and outline the scope and goals of another grant now that the situation has moved beyond the 'response' phase.

EFB viability research studies are in high demand and will remain so, especially as Great Lakes water levels continue to fluctuate. If water levels continue to drop, we may find that sites that are now too dry can be a lower priority or removed altogether. Alternatively, if EFB turions persist even in dry conditions, it will be important to earmark those sites for monitoring when water levels eventually increase, as some of these areas may directly impact high-quality sites.

EFB COLLABORATIVE
As mentioned in the Data Collection section, Wisconsin DNR has been using an adapted version of the STIMP to create subplots and collect EFB and native plant data. With the expansion of the European frog-bit Collaborative from a Michigan-centric organization to a Great Lakes region organization, it is a goal of the Collaborative to refine the STIMP so that it may be used across many jurisdictions with collected data used to answer specific questions and generate best management practices. With that in mind, the future of EFB monitoring in Wisconsin will change with the efforts of the Collaborative.

RECOMMMENDATION
Participate in and comment on the updated and adapted version of the STIMP, keeping in mind that it still aligns with Wisconsin DNR's as well as the Collaborative's goals. Additionally, test any apps produced by the Collaborative to determine if they increase the efficiency of field data collection.

APPENDIX I: SUBPLOT LOCATION MAPS

For all maps: North is up, and the scale is 1:20,000 unless otherwise noted.

Oconto Marsh, Unnamed Stream 5011370 & Wetland Complex, and Unnamed Stream 497300 & Wetland Complex

Oconto Sportsman's Club

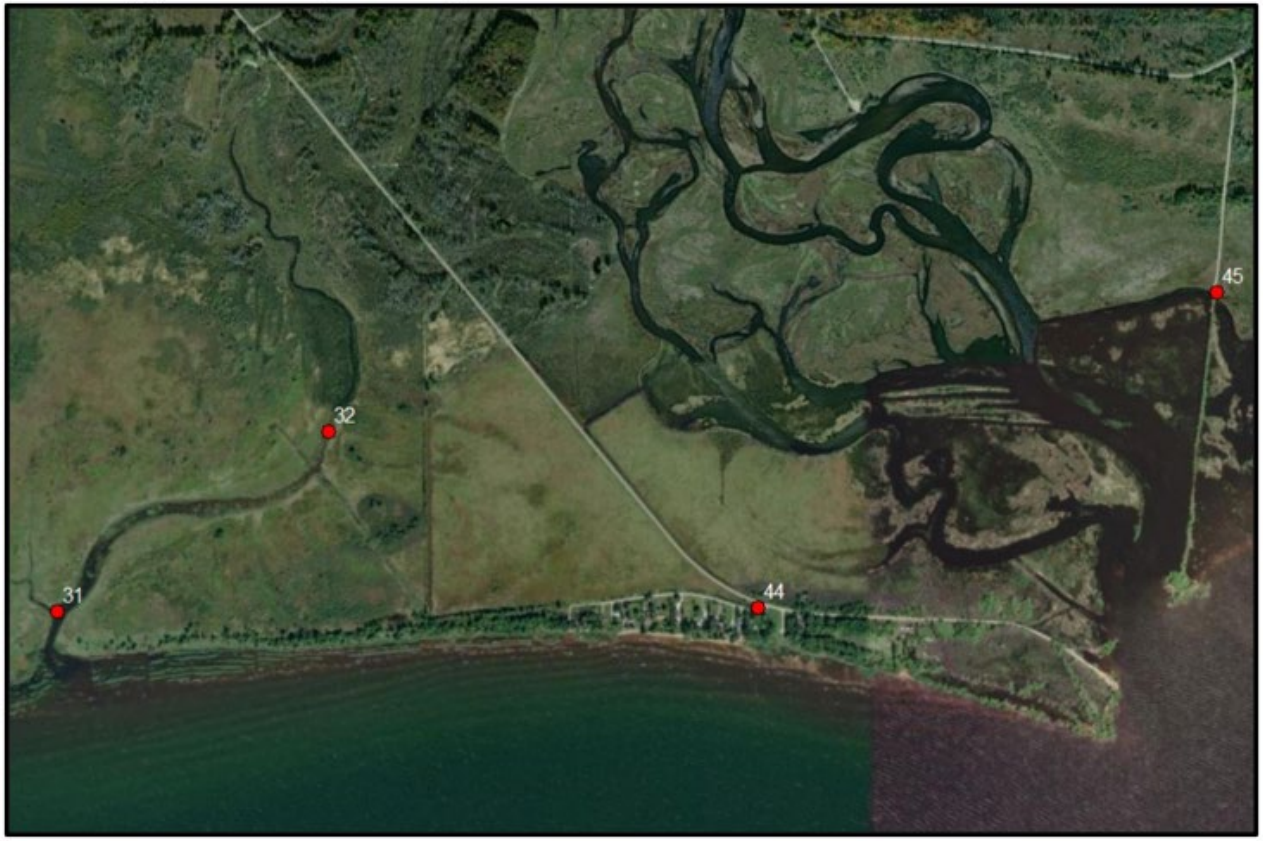
Thomas Slough, Unnamed Stream 497700, & Unnamed Stream 497800

Unnamed Stream 497400 - Laveau

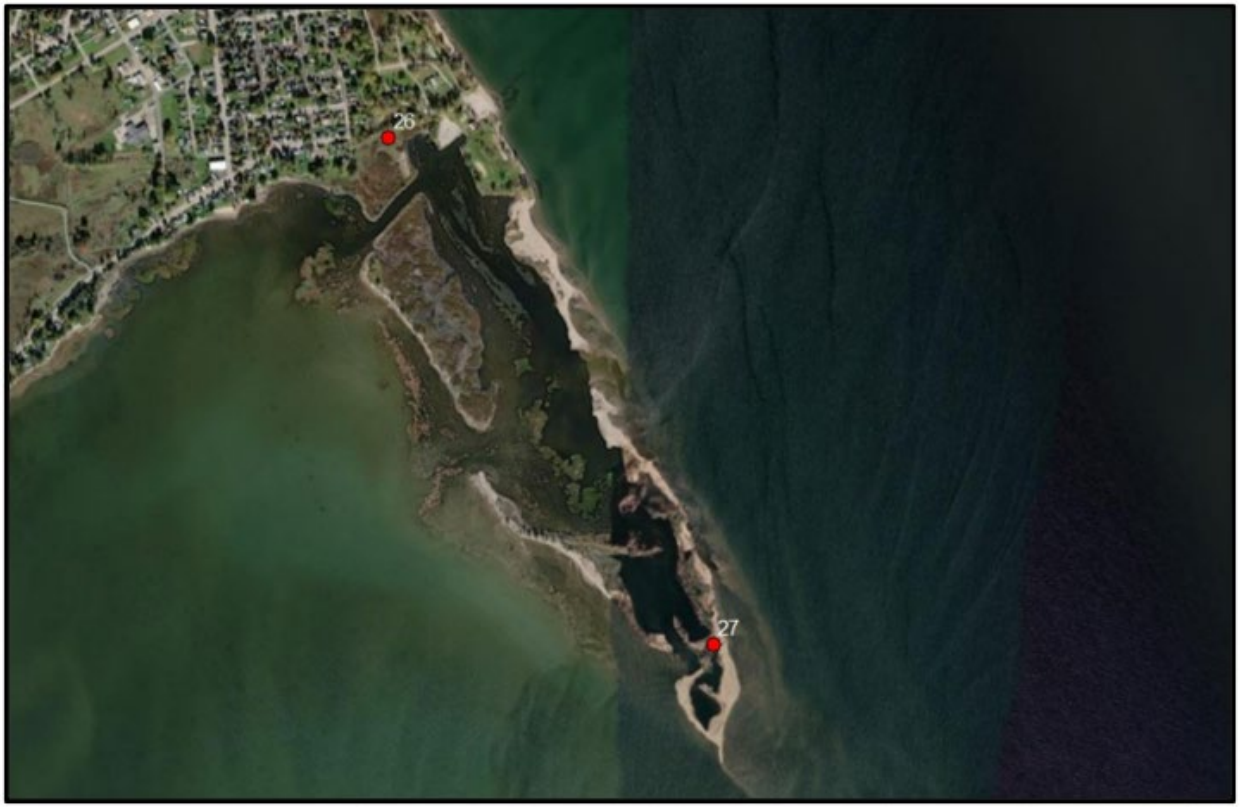
Bay Rd from Hale Rd to North Bay Shore Park & Hale Rd Bay to Bay Rd

Canal between Bay & Spitzmacher Rd 1, Short canal off of Bay, & Birding Trail

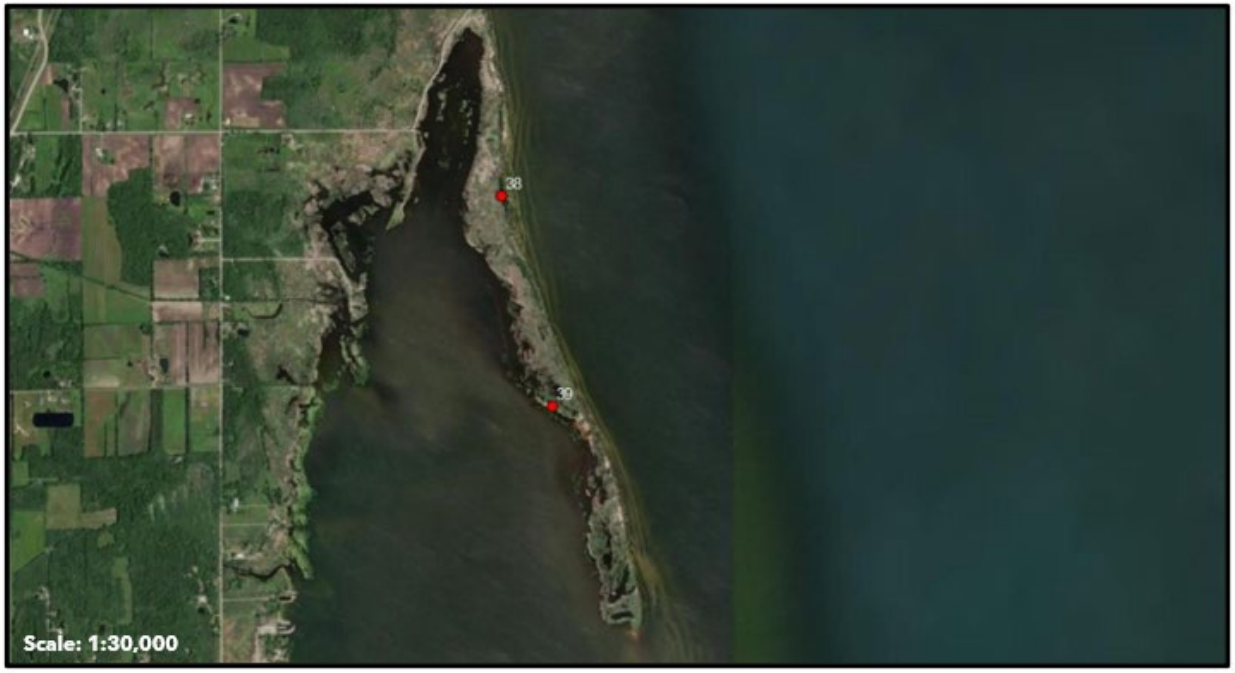
Thomas Slough, Canal Lane Canal, & Canal along Johnson Rd



Seagull Bar SNA



Little Tail Point – Interior & Exterior



Little Sturgeon Bay – West of Keyes Island

Fish Creek Estuary