Aquatic Vegetation of Lake Alexander
Morrison County, Minnesota
(DOW 49-0079-00)
June 29, 30 and July 1 and 7, 2004

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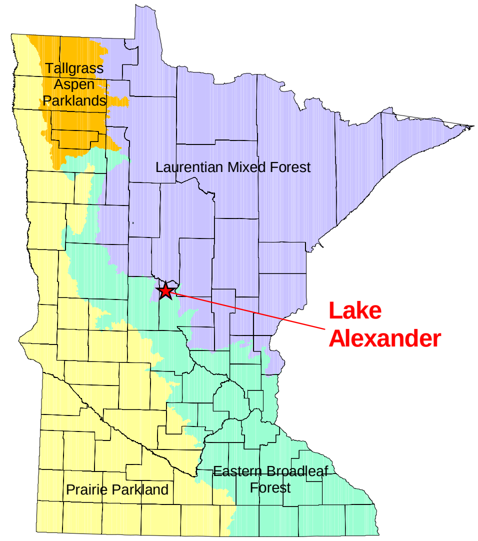
Summary

An aquatic vegetation survey of Lake Alexander (49-0079-00), Morrison County, Minnesota, was conducted on June 29, 30, July 1 and July 7, 2004. Thirty-two native aquatic plant species were identified, making Lake Alexander among the richest lake plant communities in the state. Plants were found distributed throughout the lake basin to a maximum depth of twenty-four feet, although most vegetation occurred in depths less than 16 feet. Most plant species were restricted to water depths from shore to ten feet deep and the shore to five feet depth zone contained the highest number of species. A non-native species, curly-leaf pondweed *(Potamogeton crispus)* was the most frequently occurring plant (found in 30% of the sample sites), followed by coontail (*Ceratophyllum demersum*)(24%), flat-stem pondweed (*Potamogeton zosteriformis*) (18%), star duckweed *(Lemna triscula)* (16%) and muskgrass *(Chara sp.)* (14%). All other plants occurred in eight percent or less of the sites surveyed. The non-native, Eurasian watermilfoil *(Myriophyllum spicatum)*, confirmed present in 2003, was found only on the eastern shoreline.

Introduction

Survey Lake Description
Lake Alexander (DOW 49-0079-00) is located eight miles north of the City of Randall in Morrison County, Minnesota. It occurs within an ecological region known as the Laurentian Mixed Forest Province (Fig. 1).

Figure 1. Location of Lake Alexander, Morrison Co, MN (49-0079-00)



Lake Alexander lies in the northeastern end of the Long Prairie River Watershed. Flow leaves the west side of Lake Alexander through Thoroughfare Creek into Fishtrap Lake, then northwest through Fishtrap Creek and into the Long Prairie River which drains the watershed to the northeast (Fig. 2). The non-native plant, curly-leaf pondweed (*Potamogeton crispus*) has been recorded in most of the lakes in this watershed (Fig. 2) but as of 2005, Lake Alexander is the only lake in the watershed where the non-native plant, Eurasian watermilfoil (*Myriophyllum spicatum)* has been documented.

Figure 2. Location of Lake Alexander (Morrison Co) in Long Prairie River Watershed.

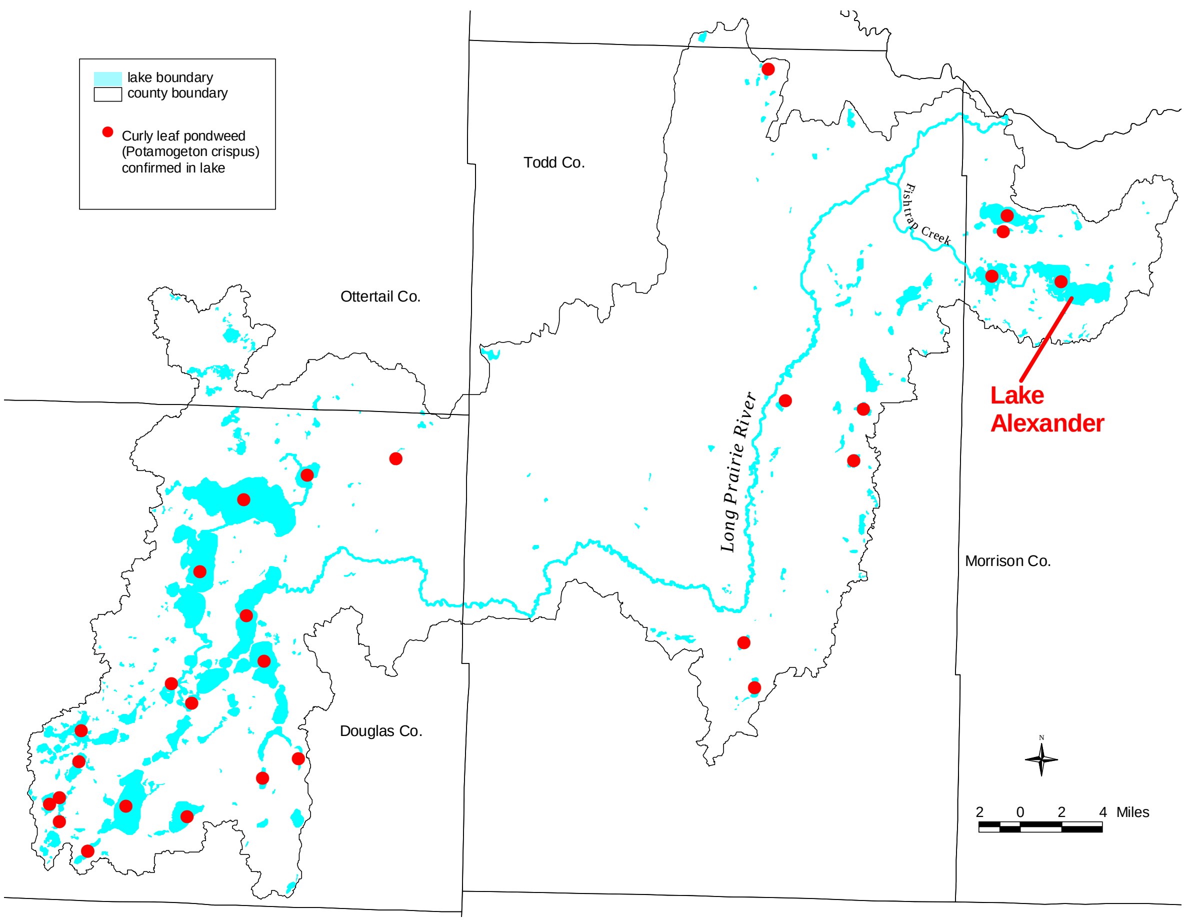
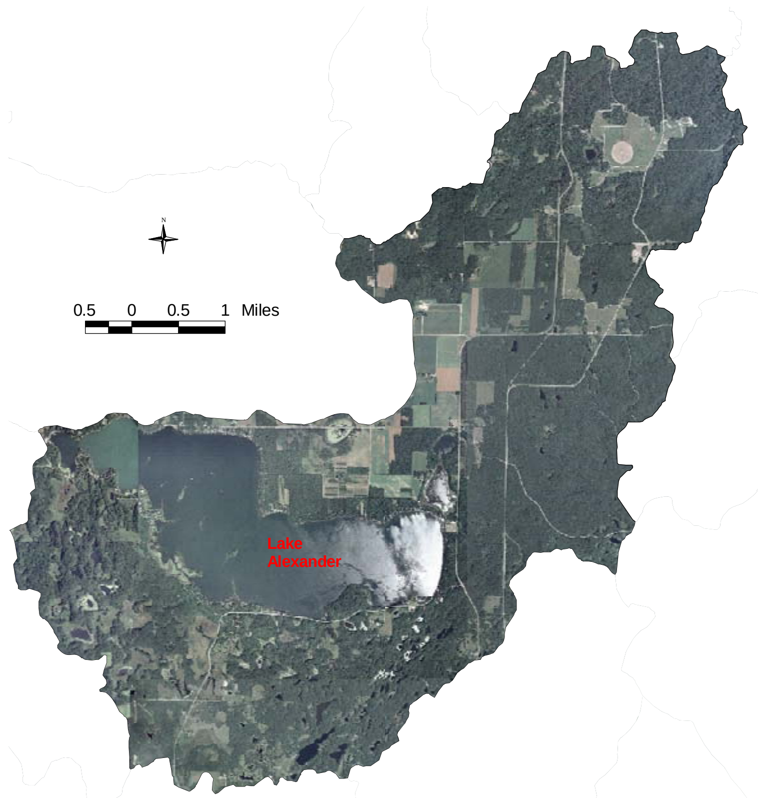


Figure 3. Landuse within subwatershed containing Lake Alexander, Morrison Co. (49-0079-00). Source: Farm Service Admin. 2003.

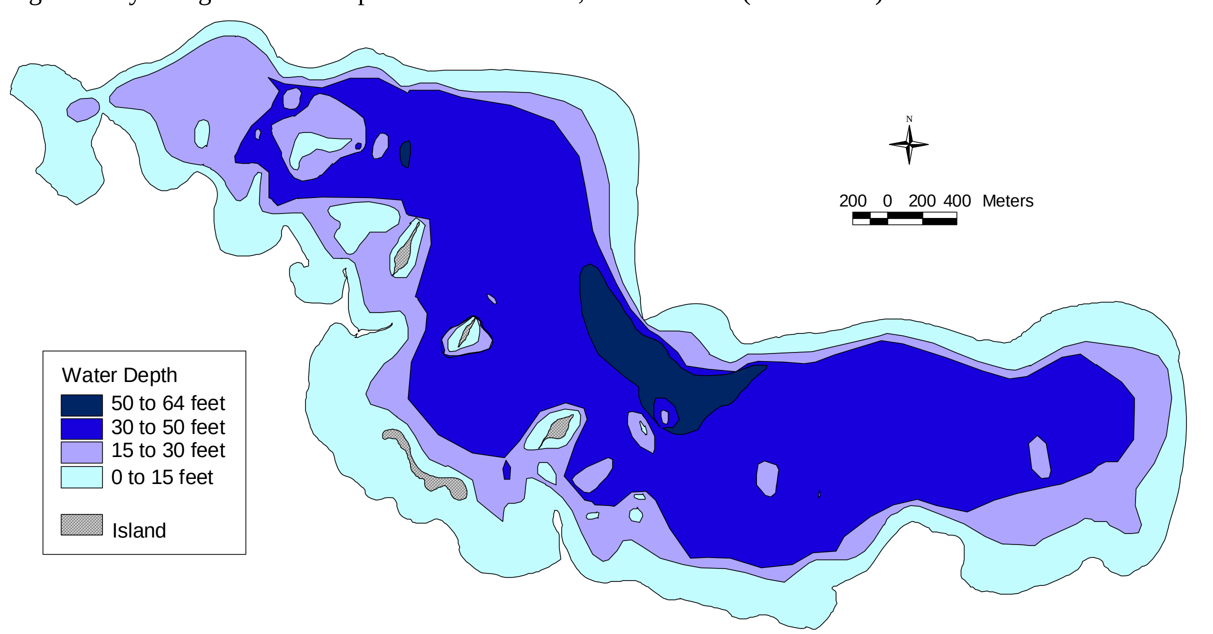


The sub-watershed of Lake Alexander is primarily forested with upland deciduous forest and numerous small wetland inclusions (Fig. 3). Other land use includes agriculture land to the north of the lake and residential development around the immediate shoreline.

Lake Alexander has a surface area of 2,763 acres and a maximum depth of 64 feet. At least 31 percent (842 acres) of the lake is less than 15 feet deep (Fig. 4). The western third of the lake has a greater portion of shallow water than the east end of the lake.

The lake is described as oligotrophic (low nutrients) with high water clarity as indicated by the 2004 mean summer Secchi depth of 17.3 feet (MPCA 2004).

Figure 4. Hydrologic contour map of Lake Alexander, Morrison Co. (49-0079-00)



Vegetation Survey Objectives
The purpose of the 2004 survey of Lake Alexander was to describe the current aquatic plant community including:

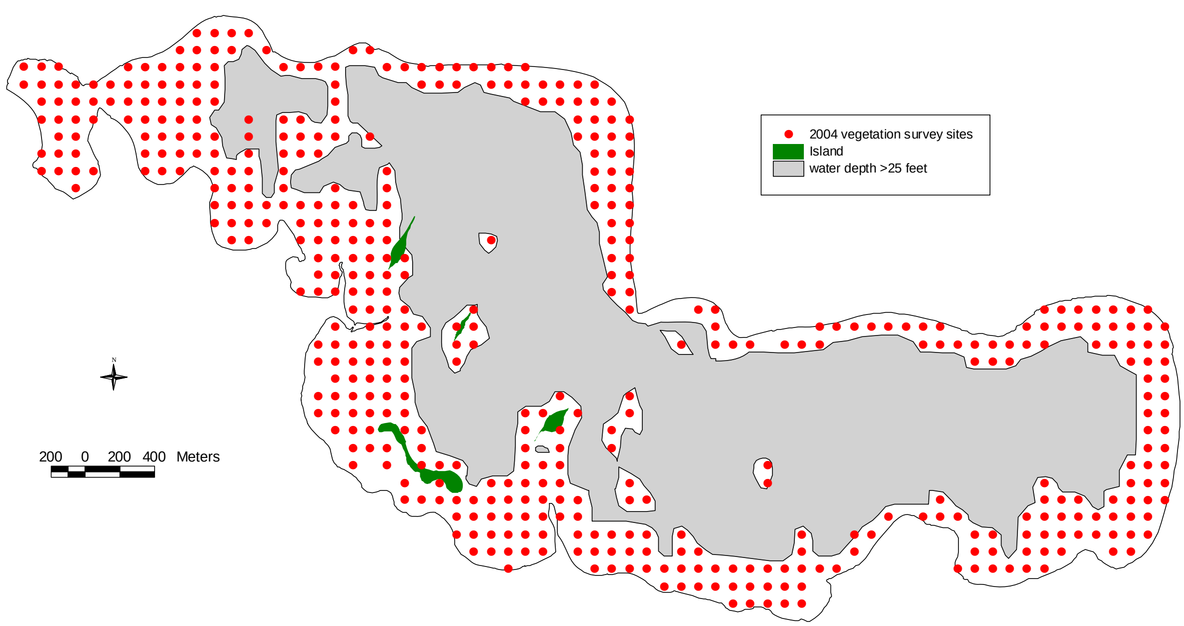
1) Estimate the maximum depth of rooted vegetation
2) Estimate the percent of the lake occupied by rooted vegetation
3) Record the aquatic plant species that occur in the lake
4) Estimate frequencies of occurrence of individual species
5) Develop maps of the distribution of the common species

Methods

Vegetation Survey Methods
A Point-Intercept vegetation survey of Lake Alexander was conducted on June 29-30 and July 1 and 7, 2004 following the methodology described by Madsen (1999). A Geographic Information System (GIS) was used to generate sample points across the lake surface in a 100 meter by 100 meter grid, resulting in a total of 1,100 potential survey points. In the field, surveyors decided not to sample in depths greater than 25 feet because vegetation was sparse beyond the 20 foot depth. As a result, 485 sites were actually sampled and 484 of those sites occurred within the zone from shore to the 25 feet depth (Fig. 5).

After the survey points were generated in the GIS, they were uploaded into a Global Positioning System (GPS) unit, which was used to navigate the boat to each sample point. One side of the

Figure 5. 2004 vegetation survey sites on Lake Alexander, Morrison Co. (49-0079-00)
Sites are 100 meters apart. 484 sites occur within the shore to 25 feet depth zone.



boat was designated as the sampling area. At each site, water depth was recorded in one foot increments using a measured stick in water depths less than eight feet and an electronic depth finder in water depths greater than eight feet. The surveyors recorded all plant species found within a one meter squared sample site at the pre-designated side of the boat. A double-headed, weighted garden rake (Fig. 6), attached to a rope was used to survey vegetation not visible from the surface. If non-native species such as curly-leaf pondweed (*Potamogeton crispus*) or Eurasian watermilfoil (*Myriophyllum spicatum*) were present at a site, surveyors recorded whether or not the plants formed surface mats at that site.

Figure 6: Rake used to sample vegetation.

Nomenclature followed Crow and Hellquist (2000). Voucher specimens were collected for most plant species.

Data were entered into a Microsoft Access database and frequency of occurrence was calculated for each species as the number of sites in which a species occurred divided by the total number of sample sites. Frequency was calculated for the entire sampled area (0-25 feet) and sampling points were also grouped by water depth and separated into five depth zones for analysis: 0 to 5 feet, and 6 to 10 feet, 11 to 15 feet, 16 to 20 feet and 21 to 25 feet.

<u>Example:</u> There were 484 sample sites within the shore to 25 feet zone.
Coontail occurred in 118 of those sample sites.
Frequency of coontail = (118 / 484)*100 = 24%

Results

Distribution of vegetation by water depth

In Lake Alexander, aquatic plants were found in 64 percent of the sampled sites (Fig. 7) to a maximum depth of 24 feet. Plant abundance varied with water depth and vegetation was most common in depths less than 16 feet where nearly 80 percent of the sites were vegetated (Fig. 8). Maximum plant abundance occurred in the six to ten feet depth zone where 86 percent of the sample sites contained vegetation (Fig. 8).

Types of aquatic plants found

Thirty-two species of native aquatic plant species were identified during the survey, including 19 submerged, three free-floating, four floating-leaved and six emergent species (Table 1). Two non-native submersed species, curly-leaf pondweed (*Potamogeton crispus*) and Eurasian watermilfoil *(Myriophyllum spicatum)*, were also observed during the survey.

Figure 7. Location of surveyed sites in Lake Alexander (49-0079-00) that contained vegetation in 2004.

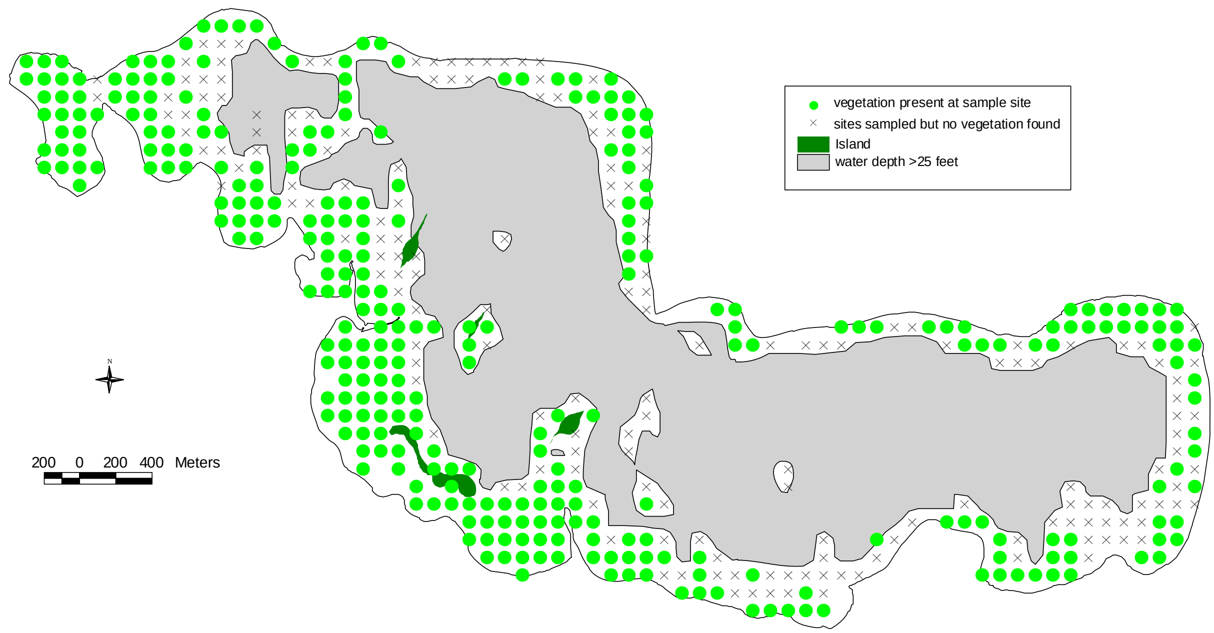


Figure 8. Plant abundance by water depth.
Lake Alexander (49-0079-00) June 29,30, July 1,7, 2004.

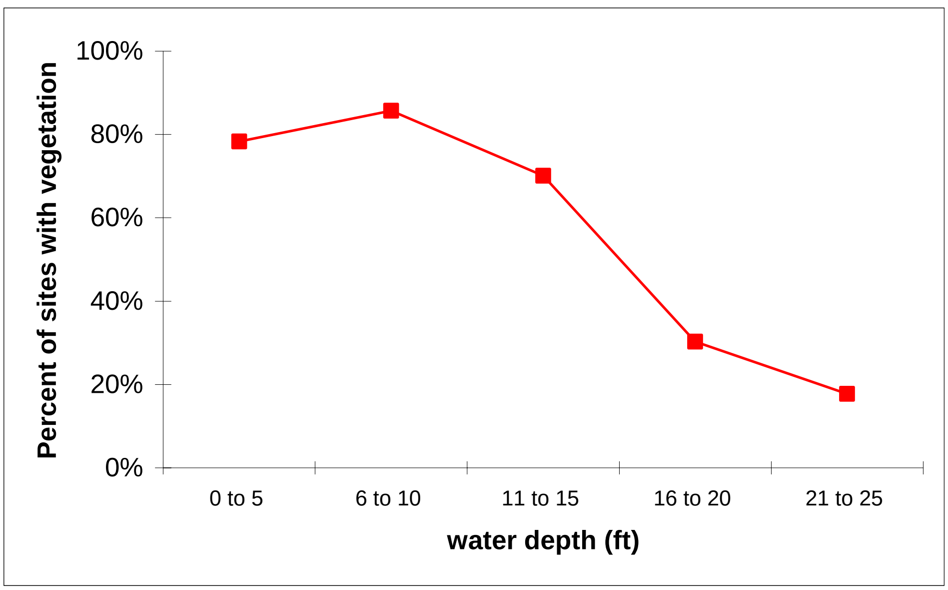


Table 1. Aquatic Plants of Alexander Lake Morrison County (49-0079-00)
June 29-30 and July 1 and 7, 2004

Frequency calculated for vegetated zone (shore to 25 feet depth)
Frequency = percent of sites in which species occurred
484 sample sites

Life Forms	Common Name	Scientific Name	Frequency
SUBMERGED These plants grow primarily under the water surface. Upper leaves may float near the surface and flowers may extend above the surface. Plants may or may not be anchored to the lake bottom.	Curly-leaf pondweed	*Potamogeton crispus (v)*	30
	Coontail	*Ceratophyllum demersum*	24
	Flat-stem pondweed	*Potamogeton zosteriformis (v)*	18
	Muskgrass	*Chara sp.*	14
	Canada waterweed	*Elodea canadensis (v)*	8
	Narrow-leaf pondweed	*Potamogeton sp.(v)*	8
	Northern water milfoil	*Myriophyllum sibiricum (v)*	6
	Clasping leaf pondweed	*Potamogeton richardsonii (v)*	5
	Robbins' pondweed	*Potamogeton robbinsii*	5
	White-stem pondweed	*Potamogeton praelongus (v)*	4
	White water buttercup	*Ranunculus sp. (v)*	4
	Water stargrass	*Zosterella dubia (v)*	4
	Large-leaf pondweed	*Potamogeton amplifolius (v)*	2
	Fries pondweed	*Potamogeton freisii (v)*	2
	Illinois pondweed	*Potamogeton illinoensis*	2
	Stonewort	*Nitella sp. (v)*	2
	Variable pondweed	*Potamogeton gramineus*	1
	Eurasian watermilfoil	*Myriophyllum spicatum (v)*	1
	Water marigold	*Megaladonta beckii (v)*	<1
	Sago pondweed	*Stuckenia pectinata (v)*	present*
	Wild celery	*Vallisneria americana (v)*	present
FREE-FLOATING These plants float on the water and drift with water currents.	Star duckweed	*Lemna trisulca (v)*	16
	Lesser duckweed	*Lemna minor*	1
	Greater duckweed	*Spirodela polyrhiza (v)*	present
FLOATING These plants are rooted in the lake bottom and have leaves that float on the water surface. Many have colorful flowers that extend above the water	Yellow waterlily	*Nuphar variegata*	2
	White waterlily	*Nymphaea odorata (v)*	2
	Floating leaf pondweed	*Potamogeton natans (v)*	1
	Watershield	*Brasenia schreberi (v)*	<1
EMERGENT These plants extend well above the water surface and are usually found in shallow water, near shore.	Needlerush	*Eleocharis acicularis*	3
	Spikerush	*Eleocharis sp.(v)*	1
	Three-square bulrush	*Scirpus sp.(v)*	<1
	Water plantain	*Alisma gramineum (v)*	present
	Soft-stem bulrush	*Scirpus tabernaemontani (v)*	present
	Cattail	*Typha sp.*	present

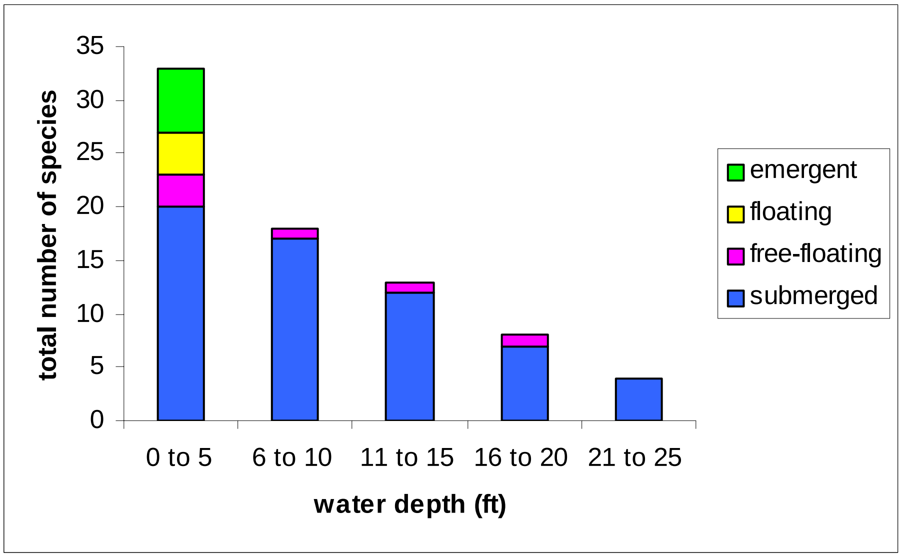
* present indicates plant was found during survey but did not occur within a specific sample site.

V = voucher specimen collected

Highlite = non-native species

The water depth zone from shore to five feet contained the most species (Fig. 9). Emergent and floating-leaved plants were restricted to this shallow depth zone. Most submerged species were found within the shore to five feet and the six to ten feet zones but as water depth increased, fewer species were located. Eight species were found in depths greater than 15 feet and only four species occurred in depths greater than 20 feet (Fig. 9).

Figure 9. Total number and types of species at each water depth interval.
Lake Alexander, Morrison Co. (49-0079-00). June 29,30, July 1,7, 2004.

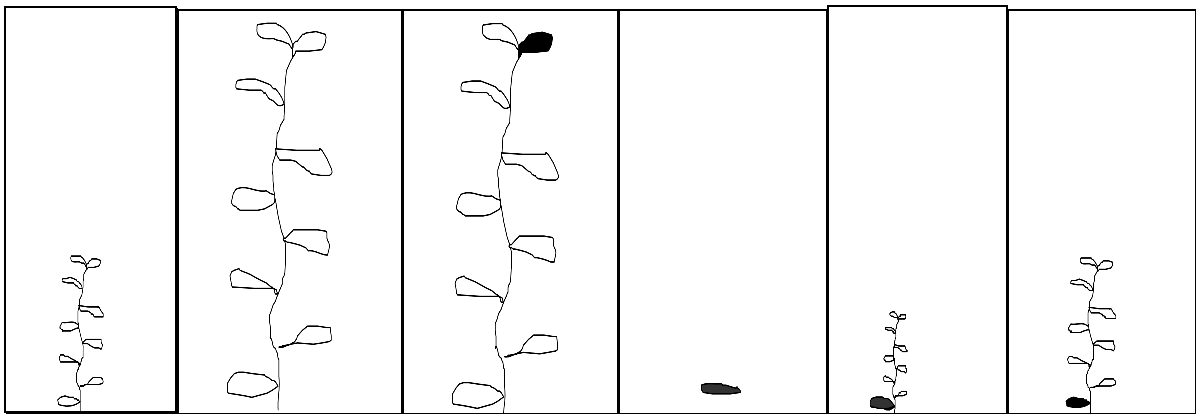


Submerged and free-floating species

Although 24 submerged and free-floating species were found in Lake Alexander, only five species were found in at least ten percent of the sample sites. These most common species were curly-leaf pondweed (*Potamogeton crispus*), coontail (*Ceratophyllum demersum*), flat-stem pondweed (*Potamogeton zosteriformis*), star duckweed (*Lemna trisulca*) and muskgrass (*Chara* sp.).

Curly-leaf pondweed is a non-native, submerged plant that has been present in Minnesota since at least 1910 (Moyle and Hotchkiss 1945) and is now found in at least 700 Minnesota lakes (Invasive Species Program 2005). Like many native submerged plants, it is perennial but it has a unique life cycle which may provide a competitive advantage over native species. Curly-leaf pondweed is actually dormant during late summer and begins new growth in early fall (Fig. 10). Winter foliage is produced and continues to grow under ice (Wehrmeister and Stuckey, 1978). Curly-leaf reaches its maximum growth in May and June, when water temperatures are still too low for most native plant growth. In late spring and early summer, curly-leaf plants form structures called "turions" which are hardened stem tips that break off and fall to the substrate. Turions remain dormant through the summer and germinate into new plants in early fall (Catling and Dobson, 1985).

Figure 10. Life cycle of Curly-leaf pondweed (*Potamogeton crispus*).



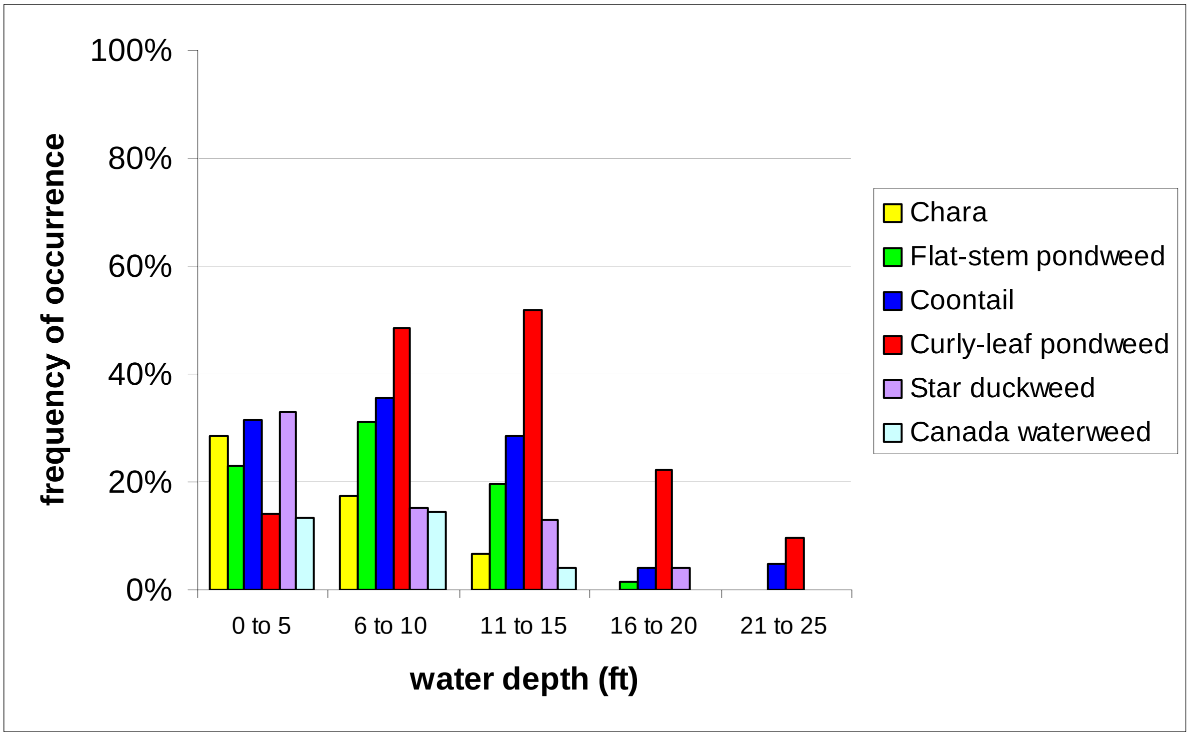
Winter	**Spring**	**Late Spring**	**Summer**	**Fall**	**Winter**
Plants Continue Growing under ice	Plants reach maximum growth	Plants begin to die back and form turions	Turions remain dormant	Turions germinate	Newly sprouted plants continue growth

During the late spring, 2004 survey of Lake Alexander, curly-leaf pondweed was identified in 30 percent of the survey sites and was the most frequently occurring aquatic plant species (Table 1). It occurred at all water depths to a maximum depth of 24 feet. It reached its maximum abundance in depths of six to 15 feet of water where it occurred in about 50 percent of the sample sites (Fig. 10). In water depths greater than five feet, it was the most commonly found species. Curly-leaf was widespread in distribution and was most often found along the southern shore and the east and west ends of Lake Alexander (Fig. 11).

In many Minnesota lakes, curly-leaf forms dense surface mats, usually in water depths less than 15 feet. During the 2004 vegetation survey of Lake Alexander, curly-leaf was not found to form surface mats but may have formed mats earlier in the season.

Coontail is native to Minnesota and is the most common submerged flowering plant in the state. It grows entirely submerged and and is adapted to a broad range of lake conditions, including turbid water. Coontail is perennial and can overwinter as a green plant under the ice and then begins new growth early in the spring. It is loosely rooted to the lake bottom and spreads primarily by stem fragmentation. In Lake Alexander, coontail was the most common native submerged plant and occurred in 24 percent of the sites sampled (Table 1). It was found at all depth zones and was most frequent in depths less than 16 feet (Fig. 11). Along with curly-leaf pondweed, it was one of the few species found in depths greater than 15 feet. Coontail and

Figure 11. Frequency of common aquatic plants in Lake Alexander by depth.



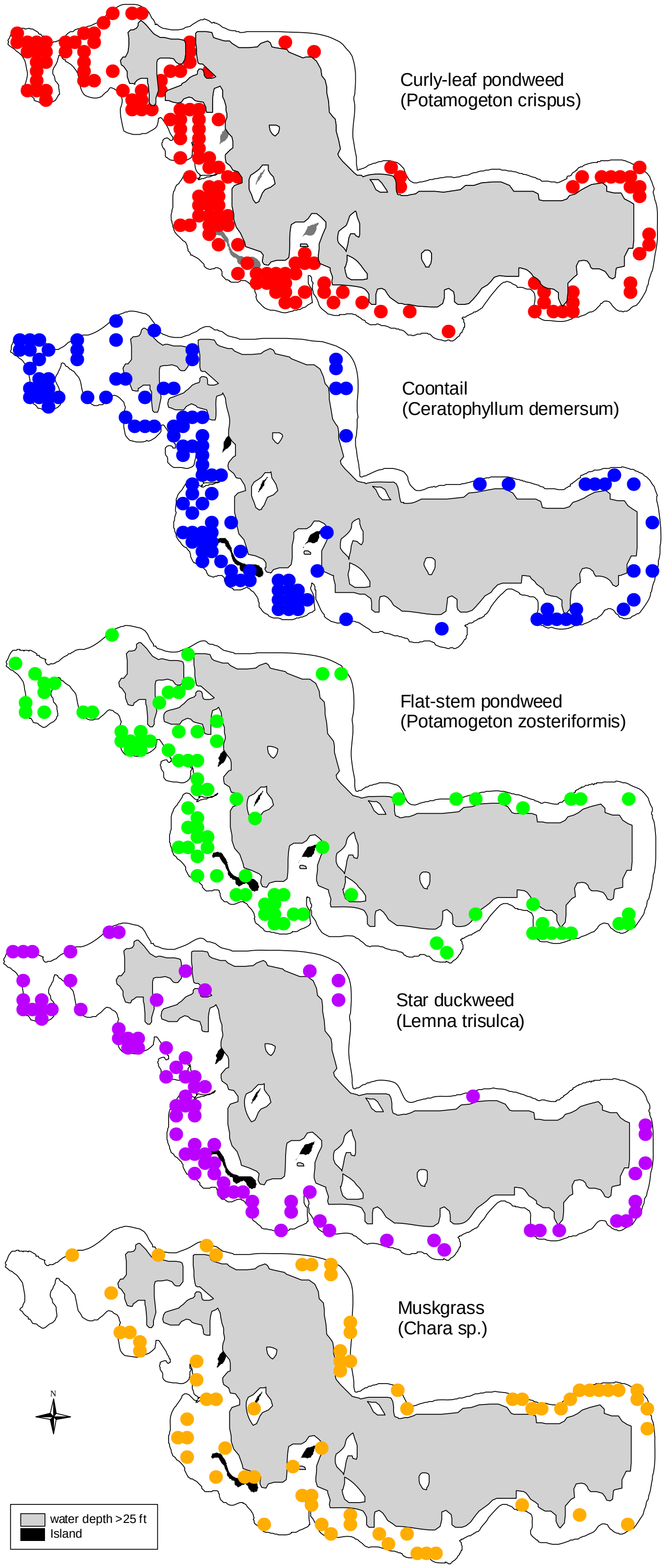
curly-leaf pondweed often co-occurred in sites and had a similar distribution pattern in the lake (Fig. 12).

Flat-stem pondweed is closely related to curly-leaf pondweed, but flatstem is native to Minnesota. This submerged plant can overwinter by rhizome and winter buds and can grow in a variety of water depths. In Lake Alexander, it was found in 18 percent of the sites surveyed in 2004 (Table 1, Fig. 12), occurring most frequently in the water depths up to fifteen feet (Fig 11). In 10 percent of the sites, flat-stem pondweed co-occurred with curly-leaf pondweed.

Star duckweed is a native, free-floating aquatic plant that is often found beneath the water surface. In late summer it forms winter buds which then rest on the lake bottom through the winter. In Lake Alexander, star duckweed occurred in 16 percent of the sites (Table 1) and was most abundant in water depths up to five feet (Fig. 11). Because it is not rooted to the lake bottom, it often drifts with water current and in Lake Alexander it was primarily found along the southern shore and in the east and west bays (Fig. 12).

Muskgrass is a native, macroscopic algae that is common in many hardwater Minnesota lakes. It is named for its characteristic musky odor. Because this species does not form true stems, it is a low-growing plant, often found entirely beneath the water surface where it may form low "carpets" on the lake bottom. Muskgrass is adapted to variety of substrates and is often the first species to invade open areas of lake bottom where it can act as a sediment stabilizer. In Lake

Figure 12. Distribution of common submerged plant species in Lake Alexander (49-0079-00). 2004

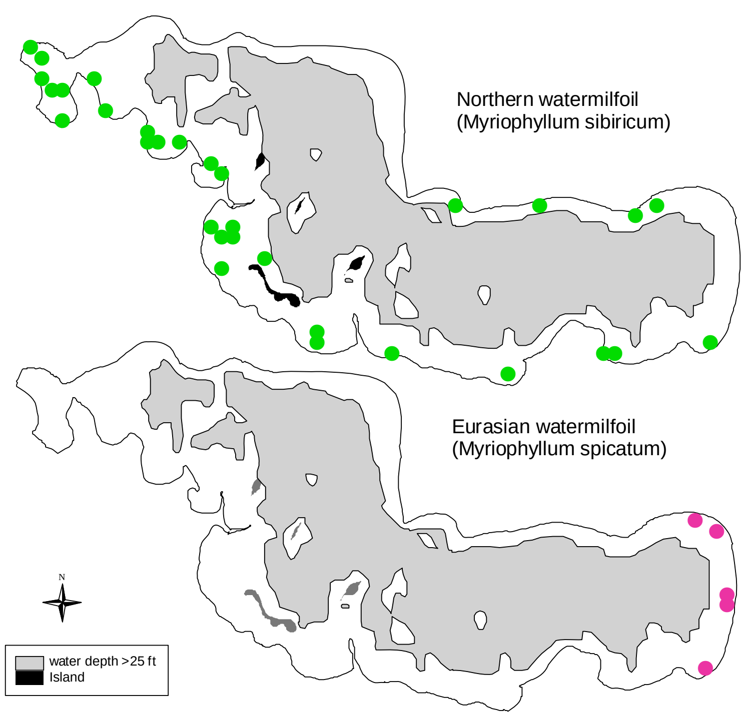


Alexander, muskgrass occurred in 14 percent of the sample sites (Table 1). It was restricted to depths less than 15 feet and was most often found in the depth zone from shore to five feet (Fig. 11). Muskgrass is often associated with sandy lake bottoms and may be found at sites where other species do not grow (Fig. 12).

All other submerged and free-floating species occurred in less than eight percent of the sites but the community includes a large variety of plant types. Compared to other lakes in Minnesota, Lake Alexander contains a high number of native submerged plant species. The different life forms, such as broad-leaved pondweeds, grass-like plants, and species with finely-dissected leaves, provide diverse structure for invertebrates and fish. Several of the submerged species found in Lake Alexander require high water clarity for growth and are not found in lakes with high turbidity.

The non-native species, Eurasian watermilfoil was confirmed present in Lake Alexander in 2003, near the public access on the east shoreline. Once this species invades a waterbody, it can spread to new locations as small fragments break from the parent plant and are carried by water currents. However, the abundance and diversity of native submerged plants may help limit the abundance of Eurasian milfoil in Lake Alexander. In 2004, Eurasian milfoil was found in one percent of the survey sites (Table 1) and was only found on the eastern shoreline (Fig. 13), in water depths between four to ten feet. In comparison, the native species, northern watermilfoil (*Myriophyllum sibiricum*) was found in six percent of the sample sites (Table 1) and occurred along the southern shore and the east half of the north shore (Fig. 13).

Fig. 13. Distribution of Northern and Eurasian watermilfoil in Lake Alexander, 2004.



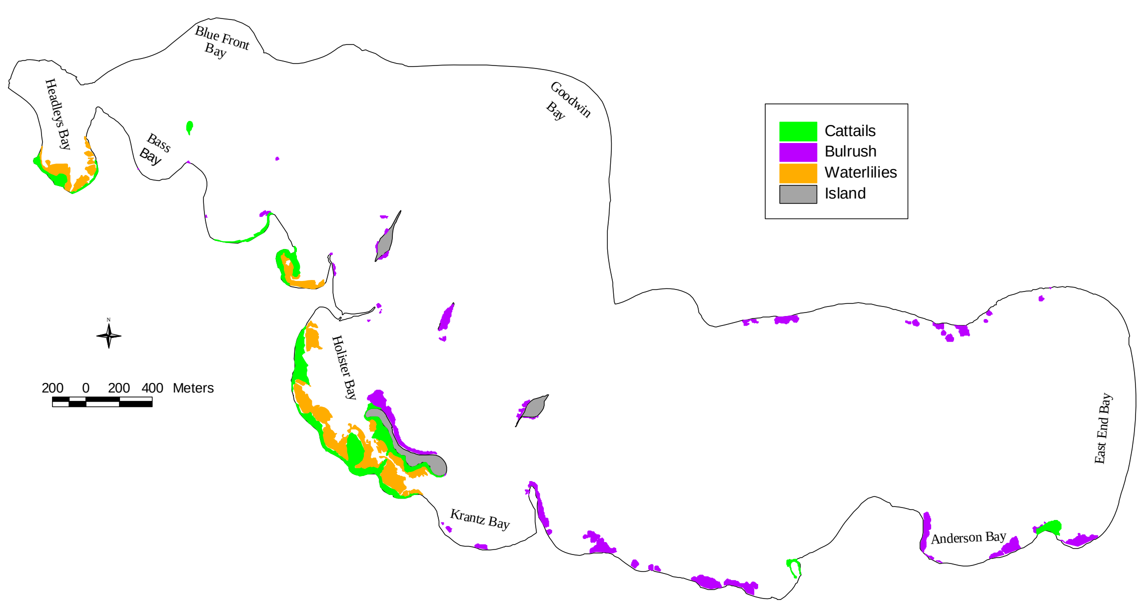
Floating-leaved and Emergent plant species
Emergent species occupy the shallowest zone, from wet, moist shoreline soils to approximately five feet deep. Emergent species help minimize shoreline erosion by stabilizing soils and dissipating wave action. Seven species of emergents were identified in Lake Alexander (Table 1). The most common species were Bulrush *(Scirpus spp.)* and Cattail *(Typha sp.)*

The boundaries of major plant beds were estimated in 2002 by MnDNR Fisheries. A GPS and a motorboat were used to map bulrush and mixed emergent vegetation stands in the field. Cattail and floating-leaf plants like waterlilies were mapped in a GIS using 1999 color infrared aerial photographs.

Approximately 29 acres of cattail were digitized from the aerial photographs. Large cattail stands occur along the southwestern shore of Lake Alexander in Holister bay and in Headleys bay on the west end. About 27 acres of bulrush and four acres of mixed emergent vegetation were mapped (Fig. 14). Large bulrush stands occurred around islands, along a portion of the central southern shore, in Anderson Bay and Weyerheuser and Mohr Points on the northern shore.

Four species of floating-leaf plants were found in Lake Alexander. Yellow waterlilies (*Nuphar variegata*) and white waterlilies (*Nymphaea tuberosa*) were found in two percent of points surveyed, mostly in the shallow areas of the western-most southern shore. The largest beds of waterlilies were found in Holister Bay along the southwestern shore near Green Island and in Headleys Bay on the western end (Fig. 14). Approximately four acres of floating-leaf plants were mapped in 2002.

Figure 14. Major beds of emergent and floating-leaf vegetation source: MnDNR Fisheries 2002.



Unique Plant Community of Lake Alexander
Clear water, protected bays and a broad zone of shallow water provide ideal conditions for aquatic plants in Lake Alexander. The lake supports a relatively diverse plant community and areas with intact aquatic vegetation communities represent valuable fish habitat, and should be protected. Lake Alexander is extremely popular with anglers, with both habitat for walleye and largemouth bass. It is also managed by the State as a trophy muskellunge lake.

While curly-leaf pondweed was the most frequently occurring species, numerous other plant species associated with healthy lake ecosystems also occurred, suggesting that native plants may help buffer the negative impacts of non-native species. With the introduction of Eurasian watermilfoil into the system, it is even more important to implement practices that promote healthy native plant communities.

Change in Lake Alexander plant community over time
The 2004 vegetation survey gives a "snapshot" of Lake Alexander conditions. Data collected during the 2004 survey can be compared to future quantitative surveys of Lake Alexander to better estimate how the plant community may be changing. Monitoring changes in aquatic plant communities can help reflect changes in the overall water quality of the lake and watershed.

In general, factors that may lead to change in native and non-native aquatic plant communities include:

- **Change in water clarity**
  Light availability is a significant factor limiting plant distribution and abundance. The amount of light available to submersed aquatic plants is typically dependent on both water clarity and depth. Excess nutrients, such as elevated phosphorus levels, often result in nuisance algal levels that contribute to decreased water clarity. If Lake Alexander water clarity increases, native submerged vegetation may be more common at depths greater than 15 feet.
- **Snow and ice cover**
  Curly-leaf pondweed, in particular, may fluctuate in abundance in response to snow and ice cover. Many native submerged plants also have the ability to grow under the ice, particulary if there is little snow cover and sunlight reaches the lake bottom. In years following low snow cover, and/or in years with shorter ice over periods, curly-leaf and some native submerged plants may increase in abundance.
- **Water temperatures / length of growing season**
  In years with cool spring temperatures, submerged plants may be less abundant than in years with early springs and prolonged warm summer days.
- **Natural fluctuation in plant species.**
  Many submerged plants are perennial and regrow in similar locations each year. However, a few species such as wild rice (*Zizania aquatica*) and bushy pondweed (*Najas flexilis*) are annuals and are dependant on the previous years seed set for regeneration.
- **Aquatic plant management activities**
  Herbicide and mechanical control of aquatic plants can directly impact the aquatic plant community. Monitoring these control activities can help insure that non-target species are not negatively impacted.
- **Shoreland management activities**

Although the Lake Alexander shoreline has been developed with cottages since at least the 1950s, most have been converted to year round homes. In order to maintain the relatively good water quality that promotes a healthy aquatic plant community, efforts should be made to minimize disturbance to the aquatic environment through the use of shoreline best management practices. These include minimizing activities that contribute to eutrophication (high-nutrient lake with poor water quality due to nuisance algal blooms) such as fertilizing lawns and malfunctioning septic systems, both of which add nutrients to a lake. Additionally, the Lake Alexander aquatic ecosystem would benefit from implementing lakescaping and shoreline restoration. A strip of shoreline vegetation provides a buffer zone between the lake and developed residential areas. Benefits include minimizing soil erosion from wave action while the plants uptake excess nutrients that may otherwise flow into the lake.

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