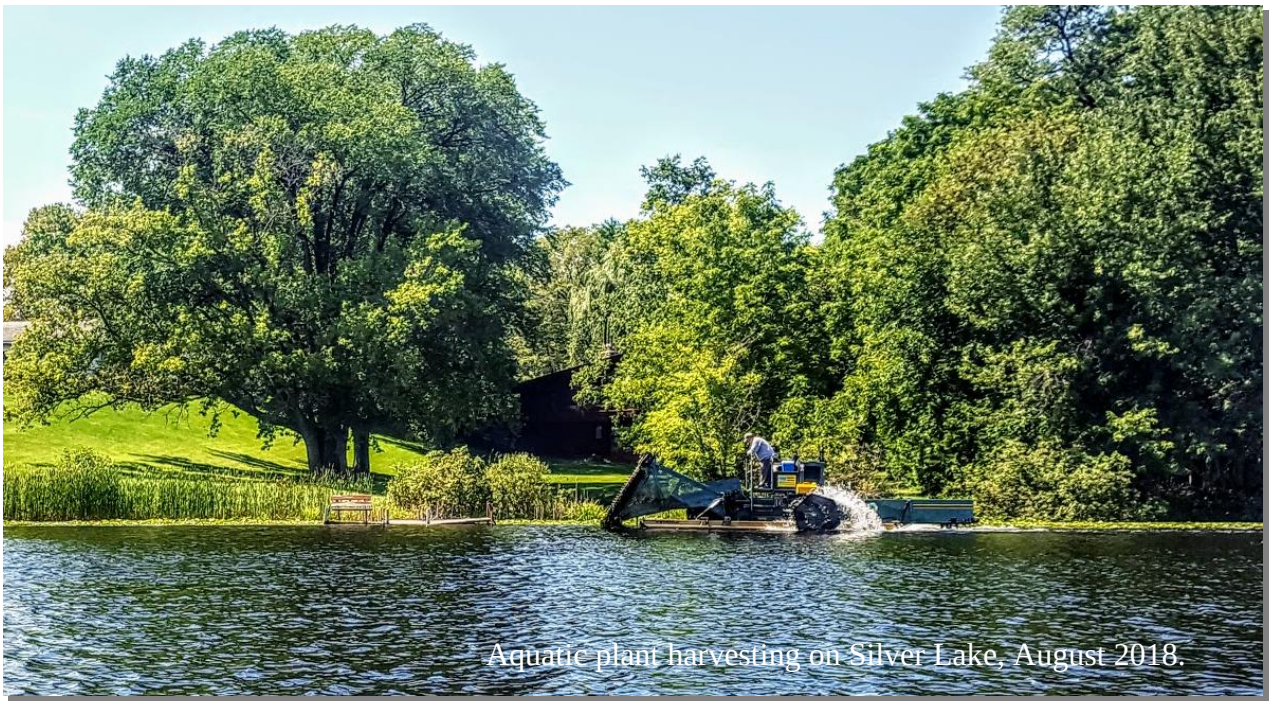
APPENDIX B
2020 Aquatic Plant Management Plan
Silver Lake, Columbia County
WBIC #107700



Aquatic plant harvesting on Silver Lake, August 2018.

Aquatic Plant Management Plan for Silver Lake

The aquatic plant community in Silver Lake is characterized by healthy and relatively diverse plant species. As an urban lake, Silver Lake has a fair amount of development on the shores, which can have an impact on the presence and diversity of plant species. There are aquatic plants distributed throughout the near shore littoral zone of the lake which comprises 100% of the lake's 24-acre east basin (Figure 1) with a maximum depth of 16 feet. The 50-acre west basin, with a very different morphology, has a maximum depth of 42 feet and a narrow littoral zone (16 foot max rooting depth), sometimes extending only 15-20 feet from shore. Aquatic plant growth in the littoral zones is dense and often impedes recreation. In response, this aquatic plant management strategy was developed as part of the lake's management plan. The plan was developed during winter-spring 2020 by the Silver Lake Restoration Ad-hoc Committee with input from interested citizens. Technical guidance was provided by professionals from the Wisconsin Department of Natural Resources and UW-Stevens Point's Center for Watershed Science and Education.

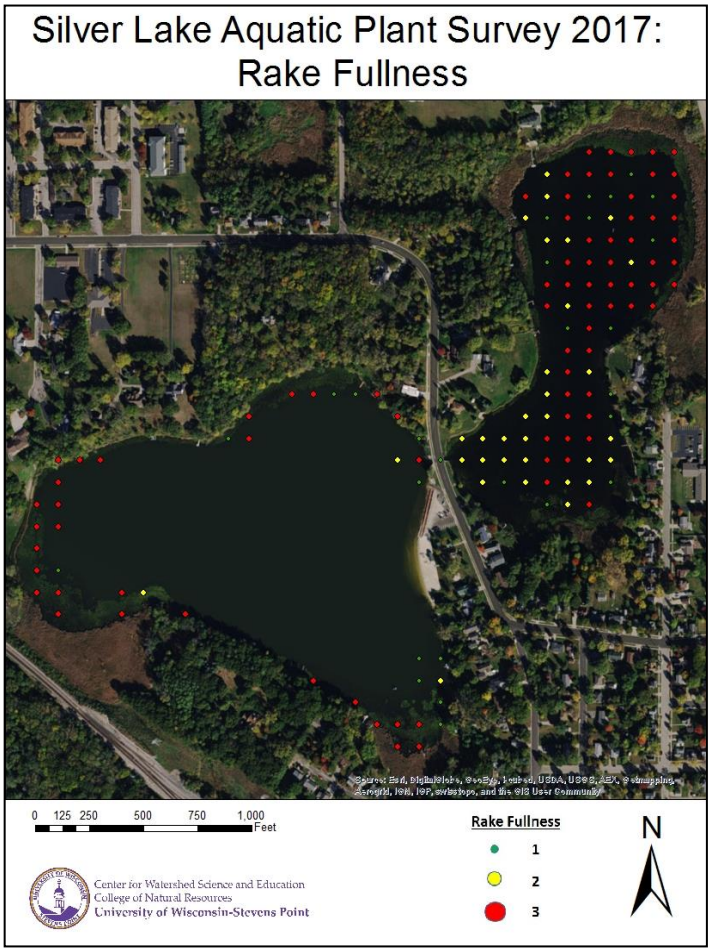


Figure 1. Rake fullness in Silver Lake, July 2017.

In Silver Lake, a successful aquatic plant management strategy will include minimal inputs and will achieve a balance between healthy aquatic habitat, good water quality, and recreational activities with minimal management.

Background Information

The most recent aquatic plant survey conducted in Silver Lake provided guidance for the development of this plan. This comprehensive survey based on the point-intercept method, was conducted in July 2017; a subsequent survey targeting the non-native curly leaf pondweed (*Potamogetan crispus*) was conducted in May 2018. Twenty-three aquatic plant species were found in Silver Lake (Table 1), with the greatest diversity located near groundwater inflow areas along the north side of the west basin. Aquatic mosses and filamentous algae were also noted. In 2017, the most common plant species was Eurasian water-milfoil (*Myriophyllum spicatum*) which occurred at 73% of sites. Coontail (*Ceratophyllum demersum)* at 41% of sites and largeleaf pondweed (*Potamogeton amplifolius*) at 39% of sites were also prevalent plant species. During the July 2017

survey, 82% (113 of 138) of the sample sites had vegetative growth. Dense vegetative growth occurred in patchy beds throughout the lake.

Eurasian watermilfoil (EWM) was documented Silver Lake in 1994 and was found in abundance during the July 2018 survey (Figure 2). Hybrid Eurasian watermilfoil (HWM) was confirmed in 2012. Curly-leaf pondweed (CLP) was also documented in Silver Lake in 1994. A special survey for CLP in May 2018 found numerous patches, some were quite dense (Figure 3).

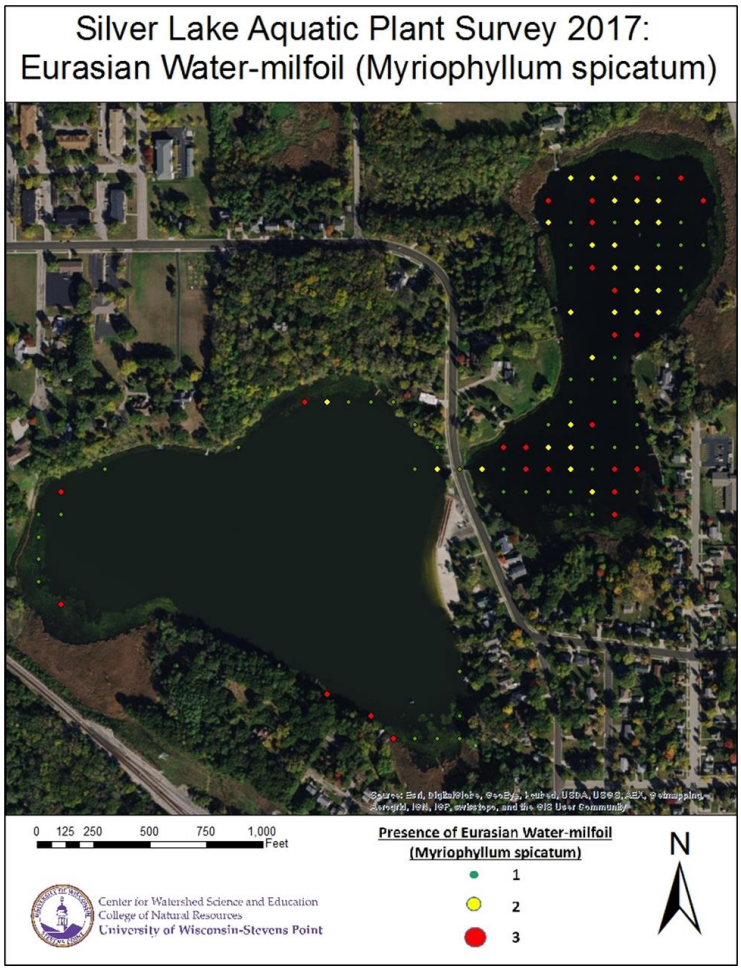


Figure 2. Eurasian watermilfoil in Silver Lake, July 2017.

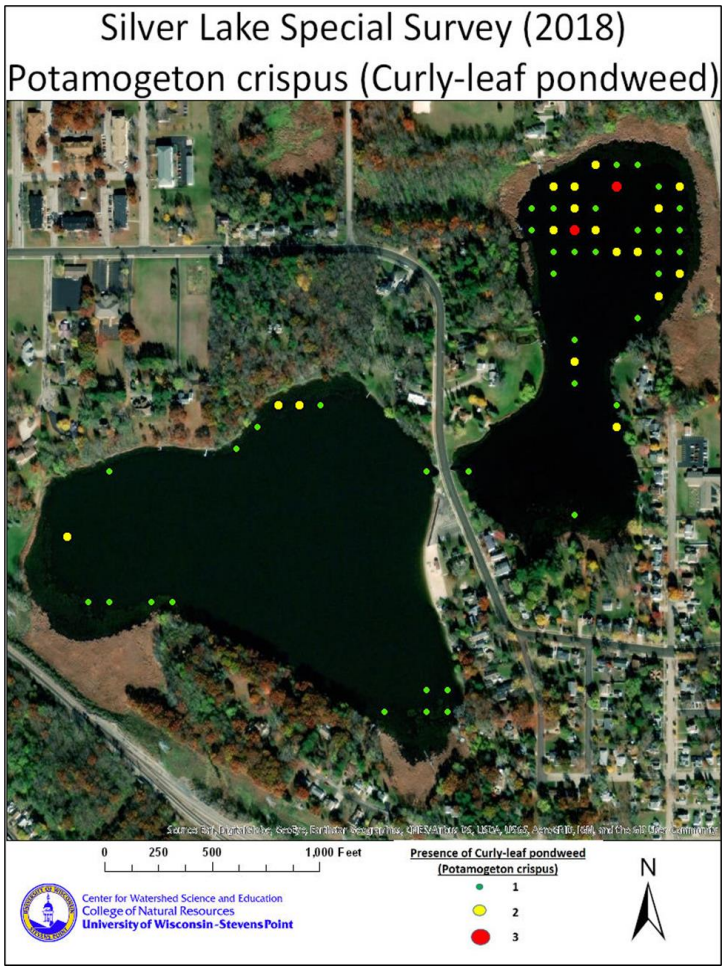
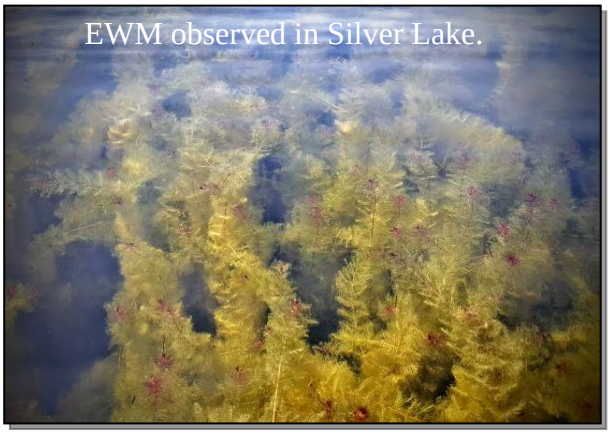


Figure 3. Curly-leaf pondweed in Silver Lake, May 2018.

During the development of this plan, committee members indicated many nuisance areas of aquatic plant and algae growth, which have impeded some recreational activities and reduced their enjoyment of the lake. Beds of EWM are the primary causes of recreational limitations in this lake.


EWM observed in Silver Lake.

For more details on the aquatic plant community of Silver Lake, see the 2018 Aquatic Macrophyte Survey of Silver Lake or the 2019 Silver Lake Study Report.

Table 1. List of aquatic plants identified in 1996, 2002, 2006 and 2017aquatic plant surveys of Silver Lake.

Scientific Name	Common Name	1996 Survey	2002 Survey	2006 Survey	2017 Survey
Brasenia schreberi	Watershield	x	x	x	
Ceratophyllum demersum	Coontail	x	x	x	x
Chara spp.	Muskgrasses	x		x	x
Elodea canadensis	Common waterweed	x	x	x	x
Elodea nuttallii	Slender waterweed				x
Heteranthera dubia	Water star-grass			x	x
Lemna minor	Small duckweed	x	x	x	
Lemna trisulca	Star duckweed			x	
Myriophyllum sibiricum	Northern watermilfoil				x
Myriophyllum spicatum	Eurasian watermilfoil	x	x	x	x
Najas flexilis	Slender naiad	x			x
Najas guadalupensis	Southern naiad		x		x
Nitella spp.	Stoneworts				x
Nuphar lutea	Yellow pond lily	x	x	x	
Nymphaea odorata	White water lily	x	x	x	x
Potamogeton amplifolius	Large-leaf pondweed		x	x	x
Potamogeton crispus	Curly-leaf pondweed	x	x	x	x
Potamogeton foliosus	Leafy pondweed	x			x
Potamogeton friesii	Fries' pondweed				x
Potamogeton gramineus	Variable pondweed				x
Potamogeton illinoensis	Illinois pondweed		x		x
Potamogeton natans	Floating-leaf pondweed				x
Potamogeton perfoliatus	Clasping-leaf pondweed		x		
Potamogeton praelongus	White-stem pondweed	x			x
Potamogeton pusillus	Small pondweed				x
Potamogeton strictifolius	Stiff pondweed				x
Potamogeton zosteriformis	Flat-stem pondweed				x
Schoenoplectus acutus	Hardstem bulrush		x	x	
Stuckenia pectinata	Sago pondweed		x	x	x
Vallisneria americana	Water celery				x

Aquatic Plant Management Plan

Management strategies in Silver Lake were designed to achieve a balance between healthy aquatic habitat, good water quality, and recreation. With a permit from the Wisconsin Department of Natural Resources, aquatic plant management may occur in areas of the lake exhibiting heavy aquatic plant and/or algae growth that restricts boating and other recreational activities. A variety of management options were discussed during the development of this plan, some of which were rejected due to the nature of the lake.

At least every 5 years, the state of the aquatic plants should be assessed. The results of the assessment (point-intercept survey, special CLP survey, etc.) should be reviewed by the City of Portage (committee) with assistance from the WDNR Lake Manager, Columbia County LCD, and/or a consultant. Based on conditions, the strategy for the renewed 5-year permit should be developed. A strategy may include one or more of the following options. Some of the options require a permit from the Wisconsin Department of Natural Resources.

Manual removal, target species: EWM/HWM, CLP, other Aquatic Invasive Species (AIS)

Manual removal is focused on limited areas. A permit is not required to remove AIS. This is commonly conducted by individual waterfront property owners that are trained in identification and removal of and remove EWM and other aquatic invasive species can remove those plants manually any time of year, without a permit. Trained divers can be hired to manually remove EWM/HWM in deeper parts of the lake in areas less than 1 acre. This is most effective as a follow-up to chemical treatments, where EWM/HWM presence is spotty.

Individuals may hand-pull aquatic plants (invasive or native) near their property for the purpose of clearing a channel for access adjacent to their dock (thirty feet or less) without a permit. Any hand-pulled aquatic plants should be removed from the water and composted away from the lake. These property owners should monitor cleared areas for AIS.

Option: Provide a pick-up service for hand-pulled plants from docks with the harvester.

Herbicide Treatment, target species: EWM/HWM and CLP

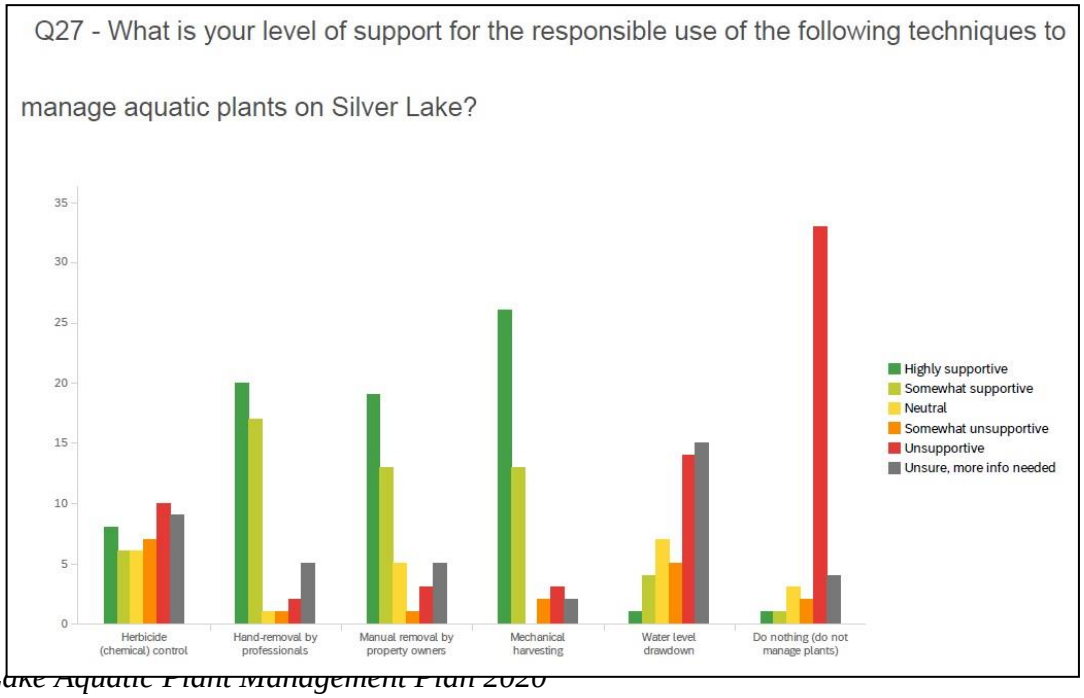
An annual permit is required. Each lake is different and its response to control of EWM/HWM may differ from lake to lake. No single approach will be appropriate for all lakes. Often multiple approaches and adaptive year-to-year changes in approach are most successful. The population of EWM/HWM should be evaluated using a 'point-intercept' method (accompanied by more thorough observations) before and after chemical treatments to determine the effectiveness of an approach in a given year. Strategies for the subsequent year should be adjusted accordingly. EWM/HWM management involves evolving scientific knowledge; therefore the management strategies for the management of EWM/HWM in Silver Lake should be adapted as EWM/HWM populations in the lake change and as new information becomes available.

Results of recent studies of the effectiveness of chemical spot treatment suggest the treatment is less effective than previously thought and may actually promote chemically resistant forms of HWM. However, chemical spot treatments may still be appropriate in certain conditions to control EWM/HWM in the future. The use of herbicides to control aquatic invasive species is an evolving science. While herbicides can have immediate effect on the target plant species, there can be unanticipated effects on other species. Over the long-term, success to manage or eliminate the target species often relies on integrated management approaches. AIS species such as EWM/HWM are best if treated early in the growing season, typically before June 1, when water temperatures are below 60 F to minimize the impacts of the herbicides on native plants, which often emerge later in the growing season. Balancing eradication of invasive species with the survival and flourishing of native species is essential to long-term success.

While there are approximately 300 herbicides registered for use on land in the United States, only 13 can be applied into or near aquatic systems. All herbicides must be applied according to the US EPA approved label rate and requires a permit if "you are standing in socks and they get wet." The toxicity tests that are conducted are related to specific effects such as carcinogenicity. Even those that have been tested may consequences to the aquatic ecosystem that have not yet been identified.

Herbicides can be divided into two main categories: contact herbicides that cause extensive cellular damage upon contact and systemic herbicides that act slower, often by speeding up cellular division. Systemic herbicides are taken up by the plant and transported throughout the entire plant, often resulting in complete mortality. Successful control of the target plant is achieved when it is exposed to a lethal concentration of the herbicide for a sufficient amount of time.

Herbicides are applied directly to the water, either as a liquid or an encapsulated granular formation. Factors such as water depth, water flow, treatment area size, retention time, lake stratification, and plant density play a role in herbicide concentration. Application rates and exposure times are important considerations for aquatic herbicides. Herbicide costs vary greatly between about $400 and $1,500 per acre depending on the chemical used, who applies it, permitting procedures, and the size of the treatment area.



The target population should be evaluated with an aquatic plant survey using the WDNR's 'point-intercept' methods before and after treatments to quantify the effectiveness of an approach in a given year. This information should guide subsequent management such as manual removal.

Plan: A lake user and property owner survey conducted in 2019-2020 during development of the lake's comprehensive plan indicated little support for herbicide use in Silver Lake. Additionally, the death and decay of plant material will release a large slug of nutrient into the system and made available to algae and additional aquatic plants, potentially exacerbating the problem. With the average summer total phosphorus concentrations in Silver Lake approaching the lake's phosphorus standard of 30 ug/L already, it could have disastrous effects.

Mechanical Harvesting, target species: CLP, overly dense native plants

A permit is required. Benefits of mechanically harvesting aquatic plants include the removal of nutrients and oxygen-demanding plant material from the lake system; and the temporary recreational relief from dense aquatic plant beds and filamentous algae. Harvesting may have negative effects on native aquatic plants that provide valuable habitat. Harvesting in depths less than 3 feet should be avoided to minimize impact on habitat and to reduce sediment disturbance. Because EWM/HWM is already so ubiquitous in Silver Lake, these beds should be targeted to remove this biomass.

CLP should be harvested in May when the plants develop turions. Though not often a navigational impediment yet, removing the plants at this stage will limit their ability to reproduce in the subsequent year in addition to removing the biomass from the system.

Dense beds of native aquatic plants should be harvested as needed to provide navigation and help balance predator/prey relationships in the summer.

Plan: With a WDNR permit, harvesting in Silver Lake may be conducted in depths of water greater than three feet up as needed to maintain navigational and habitat lanes. A second pass with the harvester should be run on harvested areas to remove plant fragments and floaters. Based on the lake bathymetry, these areas are shown on the map in **Error! Reference source not found.4**. Planned routes and lane widths for the harvester are indicated in Figure 5. Additional lanes to provide access to individual piers will be cut as needed. It is recommended that the harvesting equipment have a depth finder with the transducer mounted on the cutting end to ensure that cutting is occurring at least 2 feet from the lake's bottom (Table 2). The calculated area of harvesting is shown in Table 3. A geo-referenced bathymetric map (provided to the city) should be loaded into the depth finder for orientation. All harvested material will be tallied and disposed of at the city's compost site at the municipal airport.

1. Aquatic plant harvesting will be done to cut a 48' main channel half the depth of the water column in a 'Figure 8'.
2. Aquatic plant harvesting will be done to cut a 24' long channels connecting to the 48' main channel at half the depth of the water column. This provides fishing predator allies for fishing and more access.
3. Skim cuts allowed inside 'Figure 8' at a depth not greater than 1' in a water column.

Situations in which harvesting may occur:

1. Removal of CLP.

2. Nuisance aquatic plant beds and/or filamentous algae significantly impede recreation and/or adversely impact predator/prey relationships.

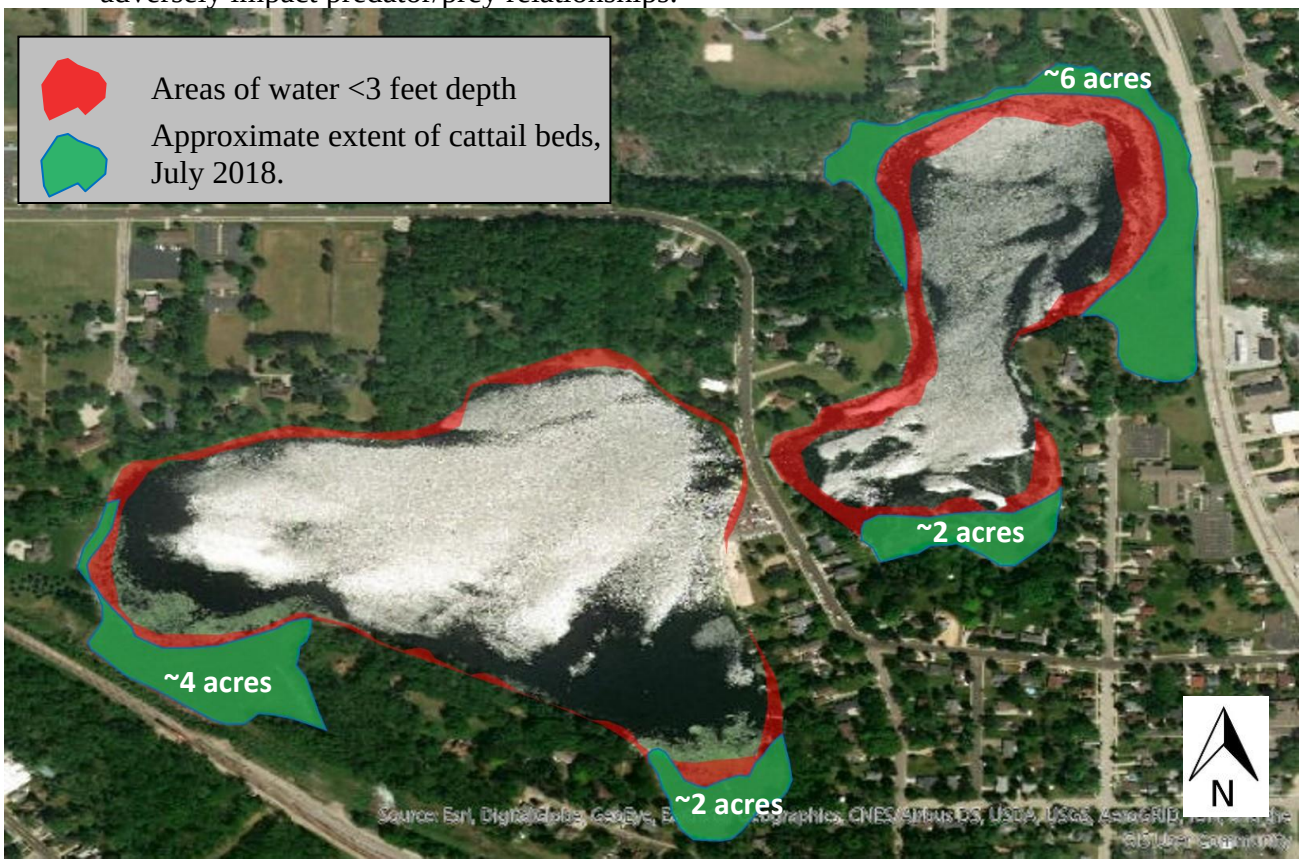


Figure 4. Areas <3 feet depth and cattail beds in Silver Lake, 2018.

Figure 5. Planned harvester routes and lane widths in Silver Lake.

Depth of Water	Maximum Cutting Depth	Resulting Plant Height	Limiting Factor
1.0	No Mechanical Cutting. Hand pulling along docks allowed on 30% of frontage, not to exceed 30’of shoreline	1.0	Water Depth
2.0		2.0	Water Depth
2.5		2.5	Water Depth
3.0		3.0	Water Depth
3.5	1.5’	2.0	2’ from lake bed
4.0	2.0	2.0	2’ from lake bed and 50% of water column
5.0	2.5	2.5	2’ from lake bed and 50% of water column
6.0 and greater	3.0	3.0	2’ from lake bed and 50% of water column

Table 2. Planned cutting depths in Silver Lake.

Area of Lateral Cutting Chart

Table 3. Planned harvested area in Silver Lake.

	Length (ft)	12' wide	18' wide	24' wide
Segment 1	330	0.09	0.14	0.18
Segment 2	424	0.12	0.18	0.23
Segment 3	430	0.12	0.18	0.24
Segment 4	345	0.10	0.14	0.19
Segment 5	210	0.06	0.09	0.12
Segment 6	187	0.05	0.08	0.10
Segment 7	374	0.10	0.15	0.21
Segment 8	541	0.15	0.22	0.30
Total		0.78	1.17	1.57
		48' wide	**72' wide**	**96' wide**
"Figure 8"	4000	4.41	6.61	8.82
Total Cutting Acreage		5.97		
% of East Basin		0.27		

Weevils

Milfoil weevils (*Euhrychiopsis lecontei*) are insects that are native to some Wisconsin lakes; they feed on both the native northern watermilfoil and the invasive EWM/HWM. They require nearby unmowed shoreline vegetation to overwinter and survive. Milfoil weevils are not commercially available so obtaining a starter population and rearing them in a predator-free conditions is necessary to enhance the size of the population that is released into the lake. Professional assistance should be sought if stocking or a survey of the existing population in Silver Lake is pursued.

Plan: Have a survey conducted to establish if weevils are present in Silver Lake and if so, establish their abundance. Consider the use of weevils for keeping EWM/HWM in balance in the following circumstances:

a. Shallow water less than three feet in depth where harvesting is not occurring;
b. Areas not affected by chemical treatments;
c. Primarily minimally disturbed/ unmowed shoreline;
d. Areas of concentrated EWM/HWM.

Aquatic Plant Management Plan Review

A good aquatic plant management plan strategy should reduce the amount of management activity that is needed, as time goes on. In Silver Lake, a succession of successful strategies should lead to a balance between healthy aquatic habitat, water quality and recreation with minimal annual management. To evaluate if management strategies are making progress, updates to aquatic plant point-intercept surveys should be conducted at least every five years. If chemical treatments are pursued, more frequent (pre and post treatment) surveys are necessary. Work with the Aquatic Plant Specialist with the Wisconsin Department of Natural Resources and a consultant to update surveys.

Tracking historical conditions, changes in the lake, and how those changes have affected current conditions is very important to the development of management strategies for the lake. Progress or change that occurs due to management activities documented in a plan, aquatic plant surveys, and updates to both will support future strategic decision-making. This aquatic plant management plan was developed in conjunction with a lake management plan. The following documents contain additional information about aquatic plants and other aspect of the lake.

Silver Lake Management Plan (2020).
Silver Lake Management Plan. 2020. Center for Watershed Science and Education. UW-Stevens Point. Report to City of Portage, Columbia County and WDNR.

Aquatic Plant Survey for Silver Lake, Columbia County (2018)
Haney, Ryan. 2018. *Aquatic Macrophyte Survey of Silver Lake*. University of Wisconsin-Stevens Point. Report to City of Portage, Columbia County and WDNR.