Report Twin Lakes Conservation Plan

Twin Lakes Conservation Plan

Twin Lake, Salisbury, Connecticut

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Abbreviations

Abbreviation	Full Name
ERDC	Engineering Research and Development Center
USEPA	United Station Environmental Protection Agency
CTDEEP	Connecticut Department of Energy and Environment
NDDB	Natural Diversity Database
CET	Concentration Exposure Time
AER	Aquatic Ecosystem Research
ACT	Aquatic Control Technology
GEI	Geotechnical Engineers Incorporated
ETS	Endangered, Threatened and Special Concern Species
SE	State Endangered species
ST	State Threatened species
SSC	State Special Concern species

Executive Summary

GEI Consultants, Inc., P.C. (GEI) was contracted by the Twin Lakes Association to develop a conservation plan for five state-listed rare plants (i.e., two Endangered [SE], two Threatened [ST] and one Special Concern [SSC] species, collectively abbreviated as ETS), and three snail species found within the Twin Lakes system. The Twin Lakes system includes East Twin Lake and West Twin Lake. The conservation plan is specific to the potential impacts of Environmental Protection Agency (EPA) registered aquatic herbicides on sensitive animal and plant populations. The Connecticut Department of Energy and Environmental Protection, Natural Diversity Database (CTDEEP NDDB) has reported the presence of four aquatic plant and three invertebrate ETS species present in the Twin Lake system. Past reports from previous consultants along with scientific research and literature were reviewed to develop conservation and protection strategies for these species.

General Recommendations for Conservation and Protection

- Increase voucher specimens that have undergone either qualified botanist ID or genetic identification.
- Adjust herbicide application strategy to minimize non-target impacts.
- Continue rare species targeted surveys and monitoring efforts.
- Explore restoration options for readily available rare species.

Species Specific Recommendations

- *Potamogeton strictifolius:* SE Straight-leaved pondweed
  - No treatment restrictions while using florpyrauxifen-benzyl.
  - 300-foot buffer around all known locations while using diquat dibromide.
- *Sparganium natans:* SE Small bur-reed
  - 300-foot buffer around all known locations while using florpyrauxifen-benzyl and diquat dibromide.
- *Schoenoplectus acutus:* ST Hard-stemmed bulrush
  - No treatment restrictions while using florpyrauxifen-benzyl.
  - 300-foot buffer around all known locations while using diquat dibromide if treatments are foliar.
- *Myriophyllum sibiricum:* ST Northern watermilfoil

  - 300-foot buffer around all known locations while using florpyrauxifen-benzyl and diquat dibromide.

- *Bidens beckii:* SSC Water-marigold
  - 300-foot buffer around all known locations while using florpyrauxifen-benzyl if target concentrations exceed 5.79 µg/L.
  - 300-foot buffer around all known locations while using diquat dibromide.

Long Term Treatment Plan Recommendations

- Treatments using florpyrauxifen benzyl can take place in consecutive years based on toxicity data, however based on professional experience with this active ingredient, multiple year applications to the same locations are not necessary.
- Treatments using diquat dibromide will not take place in consecutive years in consecutive lake areas.

1. Introduction

1.1 Project Background

GEI was contracted by the Twin Lakes Association to develop a conservation strategy and protection plan for state-listed SE, ST, and SCC aquatic plant species and invertebrate snail species within Twin Lakes, Salisbury, Connecticut. The CTDEEP NDDB has additional regulatory oversight beyond the division of pesticides projects concerning waterbodies with records of state-listed species. As part of the conditions to allow pesticide treatment to proceed in Twin Lakes (McKay 2020; McKay 2021a; McKay 2021b), a conservation strategy and protection plan is required for state-listed aquatic plants.

Per the May 21, 2020, letter to The Lake and Pond Connection (McKay 2020), NDDB required five aquatic plant species to be considered in the protection plan. This Conservation plan addresses five species including three SE species: *Potamogeton ogdenii, Potamogeton strictifolius,* and *Sparganium natans*; one ST species: *Schonoplectus acutus*; and one SSC species: *Bidens beckii* (aka *Megalodonta beckii*). *Potamogeton ogdenii* was delisted since it is now accepted to be a hybrid of *P. zosterformis* and *P. hillii* (William Morehead NDDB personal comm.). This species will not be considered for the conservation plan.

The same NDDB determination letter (McKay 2020) detailed three invertebrates in need of a long-term treatment plan that includes years of "no treatment" to protect state-listed snail species, including: *Valvata tricarinata, Stagnicola catascopium* and *Fossaria galbana*.

The scope of this conservation plan is focused on the potential impacts of aquatic herbicides on rare plant species. Specifically, the Twin Lakes Association's strategy involves the use of the aquatic herbicide ProcellaCOR EC (A.I Florpyrauxifen-benzyl) and/or diquat dibromide to control the *Myriophyllum spicatum* (Eurasian watermilfoil) infestation present in both East and West Twin Lakes. For the purposes of this conservation strategy and protection plan, no endorsement of specific herbicide products is intended. However, evidence is provided to support conservation strategies, should the Twin Lakes association choose to use these products to control nuisance plant growth.

1.2 Lake Background Information

The Twin Lakes system contains two lakes: Lake Washining (East Twin) and Lake Washinee (West Twin). These lakes lie within the Schenob Brook watershed, which is part of the Housatonic River drainage. This region of Connecticut is unique geologically, as it sits in the western new England marble valley ecoregion (Griffith et al. 2009). This region and waterbodies within the Housatonic River basin are high in calcium relative to the rest of the state, providing a unique aquatic habitat.

East Twin Lake is much deeper and has a more regular shoreline as compared to West Twin Lake. Isola Bella is one of the most distinctive features of East Twin, located in the northern part of the lake (see Figure 1). Northeast of Isola Bella is a large, expansive wetland complex, providing habitat for aquatic plant species. While most of the shoreline is steep around East Twin, areas such as O'Hare's Landing Marina and the western shoreline support significant aquatic macrophyte growth.

West Twin Lake, in contrast to East Twin Lake, has a much more complicated shoreline and its overall shape resembles a soup ladle (Figure 1). The lake is shallower and supports more overall plant growth relative to its surface area than East Twin Lake. A fen with rich biodiversity (NDDB 2020) is located at the northern end of the lake. The northern end of the lake also supports significant aquatic plant growth, which can become an impediment to recreation. Rowers from the Salisbury School use West Twin frequently for recreation (Bill Barton personal comm.).

Table 1. Morphometric parameters for East and West Twin Lakes.

Parameter	Unit of Measurement	East Twin	West Twin	Source
Surface Area	Acres	569	290	AER 2020
Max Depth	Feet	80	21	AER 2020
Mean Depth	Feet	32.5	8.9	AER 2020
Volume	Million Cubic Meters	26	3.2	AER 2020

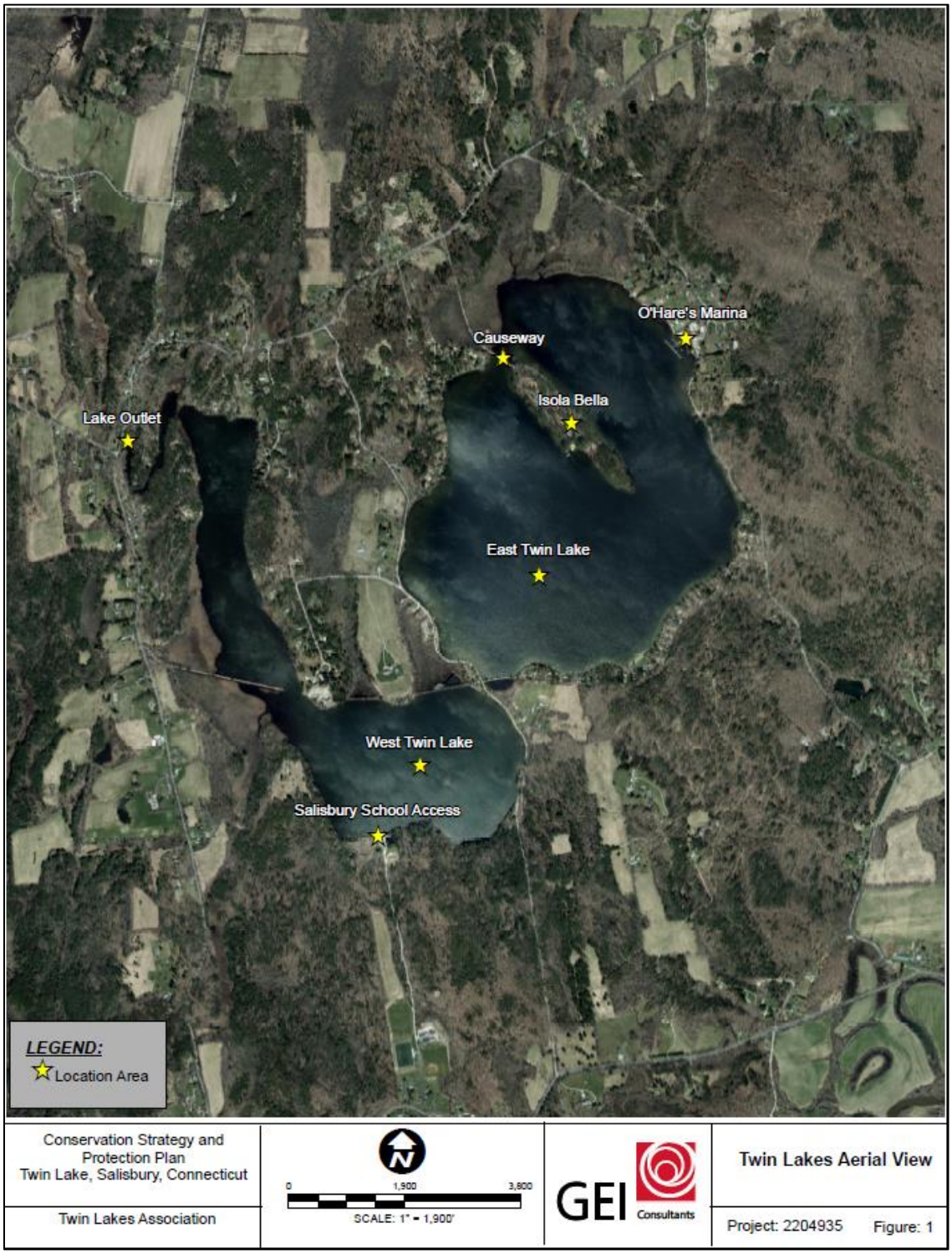

Figure 1. Map of East and West Twin Lake detailing important locations.

2. Historical Plant Information

2.1 Reports and Letters

GEI reviewed multiple reports, letters, and communications for this conservation plan. Full citations are provided in the survey reports listed below.

Aquatic Plant Survey Reports

- Aquatic Control Technology (ACT) 2015 Summary Report: Summarizes 2015 herbicide treatments and survey efforts from 2005 to 2015.
- Aquatic Ecosystem Research (AER) 2017 Twin Lakes Rare Aquatic Macrophyte Species Survey: Point intercept survey of East and West Twin Lakes.
- AER 2021 Twin Lakes Rare Plant Quantitative Plant Study: Point intercept survey of East and West Twin Lakes.
- AER 2021 Twin Lakes Digital Herbarium: Pictures of representative plant samples from the 2021 survey.
- AER 2022 Quantitative Rare Plant Study: Meander type survey for rare plants including genetic testing results for multiple specimens.
- AER 2022 Twin Lakes Digital Herbarium: Pictures of representative plant samples from the 2022 survey.

Invertebrate Survey Reports

- Biodrawversity 2015 Aquatic Snail and Mussel Survey in the Twin Lakes: Point survey of multiple locations in both East and West Twin Lakes.
- Biodrawversity 2020 Freshwater Snails and Bivalvues in East and West Twin Lake, 2020 Monitoring: Point survey of multiple locations in both East and West Twin Lakes.

3. Species Status in Twin Lakes

3.1 *Bidens beckii*

Records of *Bidens beckii* in the Twin Lakes system dates back to 2005, with ACT discovering the species every year from 2005 to 2015. During the 2015 ACT survey, *Bidens beckii* was found north of Isola Bella bridge in East Twin and the southern portion of West Twin (Figure 2). No photos or voucher specimens were submitted or available for review. The 2015 ACT survey also documented observations on the north side of Isola Bella (Transects L1-L3; Figure 2) which had a large thriving population of *Bidens beckii*. This observation in conjunction with finding the plant every year from 2005 to 2015 indicates that this larger population has been around in previous years.

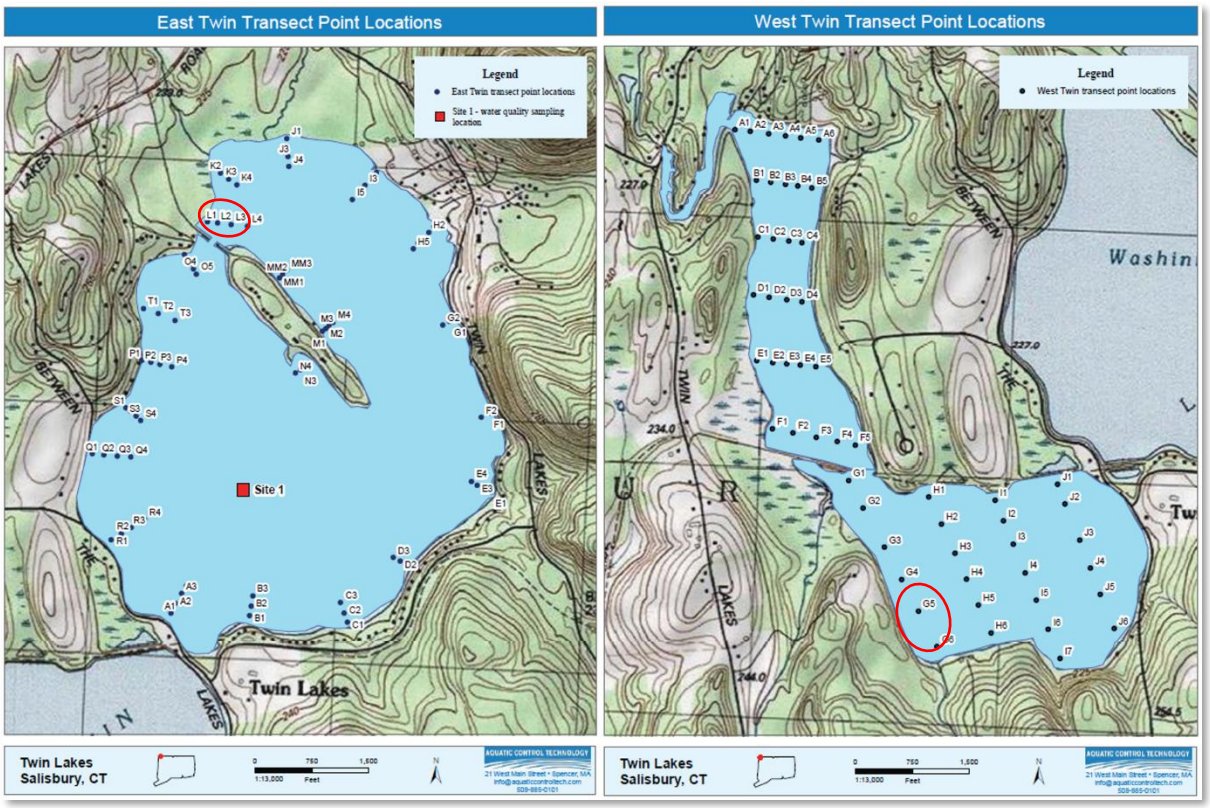

Figure 2. ACT (2015) transect locations for *Myriophyllum sibiricum* (L1, L2, L3, G6) and *Bidens beckii* (L1, L2, L3, G5, G6).

CT DEEP has a record of *Bidens beckii* in 2007 in both lakes (William Morehead Personal Comm.).

AER has records of *Bidens beckii* in East Twin in 2017, 2021 and 2022. The plant was found at four points in 2017, in the northwestern section of East Twin lakes, north of Isola Bella. This location is consistent with the previous ACT surveys. In 2021, AER only found *Bidens beckii* at one location, north of Isola Bella (Figure 3). In West Twin Lake, *Bidens beckii* was documented at two locations in 2017 and one location in 2021 (Figure 4). The 2017 and 2021 locations in West Twin were different between years and different from the previous ACT surveys.

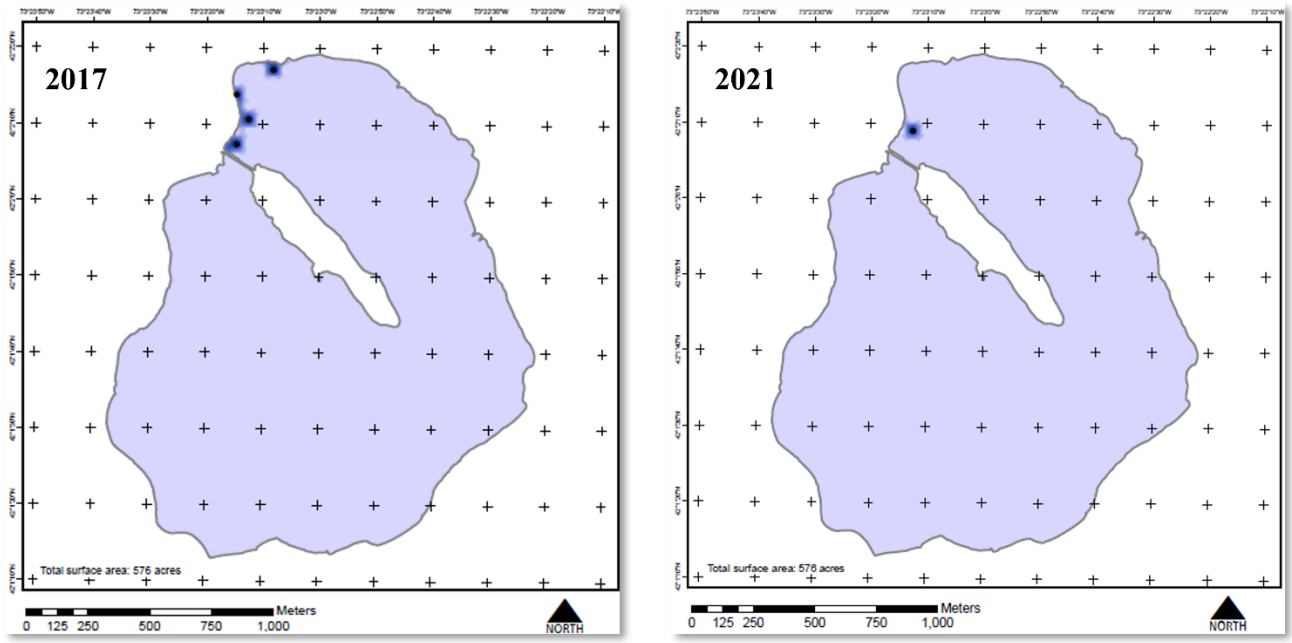

Figure 3. AER (2017, 2021) point locations for *Bidens beckii* in East Twin Lake.

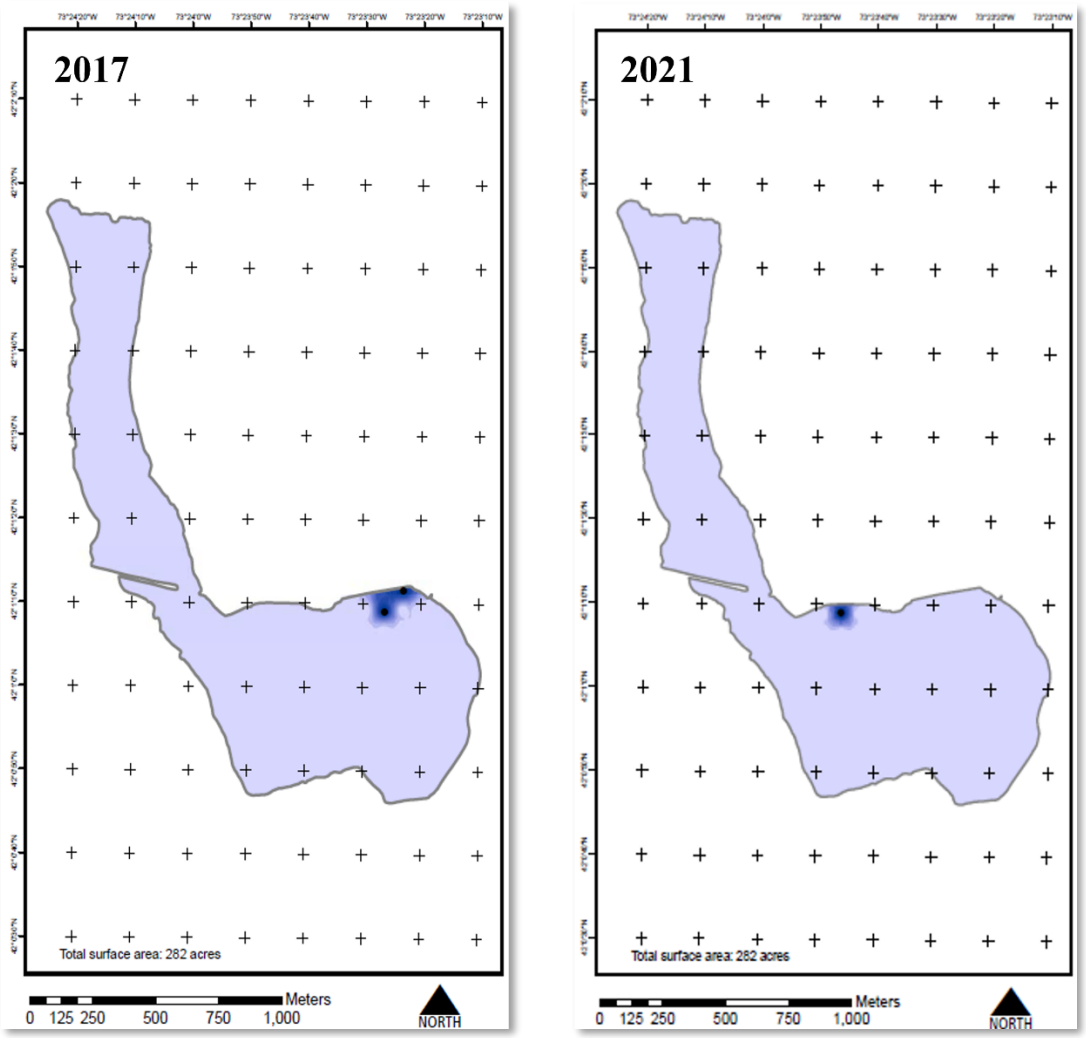

Figure 4. AER (2017, 2021) point locations for *Bidens beckii* in West Twin Lake.

During the 2022 survey, *Bidens beckii* was documented in both East and West Twin Lakes in multiple locations (Figure 5). Both locations documented in 2022, represent the areas found in 2017 and 2021. In the 2022 report, there is a slight discrepancy between nomenclature. The 2022 report in multiple places refers to *Bidens beckii* as "*Megalodonta beckii* aka *Heteranthera dubia*". *Heteranthera dubia* is another submersed aquatic plant common in lakes in the northeast but is morphologically different from *Bidens beckii*. The genetic sample sent by AER 2022 to confirm *Bidens beckii* (but labeled as *P. zosteriformisis*) was actually a sample of *Heteranthera dubia*, determined both by genetic analysis and GEI photo inspection (Figure 6). In the 2022 Twin Lakes Herbarium, there were no specimens visually consistent with *Bidens beckii*. GEI's interpretation is that this was a typo rather than a misidentification of the specimens. The 2021 herbarium contains *Bidens beckii* specimens confirmed visually by GEI (Figure 6).

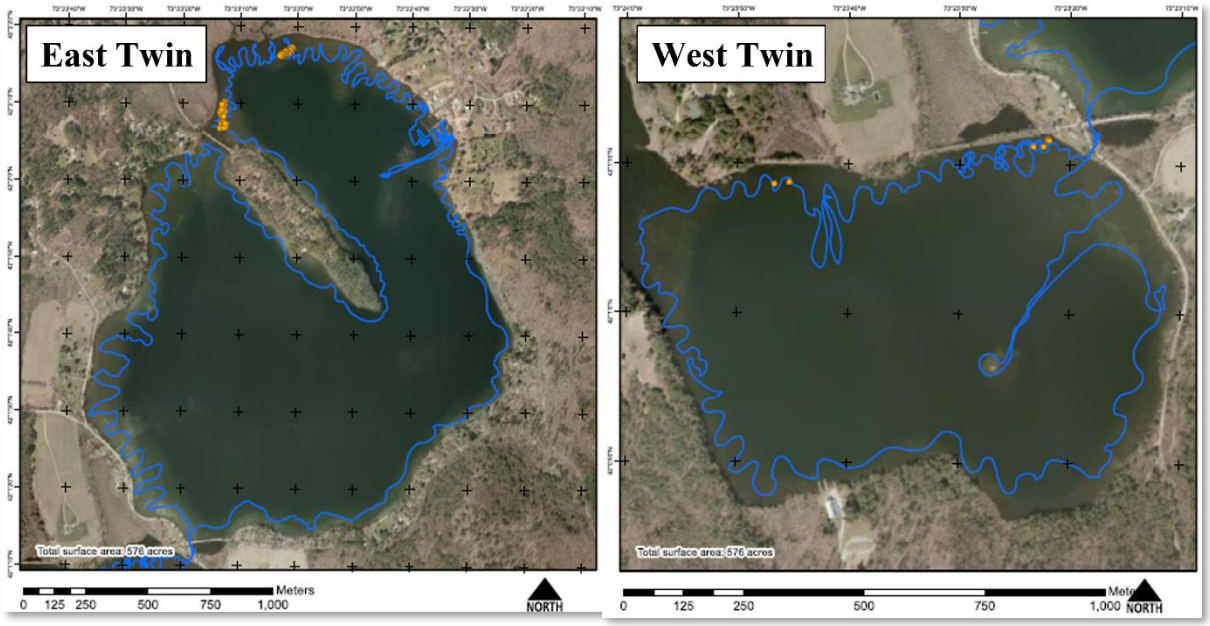

Figure 5. AER (2022) point locations and survey track for *Bidens beckii* in East and West Twin Lake.

Figure 6. Herbarium specimen of *Bidens beckii* from 2021 (Left) and specimen Washinee xx5-037 from AER 2022 (right). Genetic analysis identified the species as *Heteranthera dubia*. The tag in the lower lefthand corner indicating zosteriformisis the visual plant ID from AER prior to genetic analysis.

3.2 *Myriophyllum sibiricum*

The most recent record for *Myriophyllum sibiricum* in the Twin Lakes system, is from the CTDEEP herbarium collection in 2001 from East Twin Lake, and the same collector reported it as common in East Twin as recently as 2007.

ACT documented *M. sibiricum* every year from 2005 and 2015. In 2015, the most common areas for ACT observations were located north of Isola Bridge in East Twin and the southern portion of West Twin (Figure 2). No voucher specimens or photographs were submitted or available for review.

AER documented *M. sibiricum* in 2017 and in 2021 from East Twin Lake. The 2017 records show six observations, three of which were in the same location as *Bidens beckii*, north of Isola Bella. The remaining observations were along the northern shore, adjacent to the Marina. There were no voucher specimens from the 2017 sampling, but there was one photo available to review for a 2021 specimen (Figure 7). Examining the 2021 photo reveals the difficulty of positively identifying this species in the field, since the number of segments on one side of the rachis (14 to 15) indicates *M. spicatum* (Eurasian watermilfoil) identification, however, the uppermost leaves are rounded at the tip, which indicates a *M. sibiricum* (northern watermilfoil) identification. No fruit or flowers were available for review.

Figure 7. Suspected *M. sibiricum* sample from East Twin Lake in 2021 (AER 2021).

AER sent three suspected *M. sibiricum* samples out for genetic analysis in 2022. All three samples came back identified as *M. spicatum* (AER 2022).

Don Les, professor from the University of Connecticut, surveyed East Twin Lake specifically for *M. sibiricum* on multiple occasions through 2018, but did not find this species.

The various accounts of *M. sibiricum* and history of detections/non-detections are consistent with GEI's experience in sampling this plant. While the Crow and Hellquist 2000 key has relatively straightforward characteristics to delineate between *M. spicatum* and *M. sibiricum,* field identifications are often much more difficult. It is recognized that some of the traditional characteristics used to identify *M. spicatum* from *M. sibiricum* are not as reliable as previously thought (Moody and Les 2007). This is compounded by the fact that these species both hybridize, and specimens will often exhibit intermediate characteristics, further clouding positive identification.

3.3 *Potamogeton strictifolius*

The status of *Potamogeton strictifolius* in the Twin Lakes system has created considerable debate. The original specimen was from Nancy Murray's 2008 herbarium collection. The ACT surveys did not indicate the presence of *P. strictifolius* from 2005 to 2015 (ACT 2015). The 2017 and 2021 AER surveys did note *P. strictifolius* at nine points and 11 points respectively. However, the species identification in both reports by AER were inconclusive, since they stated that the *P. strictifolius* found in both surveys could have been either *Potamogeton zosteriformis* or a hybrid.

The largest discrepancy in terms of identification, may have been caused by using two different keys; Crow and Hellquist 2000 and the updated Potamogetonaceae key provided by Barre Hellquist. Following the Crow and Hellquist 2000 key led the authors to a *P. strictifolius* identification; whereas *P. zosteriformis* in the 2000 key could be reached by confirming that there were no nodal glands present. The implication, while not explicitly stated, is that specimens collected in 2017 had nodal glands, hence the *P. strictifolius* identification. However, the updated Potamogetonaceae key is different in that *P. zosteriformis* can be identified with and without nodal glands. The authors noted that the specimens exhibited flattened stems and three bold veins, which supported a *P. zosteriformis* identification in the supplemental key. GEI could not confirm the species identification from the 2017 report, since no photos of the 2017 specimens exist.

The follow up 2021 survey report noted much of the same taxonomic discrepancies as the 2017 report. Specimens reported in 2021 had flattened stems and three bold veins, which suggested the *P. zosteriformis* identification.

AER contracted a genetic testing laboratory to perform species-level genetic identifications on one sample from 2021 and six samples from 2022. All of the samples that were submitted were suspected to be *P. strictifolius*; however, genetic testing of the samples revealed that all species were identified as *P. zosteriformis* (AER 2022).

3.4 *Sparganium natans*

Sparganium natans was last observed in 2003 from Twin Lakes. There was no specimen to examine, but CT DEEP staff noted that the collector was a reliable source of information (William Morehead personal comm.). ACT surveys did not encounter this species during their sampling period from 2005 to 2015. In later studies, AER documented *Sparganium spp.* at seven and 13 locations throughout West Twin in 2017 and 2021 respectively. No narrative concerning identification challenges/uncertainties was provided in the 2017 or the 2021 AER report. Since members of the *Sparganium* genus are extremely difficult to distinguish from each other without reproductive structures (Crow and Hellquist 2000), it is understandable that the surveyors could only identify the specimens to the genus level if vegetative structures were not present (as in 2021 specimens; AER 2021).

Figure 8. Suspected *Sparganium spp.* sample from East Twin Lake in 2021 (AER 2021).

The ACT 2017 report, as well as the 2021 report noted that "remaining species occur – most frequently – in the wetland transitional areas adjacent to the lake. Therefore, they were not encountered during previous surveys that evaluated the littoral zone of the Twin Lakes." Multiple sources have documented *S. natans* occurrences in water depths ranging from 20 to 40 cm and up to 60 cm (Kaul and Robert 2020; Cook and Nicholls 1986), which is well within the depth range that most aquatic plant surveys cover. GEI staff have documented the growth of *Sparganium spp.* in waters greater than 1 meter deep on other lakes in the region. Therefore, it GEI's professional opinion that aquatic plant surveys which sample depths of 1 foot or greater would have included potential *S. natans* habitat. This does not mean that the

surveys should have found this plant in deeper waters; the lack of these sightings may have been due to the detection probability of the species, which is linked to the abundance and presence of other plants. Simply stated, the depth range of the aquatic plant survey areas in 2017, 2021 and 2022 was within the normal range of occurrence for *Sparganium natans*.

3.5 *Schoenoplectus acutus*

Schoenoplectus acutus was observed in 2018 by private consultants on West Twin Lake (William Morehead personal comm.). A 2001 *S. acutus* record also exists from East Twin Lake. As with *S. natans*, AER noted that "remaining species occur – most frequently – in the wetland transitional areas adjacent to the lake. Therefore, they were not encountered during previous surveys that evaluated the littoral zone of the Twin Lakes". Dabbs 1971 documented *S. acutus* (at that time this species was recognized as *Scirpus*) as tolerant of water depths between 60 and 150 cm. Madsen et al. 2012, documented *S. acutus* at depths ranging from 2 to 6 feet in the Detroit lakes, Minnesota. Similar to the discussion of *S. natans* above, the survey areas in 2017, 2021 and 2022 captured the normal depth ranges of *S. acutus*.

3.6 *Valvata tricarinata*

The state-listed snail species *Valvata tricarinata* was documented during both 2015 and 2020 invertebrate surveys (Biodrawversity 2015; 2020). During the 2015 survey, *V. tricarinata* was documented at five of the seven survey locations in East Twin Lake and two of the 10 survey locations in West Twin Lake. No strong habitat preference was noted for this species. In 2020, *V tricarinata* was documented at four of the six survey locations in East Twin Lake and two of the survey locations in West Twin Lake. For both *V. tricarinata* and *Stagnicola catascopium* snail species, due to their wide-ranging habitat tolerances, the authors suggested that both East and West Twin Lakes could provide actual or potential suitable habitat.

3.7 *Stagnicola catascopium*

The state-listed snail species *Stagnicola catascopium* was uncommon in the 2015 survey, with specimens documented in only one location per lake (Biodrawversity 2015; 2020). Only three or four live individuals in total were found between both sites. In 2020, there was an increase in detections; individuals were found at three survey locations in East Twin and two locations in West Twin.

3.8 *Fossaria galbana*

Both the 2015 and 2020 surveys found no individuals that matched the illustrations or descriptions of *Fossaria galbana*. The surveyors noted uncertainties about the historical presence of *F. galbana* in Connecticut. This uncertainty was primarily based on the reported

range occurring between the "Great Lakes-St. Lawrence River basin northward in the region west of James Bay…northwestward into the boreal forest region to the vicinity of Great Slave Lake" (Burch and Jung 1992). In addition, the species was not included in scientific monographs from Connecticut and New York.

4. Proposed Activity Overview

For the purposes of this conservation strategy and protection plan, no endorsement of specific herbicide products is intended. However, evidence is provided to support conservation strategies, should the Twin Lakes association choose to use these products to control nuisance plant growth.

4.1 ProcellaCOR

4.1.1 Herbicide overview

ProcellaCOR EC (Active Ingredient: florpyrauxifen-benzyl) is an EPA registered aquatic herbicide used for submersed aquatic plant control, specifically in the northeast for Eurasian watermilfoil (*Myriophyllum spicatum*). Originally, florpyrauxifen benzyl was granted a permit for use in rice (SePRO 2019). Florpyrauxifen benzyl is a new type of synthetic auxin mimic herbicide similar to 2,4D and triclopyr. Auxin mimic products work by effectively tricking the plant into increasing various biochemical processes such as stimulation of RNA polymerase and protein biosynthesis (WSSA 2021). Different from other auxin mimics, use rates are much lower with florpyrauxifen-benzyl, with active ingredient concentrations effective for control being in the µg/L range versus the mg/L range.

4.1.2 Impacts to Aquatic Plants

4.1.2.1 Relevant concentrations for Myriophyllum control

Label rates for florpyrauxifen-benzyl to be an effective control for species within the *Myriophyllum* genus range between 1.93 to 9.65 µg/L range (SePRO 2018), however in practice, rates on the lower end of the scale are even effective for control. Beets et al. (2019) found that a concentration and exposure time (CET) scenario of 3 µg/L at 6 hours was enough to completely reduce Eurasian watermilfoil biomass for 60 days after treatment. Mudge et al. 2021 documented that all florpyrauxifen benzyl CET scenarios tested in a growth chamber experiment resulted in 100% reductions in Eurasian watermilfoil biomass, with the smallest CET scenario evaluated being 3 µg/L at 0.5 hours. Netherland and Richardson 2016 found that the effective concentration values (EC50: concentration at which 50% of the target organisms elicit a response) for Eurasian watermilfoil were 0.11 µg/L and 0.12 µg/L for static growth chamber and mesocosm studies.

Field study results confirmed laboratory experiments that documented high sensitivity. Cattoor et al. 2022 documented a significant decline in the frequency of occurrence of hybrid watermilfoil (*Myriophyllum spicatum X Myriophyllum sibiricum*) in two plots in Lake Jane, MN using a concentration of 5.79 µg/L. Both treatment areas were 11.9 acres in size with

the frequency of occurrence dropping to 1% and 8% from 72% and 58% for each treatment area one year after treatment. Heilman et al. 2022 documented excellent selective control of variable leaf milfoil (*Myriophyllum heterophyllum*) on a small plot in New Hampshire 3 to 6 weeks post application using an application rate of 10.1 µg/L. This study also looked at dissipation rates post treatment and found that concentrations within the treatment zone dropped below 1 µg/L 24 hours after treatment and were less than 1 µg/L 6 hours after treatment outside of the treatment zone. Getsinger 2018 documented similarly fast dissipation times in a study in Morton Slough – Pend Oreille, Idaho. Within 9 hours, concentrations of florpyrauxifen benzyl were below 1 µg/L from a theoretical starting concentration of 9.65 µg/L. Eurasian watermilfoil frequency of occurrence dropped to 2% in 6 weeks post treatment, as compared to 95% frequency of occurrence prior. GEI staff have also monitored florpyrauxifen benzyl treatments in New York which exhibited similarly large reductions in Eurasian watermilfoil at concentrations below 5.31 µg/L (Reyes personal observation).

While florpyrauxifen benzyl is effective on Eurasian watermilfoil, it presumably has a high toxicity to native milfoils. The literature on native milfoil exposure to florpyrauxifen benzyl is not as extensive as either Eurasian, hybrid watermilfoil or other nuisance species. For *Myriophyllum sibiricum*, Getsinger 2018 reported a significant decrease in frequency of occurrence pre to post treatment. SePRO 2019 noted that there is unpublished data showing high sensitivity of *Myriophyllum sibiricum* to florpyrauxifen benzyl. Throughout our literature search, we were not able to find any native or invasive members of the *Myriophyllum* genus which showed tolerance to florpyrauxifen benzyl. Based on that information (lack thereof), it is GEI's professional opinion that treatments involving the active ingredient florpyrauxifen benzyl may impact *Myriophyllum sibiricum* populations if treatments are not spatially separated. Fortunately, with the rapid dissipation of florpyrauxifen benzyl after treatment, there is minimal risk for offsite drift to impact neighboring milfoil species.

4.1.2.2 Impacts to Native and Rare Species

There is a significant amount of research involving florpyrauxifen benzyl impacts on native plants. While not every native plant that is present in the Twin Lakes system has been specifically screened or laboratory tested, it is GEI's professional opinion that there is enough data to make strong inferences within genera. For this discussion of native plant susceptibility to florpyrauxifen benzyl, it is important to evaluate if non-target impacts could be affected not for just any concentration of florpyrauxifen benzyl, but concentrations relevant to Eurasian watermilfoil control. Eurasian watermilfoil is the most common invasive species to be controlled with florpyrauxifen benzyl and is the target of aquatic weed management in the Twin Lakes system. Therefore, native plant exposure will be examined using an average label-recommended concentration of 5.79 µg/L active ingredient, which is

considered a high rate for effective Eurasian watermilfoil control in the northeast (Reyes, personal observation).

Impacts to Pondweeds

Members of the *Potamogeton* genus show virtually no sensitivity to florpyrauxifen benzyl in both laboratory and field investigations. Beets et al. 2019 did not find any impacts to American Pondweed (*Potamogeton nodosus*) and Illinois Pondweed (*Potamogeton illinoensis*) up to 27 µg/L for a 24-hour exposure. Cattoor et al. 2022 documented either no impact or increases in frequency of occurrence after treatment for Robbin's pondweed (*Potamogeton robbinsii*), Largeleaf pondweed (*Potamogeton amplifolius*) and Clasping-Leaf pondweed (*Potamogeton praelongus*). Heilman et al. 2022 documented increases in frequency of occurrence for *Potamogeton robbinsii* and floating leaf pondweed (*Potamogeton natans*) post florpyrauxifen benzyl treatment. GEI staff have monitored multiple florpyrauxifen benzyl treatments in New York where *Potamogeton amplifolius* and *Potamogeton robbinsii* were the dominant native species and documented no change in species abundance or frequency of occurrence post treatment (Reyes personal observation).

In regard to *Potamogeton strictifolius,* there is no specific literature data that has tested this species for florpyrauxifen benzyl sensitivity. This is unsurprising, as most rare species have little to no specific herbicide tolerance data to base management decisions on. Since multiple species within the *Potamogeton* genus are not sensitive to florpyrauxifen benzyl, GEI believes it is reasonable to assume that *Potamogeton strictifolius* is similarly insensitive to florpyrauxifen benzyl. This is also supported by the ProcellaCOR EC label, which does not list any members of the *Potamogeton* genus as susceptible plants that florpyrauxifen benzyl can control. Confirmation of pondweed species specific tolerances via laboratory testing would provide a more concrete answer.

Impacts to *Bidens beckii*

There is one study that looked at impacts of florpyrauxifen benzyl on *Bidens beckii* (Netherland and Richardson 2016). Netherland and Richardson 2016 found EC50 values for growth chamber trials to be 11.3 µg/L and mesocosm trials to be 6.1 µg/L. For the mesocosm experiments, there were minimal impacts on *Bidens beckii* at 3 µg/L and a > 65% reduction at 9 µg/L. This suggests that *Bidens beckii* may be moderately sensitive to the higher end of the range of label recommended florpyrauxifen benzyl treatments. The authors, however, note that static exposures can greatly overestimate EC50 values and show higher sensitivity than what would be seen in field settings. Static exposures do not allow for any water exchange outside of accounting for evaporation, which does not necessarily translate to field settings, where there is an influx of new, untreated water entering from outside of the treatment zone almost immediately after treatment. In the same study, Eurasian watermilfoil EC50 values were 0.11 and 0.12 µg/L, indicating significantly higher

sensitivity to florpyrauxifen benzyl than *Bidens beckii*. With the normal use rates for control of Eurasian watermilfoil ranging from 1.93 to 9.65 µg/L range from multiple studies, it seems reasonable to expect that the actual dosage that would be harmful to *Bidens beckii* plants would be close to or greater than 50 µg/L in a field setting. More studies involving CET designs (See Beets et al. 2019 and Mudge et al. 2021) would help further refine margins of safety for this species.

Impacts to Other Native Species Relevant to Twin Lakes

GEI could not locate any research or field case studies that have examined impacts to members of the *Sparganium* genus to florpyrauxifen benzyl treatments. While there may not be specific research or case studies for *Schoenoplectus acutus,* two members of the genus, *S. tabernaemontani* and *S. californicus* were tested by SePRO in coordination with the US Army Engineer Research and Development Center (SePRO 2019). Both species showed no impacts to any exposure scenario up to 27 µg/L.

4.1.3 Impacts to Snails

USEPA noted a study submitted for registration on acute water column exposure for *Lymnaea stagnalis* (Melendez et al. 2017). All concentrations had less than 50% mortality which established a non-definitive EC_{50} > 48.2 µg/L. No sublethal effects were documented for any concentrations tested. The study indicates that florpyrauxifen benzyl is not acutely toxic to freshwater invertebrates up to ~50 µg/L.

4.2 Diquat Dibromide

As a control measure for *Potamogeton crispus* (curly leaf pondweed) and Eurasian watermilfoil, diquat dibromide has been the commonly used as an aquatic herbicide by the Twin Lakes Association. Diquat is a broad spectrum, contact aquatic herbicide, that interferes with photosynthesis and disrupts cell membranes. Most aquatic plants are impacted by diquat with varying degrees of sensitivity.

Turnage and Madsen 2015 examined flowering rush plots pre and post diquat treatment. Among the native species, *Schoenoplectus acutus* and *Myriophyllum sibiricum* frequency of occurrence was unaffected by 0.5 gallon per acre foot of diquat applied in the same manner as treatments on Twin Lakes (where they dropped hoses from a boat).

High diquat treatment rates and close proximity to non-target species can negatively impact non-target native plants. If diquat is not applied directly to sensitive non-target plants at the lowest rate feasible for control, the effect on non-target impacts should be minimal. Also, potential impacts to non-target species may be minimized by adjusting the timing of applications. For example, diquat treatments for curly leaf pondweed scheduled early in the growing season (before May 1st) can add an additional level of protection to sensitive plants.

Diquat rapidly dissipates from the water column, and readily binds to particulate matter and plant material. This limits the offsite drift of the product, reducing the chance for non-target impacts outside of the treatment zone.

4.2.1 Impacts to Snails

The apple snail has an LC50 value of 340 µg/L for diquat (WSDOE 2002). While this is lower than initial dosages, diquat rapidly dissipates (Ritter et al. 2000) in the water column, with concentrations well below the LC50 value hours after treatment. Impacts to snails are expected to be minimal if lower diquat concentrations are used for aquatic plant control, and the herbicide is applied directly to the target plant biomass instead of releasing the herbicide over open sediment areas.

5. Conservation Strategy for Endangered, Threatened and Special Concern Species

5.1 General Conservation Strategies/Recommendations

5.1.1 Species Identifications

GEI recommends confirming the presence of any suspected ETS species by requesting a positive morphological ID from a qualified aquatic plant botanist/taxonomist with notes concerning which key was used and the defining characteristic(s). Alternatively, a positive genetic identification should be done by a qualified laboratory. The qualified botanist or entity performing the survey should keep a visual and herbarium preserved specimen, if possible, for suspected ETS species.

Many ETS species are extremely difficult to identify without reproductive structures, which may not be produced in the population. Therefore, genetic analysis should be used as a confirmation tool for specimens where positive identification structures are lacking. Furthermore, hybrid pondweeds and milfoils may exhibit intermediate physical characteristics, which could complicate the species identification process, since they could key out to different or multiple species.

5.1.2 Applicator Guidance

Connecticut licensed applicators should take every measure possible to ensure that herbicide products are applied directly to the target plants and that offsite drift is minimized. Best practices include clearly delineating treatment zones using plant location information gathered from current surveys and following the boundaries of pre-determined shapefiles for treatment areas loaded onto an onboard GPS or fish finder.

The use of an airboat for herbicide applications is preferable to a skiff type boat with an outboard motor in shallow water. This reduces the chance that non-target plants will get cut by the boat propellor, while treatments are administered.

Diquat treatments should take place before May 1st to control early growth invasive species, such as curly leaf pondweed. This will maximize the effectiveness of the treatment on the target species, while protecting non-target and ETS species, which may not be growing at that time.

5.1.3 Survey and Monitoring

GEI recommends that a meander-type survey be completed at least once a year to document the presence of ETS species in Twin Lakes. This survey should be timed to maximize the chance of not only encountering ETS species, but their reproductive structures to aid in positive identification. Follow-up surveys should be performed at the end of the season to double-check the presence of rare species and to collect specimens if needed.

5.1.4 Restoration of Plant Populations

GEI recommends that the Twin Lakes Association in conjunction with CTDEEP explore the possibility of restoring select areas with rare plant species to boost the overall population viability. Specifically, *Schoenoplectus acutus* and *Bidens beckii* have abundant and robust populations within Connecticut and in neighboring states where individuals can be sourced from. Preferably, transplants should be from as close to Twin Lakes as possible to preserve the genetic makeup of the Twin Lake's populations. Alternatively, new plants might be propagated from the rare species already growing in Twin Lakes. Subsequently, "no management" zones can be delineated for rare plants to thrive and multiply without any impacts via herbicide or other aquatic plant management techniques.

5.2 *Potamogeton strictifolius*

Proposed aquatic vegetation treatments using products with the active ingredient florpyrauxifen-benzyl, do not need any special protection measures or conservation strategies to be implemented for *Potamogeton strictifolius*. Based on the available peer reviewed literature, it is highly unlikely that florpyrauxifen-benzyl treatments will have any negative impact on *P. strictifolius* populations.

However, treatments involving products with the active ingredient diquat dibromide should set a 300-foot setback from currently known and confirmed locations of *P. strictifolius*. These buffers should be in effect after May 1st of each year.

GEI recommends that genetic testing of suspect *P. strictifolius* specimens found in Twin Lakes continue on an as needed basis, in conjunction with voucher specimen collection during rare plant surveys. Currently, it is difficult to determine the true extent of the *P. strictifolius* population in both lakes due to discrepancies in taxonomic identifications. Further testing may elucidate this and help protect areas from potential non-target impacts.

5.3 *Myriophyllum sibiricum*

Proposed aquatic vegetation treatments involving products with the active ingredient florpyrauxifen-benzyl are recommended by GEI to have a 300-foot buffer zone around known and confirmed *Myriophyllum sibiricum* locations. These buffers should be in effect

for the entire calendar year. There is no margin of safety for florpyrauxifen benzyl and *M. sibiricum*, so treatments should be avoided in known and confirmed *M. sibiricum* population areas.

Proposed aquatic vegetation treatments involving products with the active ingredient diquat dibromide are recommended by GEI to have a 300-foot buffer zone around known and confirmed *M. sibiricum* locations. These buffers should be established and maintained after May 1st of each year.

GEI recommends that genetic testing of suspect *M. sibiricum* specimens found in Twin Lakes continue on an as needed basis, in conjunction with voucher specimen collection during rare plant surveys. Genetic testing may also reveal the presence of hybrid watermilfoils, which may be resistant to certain herbicides. GEI feels that understanding the genetic structure of the *Myriophyllum* genera in Twin Lakes will guide proper long-term management strategies.

5.4 *Bidens beckii*

Proposed aquatic vegetation treatments involving products with the active ingredient florpyrauxifen-benzyl, are recommended by GEI to have a 300-foot buffer zone around known and confirmed *Bidens beckii* locations, particularly if the target treatment concentration exceeds 5.79 µg/L. This buffer should be in effect after May 1st of each year. Based on the available peer reviewed literature, florpyrauxifen-benzyl treatments may have a slight impact on *Bidens beckii* vegetative growth if the target treatment dose exceeds 6.1 µg/L.

Proposed aquatic vegetation treatments involving products with the active ingredient diquat dibromide should set a 300-foot buffer zone around known and confirmed *Bidens beckii* locations. This buffer should be in effect after May 1st of each year.

5.5 *Sparganium natans*

Aquatic vegetation treatments involving products with the active ingredient florpyrauxifen-benzyl, are recommended by GEI to have a 300-foot buffer zone around known and confirmed *Sparganium natans* locations. This buffer should be in effect after May 1st of each year. Until further research is available for review concerning the effects of ProcellaCOR on members of the *Sparganium* genus, this buffer should be in place.

Aquatic vegetation treatments involving products with the active ingredient diquat dibromide, should set a 300-foot buffer zone around known and confirmed *S. natans* locations. This buffer should be in effect after May 1st of each year.

5.6 *Schonoplectus acutus*

Proposed aquatic vegetation treatments involving products with the active ingredient florpyrauxifen-benzyl should not warrant any additional protection measures for *Schonoplectus acutus* populations. Based on the available research, it is highly unlikely that florpyrauxifen-benzyl treatments will have a negative impact on *S. acutus* populations.

Proposed aquatic vegetation treatments involving products with the active ingredient diquat dibromide, are recommended by GEI to have a 300-foot buffer zone around known and confirmed *S. natans* locations. This buffer should be in effect after May 1st of each year, only if the applicators are applying the product as a foliar application.

5.7 Long Term Treatment Plan

The NDDB decision letter indicated that a long-term treatment plan including years of "no treatment" be included in future NDDB applications. GEI does not believe the available toxicity data for florpyrauxifen benzyl support the notion that "no treatment years" will effectively protect the snail populations. Treatments using ProcellaCOR are not intended to be performed in back-to-back years in the same area based on experience with other treated lakes, therefore there is a built in "No Treatment" strategy using that active ingredient. Furthermore, the established EC_{50} for acute snail exposure is at least 8 times higher than relevant concentrations used for Eurasian watermilfoil control. GEI believes that based on the available science, florpyrauxifen-benzyl treatments pose no risk to ETS snail species at concentrations used to control Eurasian watermilfoil.

For diquat dibromide, treatment areas targeting curly leaf pondweed can be rotated on an annual basis, so no one area is treated in consecutive years. If treatments are done at lower diquat concentrations and the product is not applied over open sediment areas, impacts to snail populations should be minimized. It is worth noting however, that this may lead to incomplete control of the target plant. Early season curly leaf pondweed diquat treatments are most effective as long as consecutive years of treatment on the same area are performed. This is due to the depletion of the turion bank, limiting late season re-growth and a strong population moving into the spring.

To monitor the effects of the "no treatment" plan, 5-year surveys of existing snail populations should continue from a qualified taxonomist. Previously collected data should be analyzed to determine if past consecutive diquat treatments have had negative impacts on the presence of state listed snail species. This analysis would help inform a more targeted protection plan.

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