

Lake Water Quality Program

Environmental Planning Initiatives



Whitewater Lake 2021 Aquatic Vegetation Mapping Report

City of Greater Sudbury, 2026

Overview

The City of Greater Sudbury is home to over 330 freshwater lakes, more than any other municipality in Canada. Many of these lakes are used by residents and visitors for recreational boating, swimming, fishing, and other activities. Historical smelting operations and the subsequent acidification of the surrounding landscapes including local lakes within the Greater Sudbury area caused the decline of aquatic plant and animal species in many of these lakes. The Sudbury landscape has undergone a massive transformation since the mid 1970's with industry improvements to reduce Sulphur dioxide emissions coupled with extensive greening efforts including liming and planting efforts that have had a positive impact on local waterways. Local lakes now host a healthy number of different aquatic plant and animal species.

Plants and plant-like organisms living in lakes and rivers are often separated into two categories: aquatic macrophytes and phytoplankton. Macrophytes are 'large' plants (at least visible to the naked eye) that can be emergent (leaves and stems occur mostly above the water surface), submergent (plant occurs under the surface), or floating. Phytoplankton are a varied collection of microscopic organisms that photosynthesize like plants and form the foundation of aquatic food webs. Although some are considered true plants, many others are bacteria or protists, which are not true plants.

In recent decades, aquatic invaders have been identified in some Sudbury area lakes including the invasive macrophyte Eurasian Watermilfoil (*Myriophyllum spicatum*). The City's Lake Water Quality Program has conducted educational and awareness campaigns for several years on the challenges associated with aquatic invasive species. These efforts continue to expand and now include such initiatives as the mapping of macrophytes on specific lakes. Vegetation mapping of some local lakes began in 2014 and was revised in 2017 to follow a more rigorous and robust sampling protocol to map all macrophyte species, including the invasive Eurasian Watermilfoil. To date, macrophyte mapping has been completed for McCharles Lake, Minnow Lake, Richard Lake, and Robinson Lake. These initial maps serve as baselines from which to assess change in macrophyte species composition, densities, and extent over time. Copies of these reports are available on the City's Lake Water Quality Program webpage.

Several macrophyte assessments have also been conducted on Whitewater Lake over the past century. Although no maps were generated, these historical surveys provide valuable insight into the lake's aquatic macrophyte community and highlight changes over a relatively long period. The first documented list of aquatic macrophyte species in Whitewater Lake was published in 1913 by G.R. Mickle and R.B. Thomson who were researching potential aquatic food sources for ducks in Northern Ontario by examining the content of duck gizzards (Mickle & Thomson, 1913). In 1947, aquatic and shoreline plant species on Whitewater Lake were collected and catalogued at the request of the Department of Lands and Forests of the Province of Ontario, now the Ministry of Natural Resources (Soper, 1948). Thirty years later (1977), a follow-up survey of select locations on the lake was conducted to assess changes in the aquatic macrophyte community (Dale & Miller, 1978).

These historical surveys provided the basis for undertaking a follow-up aquatic macrophyte survey of Whitewater Lake by the City of Greater Sudbury in 2021. This report provides the results of the survey and a comparison of the current aquatic macrophyte community to those found in 1947 and 1977.

Lake Description

Whitewater Lake is situated in Rayside, Snider and Creighton townships, near the town of Azilda. The lake has an area of 949.1 hectares, a shoreline perimeter of 29.5 kilometers and a maximum depth of 11 meters (see Figure 1 below). The lake has two distinct areas: a more uniformly shallow eastern bay is separated from a deeper western bay by a narrow, ~380m wide, channel. Shoreline development is most prevalent along the northern and eastern shore of the eastern bay. Development of the western bay is sparse and mainly focused along the northern shore.

Throughout the past century the lake has experienced a shift in its surrounding land use, from agriculturally dominated land use in the 1940's to a more residentially dominated land use in the 1970's with the expansion of Azilda. These land use changes are evident on aerial imagery from the 1940's, 1970's and 2020's (Figures 1 to 4).

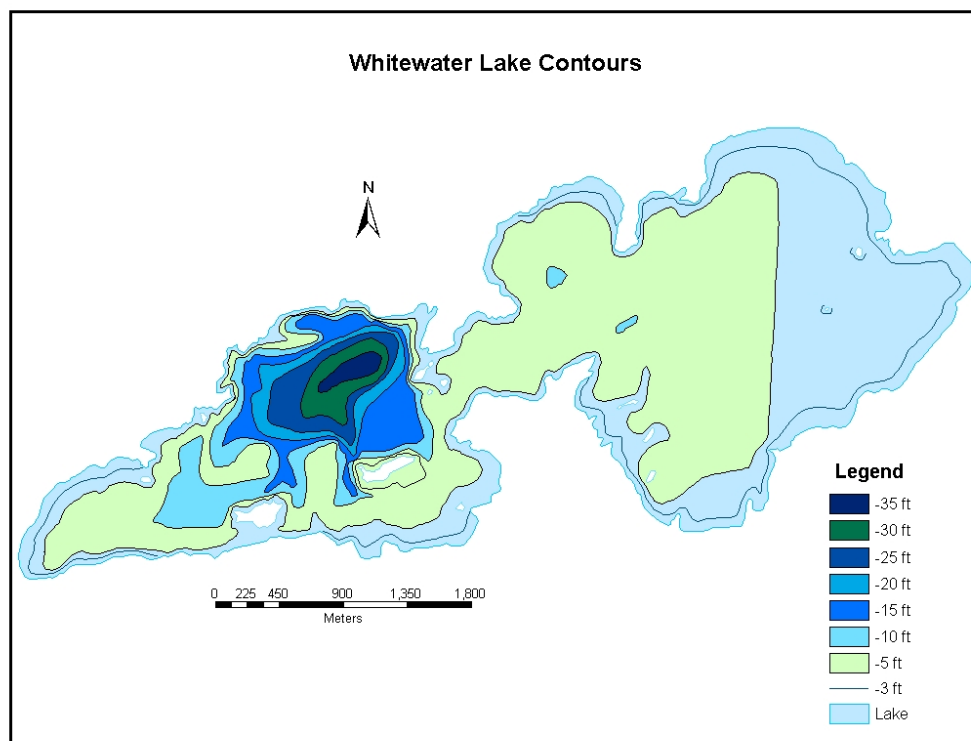


Figure 1. Whitewater Lake Contour Map. City of Greater Sudbury.



Figure 2. Aerial photograph of a portion of Whitewater Lake from 1946. City of Greater Sudbury Aerial Photography App.



Figure 3. Aerial photograph of a portion of Whitewater Lake from 1975 (City of Greater Sudbury).

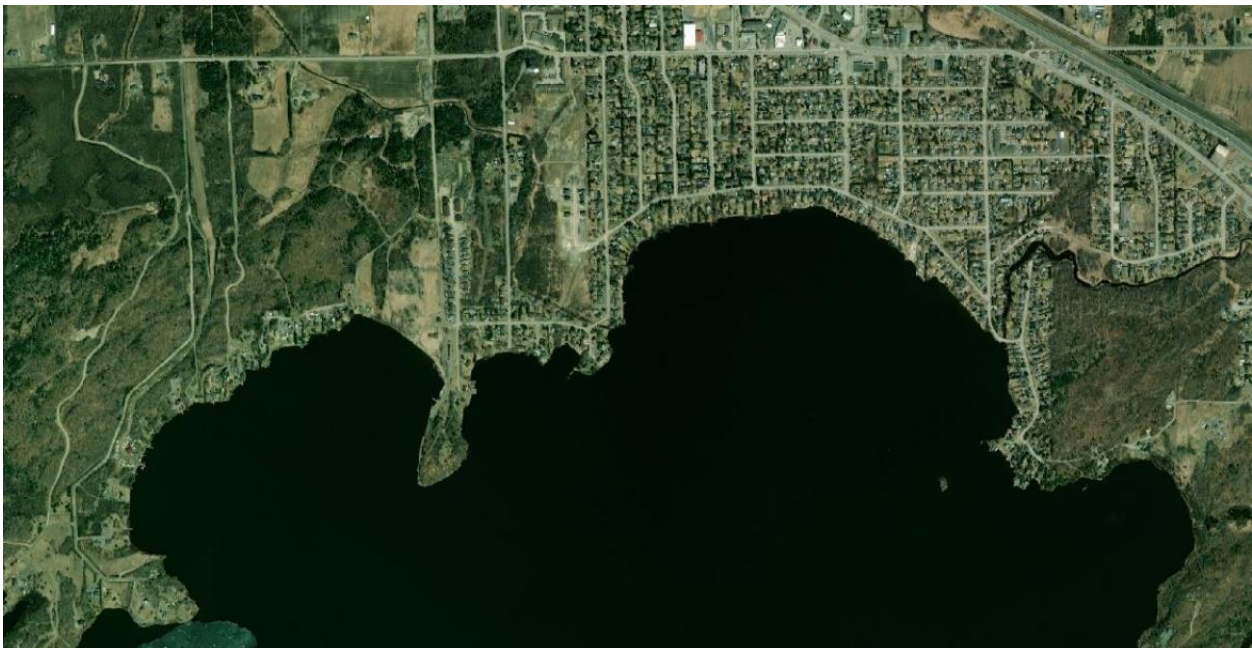


Figure 4. Aerial photograph of Whitewater Lake north-eastern shoreline from 2019 (City of Greater Sudbury).

The development and urbanization of the surrounding land has also included the creation of a public boat launch and public beach in the eastern bay along Wahamma St N. This boat launch has made it much easier to access the lake for recreational activities for residents and visitors participating in fishing, boating, and swimming. The lake is popular in both summer and winter for open water and ice fishing. The lake has a float plane base; take-offs and landings occur several times a day on the lake.

The City of Greater Sudbury has been sampling Whitewater Lake as part of its Lake Water Quality Program since 2001 to monitor changes in nutrient levels within the lake. Between 2001 and 2025, Whitewater Lake had an average spring total phosphorus concentration of 15.22 µg/L (Figure 4), which places it in the mesotrophic category in terms of productivity level. Like most lakes on the Canadian Shield, phosphorus is the limiting nutrient for aquatic plant growth in Whitewater Lake. Mesotrophic lakes generally have moderate nutrient levels, lower water clarity and warmer temperatures, all features exhibited by Whitewater Lake and ideal conditions for growth of aquatic macrophytes.

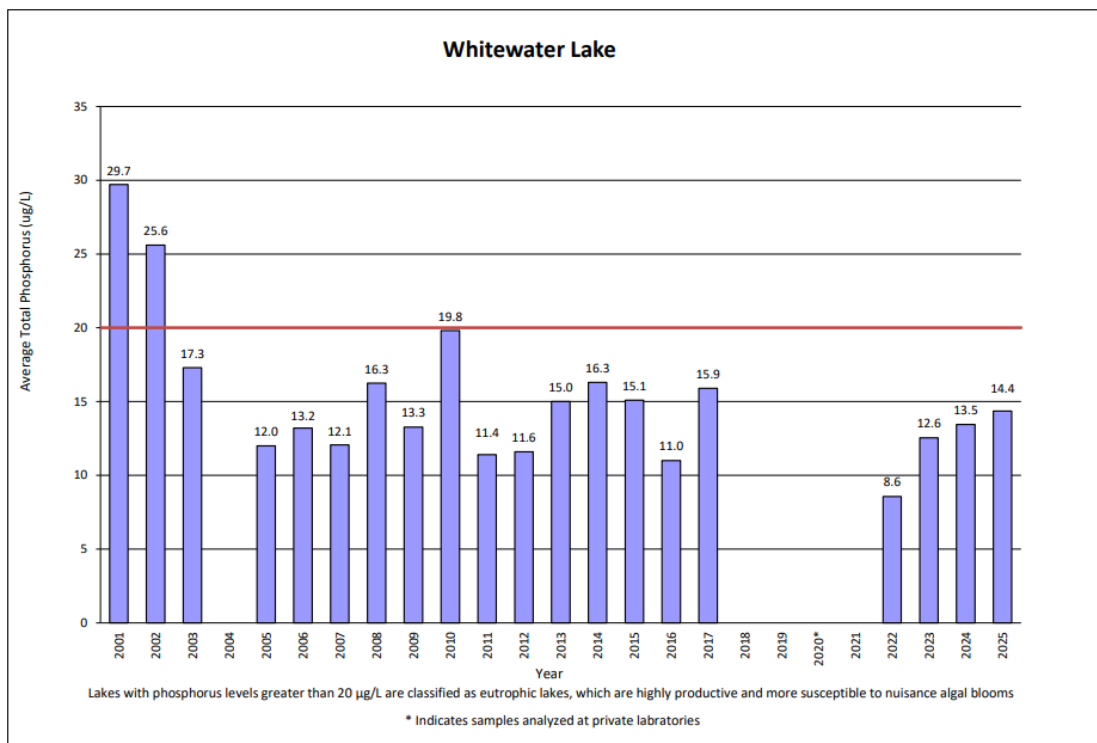


Figure 4. Whitewater Lake spring total phosphorus sampling results. All sampling undertaken by the City of Greater Sudbury Lake Water Quality Program.

Past Experiments and Research

Study reports on Whitewater Lake published over the past century were consulted for this report. All scientific names referred to in this report have been updated to the most up-to date nomenclature available through the Integrated Taxonomic Information System, ITIS, as of February 2021.

The first recorded experiment on Whitewater Lake was the introduction of Wild Celery (*Vallisneria americana*)^[1] in 1909 as a valuable food source for waterfowl (Mickle & Thomson, 1913). Roughly half a bushel of seed pods was collected from Lake Erie and Lake Ontario to be spread in Whitewater Lake. The seed pods were wrapped in balls of clay and dropped into the water at depths of approximately four feet. This introduction of *Vallisneria americana* was done for two more years with two bushels of pods in 1910 and about three bushels in 1911. The plant rapidly spread throughout the lake, most likely through wind action. Soper's 1948 report also noted that efforts to introduce Wild Rice (*Zizania aquatica*), Sago Pondweed (*Stuckenia pectinata*) and Coontail (*Ceratophyllum demersum*) into the lake were conducted but no records of these efforts are available (Soper, 1948).

In 1912, Mickle and Thomson assessed waterfowl food supply in Whitewater Lake. This work included the identification of aquatic macrophytes within the lake both by way of a visual survey for common food species for ducks and by examining the gizzards of various ducks found feeding on Whitewater Lake. Five aquatic macrophyte species were identified: *Vallisneria americana* (reported under the name *Vallisneria spiralis*), *Potamogeton natans*, *Potamogeton gramineus* (reported under the name *Potamogeton heterophyllus*), *Potamogeton richardsonii* (reported under the name *Potamogeton perfoliatus*), and *Myriophyllum sp.* *Lemna minor* from Grenadier Pond near Toronto was brought to Sudbury in May 1912 to spread in "drowned lands" and by September of that year had spread up to 1 mile upstream from where it was originally spread, although it's if the species had spread near Whitewater Lake (Mickle and Thomson, 1913). Although the findings of Mickle and Thomson did not result in an exhaustive list of aquatic plants present within Whitewater Lake in 1912, they do provide valuable insight into some of the aquatic plant species present within the lake during this period in Sudbury's history.

The first significant effort to comprehensively record aquatic macrophyte species in Whitewater Lake occurred in 1947 at the request of the Department of Lands and Forest of the Province of Ontario (Soper, 1948). Whitewater Lake had been experiencing a decline in the numbers of wild ducks visiting the lake and the survey was intended to assess the lake's aquatic vegetation as a possible cause of waterfowl decline due to lack of suitable food and shelter. This survey consisted of identifying vegetation around the lake, near the shoreline, its islands and recording descriptions, relative locations, and habitat. A total of 58 aquatic and shoreland species were identified, of which 30 are considered submergent or emergent aquatic macrophytes. A list of all species recorded by Soper can be found in Appendix C.

Dale and Miller (1978) conducted a follow-up study in 1977 to assess changes in the aquatic macrophyte community in Whitewater Lake between 1947 and 1977. Their survey was more systematic than Soper's and involved 23 sampling sites across Whitewater Lake using divers to identify and quantify the abundance of each species at each site.

Of the 23 sites, 19 were sampled from the shoreline out to a maximum depth of 2 meters with a maximum distance of 20 meters to the boat. Three of the sampling sites were considered deep-water sites, with water depths greater than 2 meters, and all aquatic vegetation within 5 meters of the boat was surveyed at these sites. A single site was also recorded as a special case where swimming was prohibited. Each species was given a cover rating and totaled to give an abundance value for each species. This survey recorded a total of 27 submergent and floating species within Whitewater Lake along with their frequency and relative abundance. Survey results (see Results section below) were compared to the Soper report by extrapolating the descriptions given by Soper into relative abundance ratings.

These previous studies provide valuable insight into changes in Whitewater Lake's aquatic macrophyte community over the past century and helped inform and guide the City of Greater Sudbury's 2021 survey.

Methodology

The City of Greater Sudbury's Lake Water Quality Program conducted aquatic macrophyte surveys on several local lakes in 2014 and has since expanded on these initial surveys beginning in 2017 to establish a baseline of the distribution and extent of the invasive Eurasian Watermilfoil (*Myriophyllum spicatum*) and its influence on the lakes' native aquatic plants. The survey technique was adapted from the baseline monitoring protocol developed by the Wisconsin Department of Natural Resources (Hauxwell et al, 2010). This protocol was modified to suit the needs and constraints of the Lake Water Quality Program. Using a point-intercept sampling design, the 23 sites established by Dale and Miller in 1977 were geo-referenced by the City of Greater Sudbury. Each site was sampled using the rake toss method, which involves tossing a double-tined thatching rake head attached to a rope into the water within approximately 5m of the boat. Once the rake reached the lake bottom it was retrieved and photos were taken of each rake before the vegetation was removed for identification. Species were then identified, with any new species placed in a plant press for future reference. For plants that were unable to be identified in the field, photos and measurements were taken along with the pressed sample to be used for future identification. The rake toss was repeated three times per sampling site. Once all rake tosses were completed, a relative abundance for each species present was recorded. The abundance levels used were as follows: Most Abundant, Abundant, Common, Occasional, and Rare.

Due to the nature of aquatic macrophytes and their growth forms some of the species were not able to be fully identified during field visits but were pressed for future identification. These pressed specimens were brought to the Laurentian University Herbarium and were identified using various keys (e.g., Crow & Hellquist, 2000, Voss & Reznicek, 2012) and cross referenced with preserved specimens at the Herbarium. The collection of pressings made by Soper in 1947 and Dale and Miller in 1977 were not available for cross reference.

In addition to the 23 sampling sites selected, a survey of three additional shoreline locations was also conducted to help identify other species that may be growing in or near the lake edges but may not have been present at the 23 sampling locations. Two of these locations included mostly naturalized

areas with no development and the third was located near the public boat launch and beach area. A list of UTM coordinates and a map of the sampling locations can be found in Appendix A of this report.

Results

Through the 2021 survey, a total of 21 aquatic macrophyte species were identified at the 23 open water sampling sites on Whitewater Lake. The three additional shoreline areas sampled resulted in an additional six aquatic species identified for a total of 27 species found to be present in 2021. Only six of the species recorded during the 1947 and 1977 surveys and considered to be submerged or floating aquatic macrophyte species by Dale & Miller, were not found during the 2021 survey. These six species, including survey years in which they were recorded, are *Eleocharis acicularis* (1947 & 1977), *Glyceria borealis* (1947 & 1977), *Potamogeton foliosus* (1947), *Potamogeton praelongus* (1947 & 1977), *Potamogeton pusillus ssp tenuissimus* (1977) and *Stuckenia pectinata* (1947 & 1977).

Of the 27 total submerged or floating aquatic species identified through the 2021 survey, 3 were not recorded in previous surveys. These species are *Elodea canadensis* (present at 6 sampling sites), *Myriophyllum spicatum* (present at 2 sampling sites), and one or more species of Charophytes, likely *Chara* spp. (present at 12 sampling sites).

Table 1 details the frequency for all species found at the 23 sampling sites on Whitewater Lake during the 1977 survey and 2021 survey. Species found at the additional 3 shoreline locations surveyed in 2021 are also noted in the table. The frequency of species found in the 1947 survey is not available as the report only reported on presence of species within the lake with short descriptions of the abundance for each species found. Results from Mickle & Thomson's 1913 report can be found in Table 2.

The 2021 survey recorded abundance for each species present at each site rated as Most Abundant, Abundant, Common, Occasional, or Rare. There were 4 species recorded as Most Abundant at one or more sites, 10 species as Abundant, 11 species as Common, 14 species as Occasional and 15 species as Rare, see Table 3 below. A full list of species found at each of the 23 sampling sites in 2021, along with abundance values for each species can be found in Appendix B of this report.

Table 1. Frequency of floating and submersed species from 23 sites in Whitewater Lake between 1977 and 2021 including presence/absence from 1947

Common Name	Scientific Name (2021)	1947 Presence/Absence	1977 Frequency	2021 Frequency
Wild Celery	<i>Vallisneria americana</i>	Present	13	20
Slender Pondweed	<i>Potamogeton pusillus</i>	Present	*	17
Bushy Pondweed	<i>Najas flexilis</i>	Present	12	16
Muskgrass	<i>Chara spp.</i>	Absent	*	12
Water Star Grass	<i>Heteranthera dubia</i>	Present	17	10
Quillwort	<i>Isoetes echinospora</i>	Present	13	9
Northern Watermilfoil	<i>Myriophyllum sibiricum</i>	Present	2	9
Slender Watermilfoil	<i>Myriophyllum tenellum</i>	Absent	3	8
Canada Waterweed	<i>Elodea canadensis</i>	Absent	*	6
Clasping-leaf Pondweed	<i>Potamogeton richardsonii</i>	Present	21	5
Water Moss	<i>Drepanocladus aduncus</i>	Present	9	4
Pipewort	<i>Eriocaulon aquaticum</i>	Present	3	4
Water Marigold	<i>Bidens beckii</i>	Present	*	3
Eurasian Watermilfoil	<i>Myriophyllum spicatum</i>	Absent	*	2
Variable Pondweed	<i>Potamogeton gramineus</i>	Present	2	2
Water Crowfoot	<i>Ranunculus aquatilis var. diffusus</i>	Present	2	2
Small Watermilfoil	<i>Myriophyllum alterniflorum</i>	Present	11	1
Floating-leaf Bur Reed	<i>Sparganium angustifolium</i>	Present	4	1
Fine-leaf Pondweed	<i>Stuckenia filiformis ssp. filiformis</i>	Present	1	1
Large-leaf Pondweed	<i>Potamogeton amplifolius</i>	Present	2	1
Floating-leaf Pondweed	<i>Potamogeton natans</i>	Present	3	1
Pickeral Weed	<i>Pontederia cordata</i>	Present	13	**
Yellow Water Lily	<i>Nuphar variegata</i>	Present	11	**
Floating-leafed Arrowhead	<i>Sagittaria cuneata</i>	Present	8	**
Small Yellow Water Lily	<i>Nuphar microphylla</i>	Present	4	**
White Water Lily	<i>Nymphaea odorata</i>	Present	1	**
Lesser Duckweed	<i>Lemna minor</i>	Present	*	**
Needle Rush	<i>Eleocharis acicularis</i>	Present	15	*
Sago Pondweed	<i>Stuckenia pectinata</i>	Present	12	*
Manna Grass	<i>Glyceria borealis</i>	Present	7	*
Narrow-leafed Pondweed	<i>Potamogeton pusillus ssp. tenuissimus</i>	Absent	5	*
Whitestem Pondweed	<i>Potamogeton praelongus</i>	Present	2	*
Leafy Pondweed	<i>Potamogeton foliosus</i>	Present	*	*

* Not found

** Found at other locations around lake

Table 2. Aquatic macrophyte species found in duck gizzard on Whitewater Lake in 1912 (Mickle & Thomson, 1913).

Common Name	Scientific Name (2021)
Wild Celery	<i>Vallisneria americana</i>
Floating Pondweed	<i>Potamogeton natans</i>
Various-leaved Pondweed	<i>Potamogeton gramineus</i>
Clasping-leaved Pondweed	<i>Potamogeton richardsonii</i>
Water Milfoil	<i>Myriophyllum sp.</i>

Table 3. List of species and abundance ratings sorted by most frequent to least frequent species.

Species Name	Abundance Count				
	Most Abundant	Abundant	Common	Occasional	Rare
<i>Vallisneria americana</i>	0	1	8	8	3
<i>Potamogeton pusillus</i>	4	1	3	4	5
<i>Najas flexilis</i>	0	3	3	7	3
<i>Chara spp.</i>	6	3	0	2	1
<i>Heteranthera dubia</i>	1	4	4	0	1
<i>Isoetes echinospora</i>	0	1	3	2	3
<i>Myriophyllum sibiricum</i>	0	0	0	1	8
<i>Myriophyllum tenellum</i>	0	1	2	4	1
<i>Elodea canadensis</i>	0	0	0	3	3
<i>Potamogeton richardsonii</i>	0	0	1	1	3
<i>Drepanocladus aduncus</i>	0	0	2	1	1
<i>Eriocaulon aquaticum</i>	0	0	0	3	1
<i>Bidens beckii</i>	0	1	1	1	0
<i>Myriophyllum spicatum</i>	0	0	2	0	0
<i>Potamogeton gramineus</i>	0	0	1	1	0
<i>Ranunculus aquatilis</i>	1	0	0	0	1
<i>Myriophyllum alteriflorum</i>	0	1	0	0	0
<i>Potamogeton amplifolius</i>	0	0	0	1	0
<i>Potamogeton natans</i>	0	0	0	0	1
<i>Sparganium angustifolium</i>	0	1	0	0	0
<i>Stuckenia filiformis</i>	0	0	0	0	1

Discussion

Previous surveys of Whitewater Lake conducted in 1947 and 1977 along with the most recent 2021 survey were completed using different survey techniques. The 1947 survey consisted of visually assessing and recording the species found around the shoreline areas of the entire lake and transects across the open water of the lake. The 1977 survey was more systematic, selecting sampling locations and surveying from these points all the way to the shore in roughly a 20m zone around the boat using divers to visually assess the plants below water. The 2021 survey sampled the same 23 sampling sites used in 1977 but used the simpler triple rake-toss method rather than divers.

Due to the differences in assessment techniques between the 1947, 1977 and 2021 surveys, it is difficult to quantify the actual changes in abundance of each species within the lake. Dale and Miller (1978) attempted to quantify the changes in abundance between their 1977 survey and the survey conducted by Soper in 1947 by estimating abundance values based on descriptions written by Soper. They found that in 1977 there were 4 new species identified, an increase in abundance in 5 species, a decrease in abundance in 15 species, no notable change in 2 species and the apparent extirpation of 6 species. In 2021, the abundance of each species at each of the 23 sites was recorded but it is difficult to extrapolate these results to quantify the abundance level for each species within the lake. Full details of the 2021 survey results, including species abundance of each site can be found in Appendix B.

Despite the differences in survey techniques between the studies, insight into temporal changes in the macrophyte community on Whitewater Lake was gained by comparing the frequency of each species found within the lake and the total species richness. The 2021 survey found species richness at sampling sites ranged between 1-13 species, with an average species richness of 5.74 (\pm 3.14). Soper recorded 58 species, including subspecies and forms, within and along the shorelines of Whitewater Lake. Of the species identified by Soper, 30 were considered as aquatic macrophyte species by Dale & Miller (1978). Dale & Miller recorded 26 aquatic species within the lake during their 1977 survey. In 2021 there were 27 aquatic species identified at the 23 sampling locations and 3 shoreline sites. These values demonstrate that the lake has not seen a dramatic change in the overall species richness within the lake since 1947.

There have been some notable changes in individual species populations when comparing the 1947, 1977 and 2021 survey results. The 2021 survey found a notable decrease in frequency for several species within the lake between 1977 and 2021, including *Myriophyllum alterniflorum*, *Nuphar variegata*, and *Potamogeton richardsonii*. Of the species not found in 2021, the most notable is *Stuckenia pectina* which was described as the second most common plant in the lake by Soper in 1947 and was rated as common by Dale & Miller and being present at 12 of 23 sites in 1977.

Eleocharis acicularis and *Glyceria borealis* were both present in previous surveys in 1947 and 1977 but were not recorded at any of the 23 open water locations or at the three shoreline locations in 2021. Both species prefer conditions ranging from shallow water to moist shoreline soil, so were not expected at the open water locations. These species may still be present in Whitewater Lake but were not observed during the 2021 survey.

Potamogeton richardsonii is another species which declined in both frequency of occurrence and abundance since 1947. *Potamogeton richardsonii* was identified at only 5 of the 23 sampling sites during the 2021 survey compared with Soper (1948) who found it to be the most abundant species in Whitewater Lake during the 1947 survey. Dale & Miller also noted that *Potamogeton richardsonii* was the most frequent species during the 1977 survey noting its presence at 21 sampling locations along with rating it with the highest abundance value of all species recorded.

One of the most notable species to not be found in 2021 was *Stuckenia pectinata* which was considered the second most abundant species during the 1947 survey and an important food source for waterfowl. There was a noted decline in *Stuckenia pectinata* in 1977 being found at 12 of the 23 sampling sites and its abundance rated by Dale & Miller as common. This decline of this species may be influenced by the presence of Charophytes, which were not noted in any prior survey of Whitewater Lake.

Charophytes appear to be new aquatic plants in the lake and are considered Most Abundant or Abundant at 75% of the sites at which it occurred. Charophytes such as *Chara* spp. are not an aquatic macrophyte but rather macroscopic green algae that form dense mats/colonies at the lake bottom (Wehr & Sheath, 2003). Charophytes are known to be important in freshwater ecosystems as they are primary producers and can assist in preserving water clarity (Rey-Boisseux & Joye, 2015). The Charophytes found within Whitewater Lake lacked any carbonate deposits commonly found on many *Chara* species, but had the characteristic skunky/garlic musk scent also typical of these species. *Nitella* species are similar but do not produce carbonate deposits but also lack any discernible scent. These findings suggest that the Charophyte species found in Whitewater Lake are all *Chara* spp. but further sampling and identification would be required to confirm the exact Charophyte species found. While Charophytes are not noted in any previous surveys, these may not have been included as they are not considered aquatic macrophyte species. Some research has shown that *Chara* growth can have a negative effect on *Stuckenia pectinata* growth under high light conditions and high bicarbonate concentrations (Hidding et al, 2010). In a study of the Heron Lake system in Minnesota it was found that *Stuckenia pectinata* biomass was limited by water light availability with maximum biomass being inversely related to water clarity during early plant growth (Wersal et al, 2006). Although Whitewater Lake likely has low bicarbonate levels as it is on the Canadian Shield, the lake is relatively shallow allowing light to penetrate the water column down to the substrate especially in the shallow eastern bay. This may explain the apparent decline and disappearance of *Stuckenia pectinata* from Whitewater Lake although further sampling or experiments would need to be conducted to verify this hypothesis.

Potamogeton pusillus was described by Soper (1948) to be abundant in 1947 at depths greater than six feet (2m) but was not found by Dale and Miller (1978) during the 1977 survey. Dale and Miller noted that “*Potamogeton pusillus* L. was probably the deep-water pondweed that we identified as *Potamogeton berchtoldii* Fieber. It is present although its abundance has decreased significantly” (Dale and Miller, 1978). According to the most up-to-date consensus through the Integrated Taxonomic Information System, ITIS, *P. berchtoldii* has had its taxonomy updated to *Potamogeton pusillus* ssp *tenuissimus*, which is the name retained for this report. The characteristics of this subspecies can be extremely difficult to distinguish between vegetative specimens of *P. pusillus* and *P. foliosus*, especially in the absence of stipules and glands at the base of its leaves (Voss and Reznicek, 2012). The presence of glands on *P. foliosus* seems inconsistent and an unreliable identifier as described by Voss and Reznicek

(2012). The collections from 1947 and 1977 were not available to City staff for cross reference during identification so it not possible to compare the samples taken that were identified as *P. pusillus* (1947), *P. foliosus* (1947) and *P. pusillus ssp. tenuissimus* (1977) with the specimens collected during the 2021 surveys. The varying presence and absence of each of these three species between 1947, 1977 and 2021 surveys and the difficulty in distinguishing between each has caused some uncertainty in past identifications so it may be best to treat these three species as a singular group of similar species.

Vallisneria americana was the most frequently found species during the 2021 survey, a species originally introduced to Whitewater Lake in 1909. This species has since flourished in the lake providing an important food source for waterfowl and habitat for fish (Catling *et al.* 1994). This species was described as “exceedingly abundant” by Soper in 1947 while it was only rated as common, being present at 13 of the 23 sampling sites, when surveyed by Dale & Miller in 1977. The 2021 surveys found that this species to be the most frequently found species within the lake, found at 20 of the 23 open water sites. *Vallisneria americana* was considered Abundant at 1 site, Common at 8 sites, Occasional at 8 sites and Rare at 3 sites during the 2021 survey. Abundance ratings were based on the vegetation that had attached to the rake during the three rake tosses at each site. *Vallisneria americana* has long, flat, thin leaves which can be difficult to capture between the tines of the sampling rake, which may have influenced the abundance values as only the vegetation on the rake was taken into consideration when determining abundance values. The high frequency of this species within the lake is evidence to its success since being introduced into the lake in 1909.

Myriophyllum spicatum is an aggressive invader of many freshwater lakes throughout Ontario including in Greater Sudbury with 18 local lakes currently reported to have this species present within its water. Despite this species ability to spread rapidly through fragmentation in lakes where it is present, Whitewater Lake has quite low distribution and abundance of this invasive macrophyte. *Myriophyllum spicatum* was only found at two sampling locations growing amongst other macrophytes. In addition to the vegetation collected at the sampling sites and the aquatic vegetation found at the near shore sites during this study, staff also conducted a general visual survey of the lakes eastern and western bays. This survey noted an abundance of aquatic plant growth found throughout the lake especially prevalent in the eastern bay with vegetation growing up to ~1m below the surface. The visual surveys did not note any significant stands of *Myriophyllum spicatum* within the lake. The lack of significant monoculture stands of this invasive species may be due to the abundance of native aquatic species which may be out-competing *Myriophyllum spicatum* and preventing it from spreading as aggressively as other local lakes.

Conclusion

Results of the 2021 Whitewater Lake aquatic vegetation survey provides insight into the changes in the aquatic macrophyte community within the lake over the past century. Overall, Whitewater Lake displays high species richness and has only experienced a slight decline in richness throughout the past century from 30 submergent and emergent species found in 1947 to 27 species found in 2021. There have been some notable changes in the aquatic plant community over the course of the past century. *Vallisneria americana*, a species introduced into the lake in the early 1900’s as a food source for waterfowl has now

become the most frequent species within the lake. Other species, however, such as *Potamogeton richardsonii* and *Stuckenia pectinata*, have decreased dramatically or have disappeared from the lake altogether.

Further surveys and studies may be needed to fully understand the changes in the aquatic plant community in Whitewater Lake and to understand the implications of these changes. The surveys completed in 1947, 1977 and 2021 provide a rich baseline dataset that can be used as reference for future scientific studies of Whitewater Lake.

Notes

[1] Mickle & Thomson identified wild celery, reported as *Vallisneria spiralis*, as one of the most important food supplies for ducks within their 1913 report. The authors identified wild celery as being non-native to northern Ontario. The first report of the introduction of *Vallisneria spiralis* into Whitewater Lake was in 1909 using bushels of seedpods from Lake Erie.

Vallisneria spiralis is native to southern Europe and Eurasia and is considered an invasive species in North America with only a single occurrence being reported in British Columbia in 1994. (Warrington, 1994) This occurrence in British Columbia is now considered to be incorrect and *Vallisneria americana* to be the species present (Government of British Columbia, 2009). Soper also identified the species as *Vallisneria americana* within the 1948 report.

It can be concluded that the species introduced into Whitewater Lake in 1909 was likely misidentified and is in fact *Vallisneria americana*.

Citations

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Appendix A

2021 UTM Locations

Sample Site	Zone	Easting	Northing
1	17T	487399.190	5152050.118
2	17T	487017.681	5151939.992
3	17T	485831.859	5152175.976
4	17T	486506.382	5151914.427
5	17T	486760.065	5152706.941
6	17T	488415.889	5151938.025
7	17T	491477.788	5154502.390
8	17T	489174.973	5154185.777
9	17T	488929.156	5153835.734
10	17T	489668.574	5153078.617
11	17T	490126.777	5152120.913
12	17T	491405.026	5152905.561
13	17T	491021.551	5154148.413
14	17T	492063.816	5153456.192
15	17T	489764.934	5154221.175
16	17T	489226.103	5152994.056
17	17T	489029.449	5153241.839
18	17T	488797.398	5153464.058
19	17T	488378.525	5153521.088
20	17T	487707.936	5153507.322
21	17T	488050.113	5152496.522
22	17T	488883.925	5152376.563
23	17T	488258.566	5152317.567

Appendix B

2021 Sampling Results

Site	Species Scientific Name	Abundance	Site	Species Scientific Name	Abundance
1	<i>Heteranthera dubia</i>	Abundant	12	<i>Heteranthera dubia</i>	Abundant
1	<i>Najas flexilis</i>	Occasional	12	<i>Potamogeton pusillus</i>	Abundant
1	<i>Drepanocladus aduncus</i>	Occasional	12	<i>Najas flexilis</i>	Occasional
1	<i>Isoetes echinospora</i>	Common	12	<i>Vallisneria americana</i>	Occasional
1	<i>Chara spp</i>	Rare	12	<i>Myriophyllum sibiricum</i>	Rare
1	<i>Potamogeton pusillus</i>	Rare	12	<i>Isoetes echinospora</i>	Rare
1	<i>Vallisneria americana</i>	Common	13	<i>Heteranthera dubia</i>	Abundant
2	<i>Sparganium angustifolium</i>	Abundant	13	<i>Potamogeton pusillus</i>	Most Abundant
2	<i>Drepanocladus aduncus</i>	Common	13	<i>Vallisneria americana</i>	Occasional
2	<i>Stuckenis filiformis</i>	Rare	14	<i>Chara spp</i>	Most abundant
2	<i>Myriophyllum sibiricum</i>	Rare	14	<i>Vallisneria americana</i>	Occasional
2	<i>Vallisneria americana</i>	Occasional	14	<i>Najas flexilis</i>	Occasional
2	<i>Potamogeton pusillus</i>	Rare	14	<i>Isoetes echinospora</i>	Occasional
2	<i>Najas flexilis</i>	Rare	14	<i>Myriophyllum sibiricum</i>	Occasional
3	<i>Chara spp</i>	Most abundant	14	<i>Potamogeton pusillus</i>	Occasional
3	<i>Potamogeton amplifolius</i>	Occasional	14	<i>Bidens beckii</i>	Occasional
3	<i>Najas flexilis</i>	Abundant	14	<i>Myriophyllum tenellum</i>	Occasional
3	<i>Vallisneria americana</i>	Common	14	<i>Eriocaulon aquaticum</i>	Occasional
3	<i>Potamogeton richardsonii</i>	Rare	15	<i>Potamogeton richardsonii</i>	Occasional
3	<i>Myriophyllum tenellum</i>	Abundant	15	<i>Vallisneria americana</i>	Common
3	<i>Potamogeton pusillus</i>	Occasional	15	<i>Ranunculus aquatilis</i>	Most Abundant
4	<i>Chara spp</i>	Most abundant	15	<i>Elodea canadensis</i>	Occasional
4	<i>Najas flexilis</i>	Abundant	15	<i>Heteranthera dubia</i>	Common
4	<i>Elodea canadensis</i>	Rare	15	<i>Myriophyllum spicatum</i>	Common
5	<i>Vallisneria americana</i>	Common	15	<i>Najas flexilis</i>	Common
5	<i>Potamogeton pusillus</i>	Most Abundant	15	<i>Eriocaulon aquaticum</i>	Occasional
5	<i>Potamogeton richardsonii</i>	Rare	15	<i>Chara spp</i>	Occasional
5	<i>Myriophyllum spicatum</i>	Common	15	<i>Isoetes echinospora</i>	Occasional
6	<i>Drepanocladus aduncus</i>	Common	15	<i>Potamogeton gramineus</i>	Common
6	<i>Myriophyllum tenellum</i>	Common	15	<i>Myriophyllum tenellum</i>	Occasional
6	<i>Isoetes echinospora</i>	Common	15	<i>Elodea canadensis</i>	Occasional
6	<i>Najas flexilis</i>	Occasional	16	<i>Isoetes echinospora</i>	Abundant
6	<i>Vallisneria americana</i>	Rare	16	<i>Potamogeton pusillus</i>	Common
6	<i>Potamogeton pusillus</i>	Common	16	<i>Najas flexilis</i>	Occasional
7	<i>Heteranthera dubia</i>	Most abundant	16	<i>Elodea canadensis</i>	Rare
7	<i>Vallisneria americana</i>	Common	16	<i>Vallisneria americana</i>	Occasional
8	<i>Heteranthera dubia</i>	Abundant	16	<i>Myriophyllum tenellum</i>	Occasional

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8	<i>Vallisneria americana</i>	Abundant	16	<i>Myriophyllum sibiricum</i>	Rare
8	<i>Potamogeton richardsonii</i>	Rare	17	<i>Vallisneria americana</i>	Common
8	<i>Potamogeton pusillus</i>	Rare	17	<i>Chara spp</i>	Most Abundant
9	<i>Chara spp</i>	Abundant	17	<i>Potamogeton richardsonii</i>	Common
9	<i>Najas flexilis</i>	Common	17	<i>Potamogeton pusillus</i>	Occasional
9	<i>Myriophyllum alteriflorum</i>	Abundant	17	<i>Myriophyllum sibiricum</i>	Rare
9	<i>Potamogeton pusillus</i>	Occasional	17	<i>Elodea canadensis</i>	Rare
9	<i>Heteranthera dubia</i>	Rare	17	<i>Heteranthera dubia</i>	Common
9	<i>Myriophyllum sibiricum</i>	Rare	18	<i>Chara spp</i>	Occasional
9	<i>Isoetes echinospora</i>	Rare	18	<i>Heteranthera dubia</i>	Common
9	<i>Eriocaulon aquaticum</i>	Rare	18	<i>Vallisneria americana</i>	Common
9	<i>Vallisneria americana</i>	Rare	18	<i>Myriophyllum sibiricum</i>	Rare
9	<i>Myriophyllum tenellum</i>	Rare	18	<i>Isoetes echinospora</i>	Common
9	<i>Potamogeton natan</i>	Rare	18	<i>Najas flexilis</i>	Rare
9	<i>Ranunculus aquatilis</i>	Rare	18	<i>Potamogeton pusillus</i>	Common
10	<i>Vallisneria americana</i>	Occasional	18	<i>Drepanocladus aduncus</i>	Rare
10	<i>Bidens beckii</i>	Common	19	<i>Vallisneria americana</i>	Rare
10	<i>Najas flexilis</i>	Common	19	<i>Isoetes echinospora</i>	Rare
10	<i>Eriocaulon aquaticum</i>	Occasional	19	<i>Najas flexilis</i>	Rare
10	<i>Chara spp</i>	Abundant	20	<i>Potamogeton pusillus</i>	Rare
10	<i>Myriophyllum tenellum</i>	Common	21	<i>Potamogeton pusillus</i>	Most Abundant
10	<i>Myriophyllum sibiricum</i>	Rare	21	<i>Vallisneria americana</i>	Occasional
10	<i>Potamogeton gramineus</i>	Occasional	21	<i>Najas flexilis</i>	Occasional
11	<i>Najas flexilis</i>	Abundant	22	<i>Chara spp</i>	Most Abundant
11	<i>Vallisneria americana</i>	Occasional	22	<i>Potamogeton pusillus</i>	Rare
11	<i>Potamogeton Pusillus</i>	Most Abundant	23	<i>Chara spp</i>	Most Abundant
11	<i>Myriophyllum tenellum</i>	Occasional	23	<i>Vallisneria americana</i>	Common
11	<i>Chara spp</i>	Abundant	23	<i>Heteranthera dubia</i>	Common
11	<i>Myriophyllum sibiricum</i>	Rare	23	<i>Elodea canadensis</i>	Occasional
			23	<i>Najas flexilis</i>	Occasional

Appendix C

Species Recorded in Whitewater Lake by J.H Soper (1948)

	Scientific Name*	Updated Scientific Name**	Common Name***
1	<i>Acorus calamus</i>	<i>Acorus calamus</i>	Sweet Flag
2	<i>Alisma subcordatum</i>	<i>Alisma subcordatum</i>	Water Plantain
3	<i>Calamagrostis canadensis</i>	<i>Calamagrostis canadensis</i>	Bluejoint
4	<i>Carex retrorsa</i>	<i>Carex retrorsa</i>	No common name recorded
5	<i>Carex rostrata</i>	<i>Carex rostrata</i>	No common name recorded
6	<i>Drepanocladus aduncus</i> var. <i>typicus</i>	<i>Drepanocladus aduncus</i>	Water-moss var.
7	<i>Eleocharis palustris</i> var. <i>major</i>	<i>Eleocharis palustris</i>	Giant Creeping Spike-rush
8	<i>Equisetum fluviatile</i>	<i>Equisetum fluviatile</i>	Water Horsetail
9	<i>Equisetum fluviatile</i> forma <i>Linnaeanum</i>	<i>Equisetum fluviatile</i>	Water Horsetail
10	<i>Eriocaulon septangulare</i>	<i>Eriocaulon aquaticum</i>	Pipewort
11	<i>Galium palustre</i>	<i>Galium palustre</i>	Bedstraw
12	<i>Glyceria borealis</i>	<i>Glyceria borealis</i>	Manna Grass
13	<i>Heteranthera dubia</i>	<i>Heteranthera dubia</i>	Water Star-grass
14	<i>Isoetes braunii</i>	<i>Isoetes echinospora</i>	Quillwort
15	<i>Lemna minor</i>	<i>Lemna minor</i>	Duckweed
16	<i>Lysimachia terrestris</i>	<i>Lysimachia terrestris</i>	Swamp-candle
17	<i>Megalodonta beckii</i>	<i>Bidens beckii</i>	Water Marigold
18	<i>Mentha arvensis</i> var. <i>villosa</i> forma <i>glabrata</i>	<i>Mentha arvensis</i>	Mint
19	<i>Mimulus ringens</i>	<i>Mimulus ringens</i>	Monkey-flower
20	<i>Myriophyllum alterniflorum</i> var. <i>americanum</i>	<i>Myriophyllum alterniflorum</i>	Small Water-milfoil
21	<i>Myriophyllum exalbescens</i>	<i>Myriophyllum sibiricum</i>	Water-milfoil
22	<i>Najas flexilis</i>	<i>Najas flexilis</i>	Bushy Pondweed
23	<i>Nuphar microphyllum</i>	<i>Nuphar microphylla</i>	Yellow Waterlily
24	<i>Nuphar rubrodiscum</i>	<i>Nuphar X rubrodisca</i>	No common name recorded
25	<i>Nuphar variegatum</i>	<i>Nuphar variegata</i>	No common name recorded
26	<i>Nymphaea odorata</i>	<i>Nymphaea odorata</i>	Waterlily
27	<i>Nymphoides cordatum</i>	<i>Nymphoides cordata</i>	Floating Heart
28	<i>Potamogeton amplifolius</i>	<i>Potamogeton amplifolius</i>	Large-leaf Pondweed
29	<i>Potamogeton foliosus</i>	<i>Potamogeton foliosus</i>	Leafy Pondweed
30	<i>Potamogeton foliosus</i> var. <i>macellus</i>	<i>Potamogeton foliosus</i> ssp. <i>foliosus</i>	Leafy Pondweed var.
31	<i>Potamogeton gramineus</i> var. <i>graminifolius</i> forma <i>myriophyllum</i>	<i>Potamogeton gramineus</i>	Variable Pondweed
32	<i>Potamogeton natans</i>	<i>Potamogeton natans</i>	Floating-lead Pondweed
33	<i>Potamogeton pectinatus</i>	<i>Stuckenia pectinata</i>	Sago Pondweed
34	<i>Potamogeton praelongus</i>	<i>Potamogeton praelongus</i>	Whitstem Pondweed

35	<i>Potamogeton pusillus</i>	<i>Potamogeton pusillus</i>	No common name recorded
36	<i>Potamogeton richardsonii</i>	<i>Potamogeton richardsonii</i>	Clasping-lead Pondweed
37	<i>Pontederia cordata</i>	<i>Pontederia cordata</i>	Pickerel-weed
38	<i>Potentilla palustris</i>	<i>Comarum palustre</i>	Marsh Cinquefoil
39	<i>Polygonum natans</i>	<i>Persicaria amphibia</i>	Water Smartweed
40	<i>Ranunculus reptans</i>	<i>Ranunculus flammula var. reptans</i>	Creeping Spearwort
41	<i>Ranunculus trichophyllus var. calvescens</i>	<i>Ranunculus aquatilis var. diffusus</i>	Water Crowfoot
42	<i>Sagittaria brevirostra</i>	<i>Sagittaria brevirostra</i>	Arrowhead
43	<i>Sagittaria cuneata</i>	<i>Sagittaria cuneata</i>	No common name recorded
44	<i>Sagittaria latifolia forma gracilis</i>	<i>Sagittaria latifolia</i>	Duck Potato
45	<i>Sagittaria latifolia forma obtusa</i>	<i>Sagittaria latifolia</i>	Duck Potato
46	<i>Scirpus acutus</i>	<i>Schoenoplectus acutus var. acutus</i>	Hardstem Bulrush
47	<i>Scirpus cyperinus var pelius</i>	<i>Scirpus cyperinus</i>	No common name recorded
48	<i>Scirpus fluviatilis</i>	<i>Bolboschoenus fluviatilis</i>	River Bulrush
49	<i>Scirpus microcarpus var rubrotinctus</i>	<i>Scirpus microcarpus</i>	No common name recorded
50	<i>Scirpus validus</i>	<i>Schoenoplectus tabernaemontani</i>	Softstem Bulrush
51	<i>Scutellaria epilobiifolia</i>	<i>Scutellaria galericulata</i>	Skullcap
52	<i>Sium Suave</i>	<i>Sium Suave</i>	Water Parsnip
53	<i>Sparganium chlorocarpum</i>	<i>Sparganium emersum</i>	Bur-reed
54	<i>Sparganium eurycarpum</i>	<i>Sparganium eurycarpum</i>	Giant Bur-reed
55	<i>Sparganium fluctuans</i>	<i>Sparganium fluctuans</i>	Floating-leaf Bur-reed
56	<i>Typha latifolia</i>	<i>Typha latifolia</i>	Cat-tail
57	<i>Vallisneria americana</i>	<i>Vallisneria americana</i>	Wild Celery
58	<i>Zizania aquatica var angustifolia</i>	<i>Zizania palustris var. palustris</i>	Wild Rice

*Scientific names as recorded by Soper, 1948

**Updated Scientific names using the Integrated Taxonomic Information System

***Common name as described by Soper, 1948