# Aquatic Plant Management Plan for Lower Spring Lake

2011

Jefferson County
Land and Water Conservation Department

This plan was approved by the Lower Spring Lake Protection and Rehabilitation District at their meeting on January 29, 2011.

The preparation of this publication was financed in part through the Lower Spring Lake Protection and Rehabilitation District.

# CONTRIBUTORS

**Jefferson County Land and Water Conservation Department**
320 S Main Street, Room 113
Jefferson, WI  53549
920-674-7121
fax: 920-674-7114

Patricia Cicero, Water Resources Management Specialist
patriciac@jeffersoncountywi.gov

Jennifer Kiser, 2009 Summer Intern

Janelle Dunlavy, 2010 Summer Intern

James Daly, volunteer

**Lower Spring Lake Protection and Rehabilitation District Board**
P.O. Box 434
Palmyra, WI  53156

Ed Shields, President to August 2010
Allen Fehrmann, President from August 2010

Linda Plennes, Secretary

Mark Ley, Treasurer

Tim Gorsegner, Village of Palmyra Representative

Jan Roou, Jefferson County Representative

# TABLE OF CONTENTS


Introduction …………………………………………………………………………………..… 3

Characteristics of Lower Spring Lake ……………………………………………………..… 4
    Water Quality, 4
    Fish and Wildlife, 7

Aquatic Plants ……………………………………………………………………………… 9
    Aquatic Plant Species, 9
    Aquatic Plant Survey Data, 11
    Data Comparison, 15

Public Input …………………………………………………………………………………… 17
    October 2009 Meeting, 17
    February 2010 Meeting, 18

Previous Aquatic Plant Control ……………………………………………………………….. 19
    Harvesting, 19
    Chemical Treatment, 19

Aquatic Plant Management – Recommendations ………………………..…………………… 23
    Problem Identification & Benefits of Plant Management, 23
    Plant Management Goals, 23
    Chemical Management, 24
    Mechanical Removal of Aquatic Plants: Harvesting, 26
    Shallow Areas in front of Developed Lots, 27
    Funding, 28
    Other Recommendations, 29
        Communication and Education, 29
        Filamentous Algae, 29
        Upper Spring Lake and the Scuppernong River, 30
        Exotic Species Monitoring, 30
        Clean Boats, Clean Waters, 31
        Other Factors Impacting Lake Quality, 31

References, 33

Appendix A. Lake Characteristics Maps, 34
Appendix B. Aquatic Plant Species Maps, 38
Appendix C. Harvesting Permit Map, 45
Appendix D. Chemical Residual Sampling Points, 47

# INTRODUCTION

Lower Spring Lake is a 109 acre lake located in Jefferson County. The western shore of the lake is located in the Village of Palmyra, with the remainder of the shoreline in the Town of Palmyra. The 27.1 square mile watershed is located in both Jefferson and Waukesha Counties.

The 2 exotic aquatic plant species in the lake are Eurasian water milfoil and curly-leaf pondweed. In 2005, "An Aquatic Plant Management Plan for Lower Spring Lake" was developed by Environmental Horizons, Inc. for the Lower Spring Lake Management District. The 2005 plan set forth recommendations on mechanical harvesting, chemical treatment, manual plant removal, demarcated boating lanes, and a program for public information and education.

In 2008, the Department of Natural Resources (DNR) developed a new protocol for determining the need for herbicide applications and evaluating the results of chemical applications. This protocol is specifically aimed at lakes where restoration is the goal to management. In February 2010, the Lower Spring Lake Management District voted to manage the lake with the goal of restoration. In order to follow the DNR protocols and obtain a permit for future herbicide applications, the aquatic plant management plan must be updated.

This document is an update to the 2005 Aquatic Plant Management Plan for Lower Spring Lake. It was developed by the Jefferson County Land and Water Conservation Department and the Lower Spring Lake Protection and Rehabilitation District with the assistance of the Wisconsin Department of Natural Resources. In the plan development process, the public contributed comments on aquatic plant management and recreational uses at various meetings of the Lower Spring Lake Protection and Rehabilitation District.

# CHARACTERISTICS OF LOWER SPRING LAKE

Lower Spring Lake is an impoundment on the Scuppernong River and is located in the Town and Village of Palmyra, Jefferson County (Appendix A). The watershed of Lower Spring Lake includes portions of Jefferson and Waukesha Counties (Appendix A).

A DNR public boat launch is accessible on the north shore of the lake. The Village of Palmyra has a public park located on the western side of the lake and includes a beach.

Table 1. Physical Characteristics of Lower Spring Lake

| Watershed Area ($mi^2$) | Lake Area (acres) | Maximum Depth (feet) | Mean Depth (feet) | Shoreline Length (miles) |
|---|---|---|---|---|
| 27.1 | 109 | 11 | 4 | 3.2 |

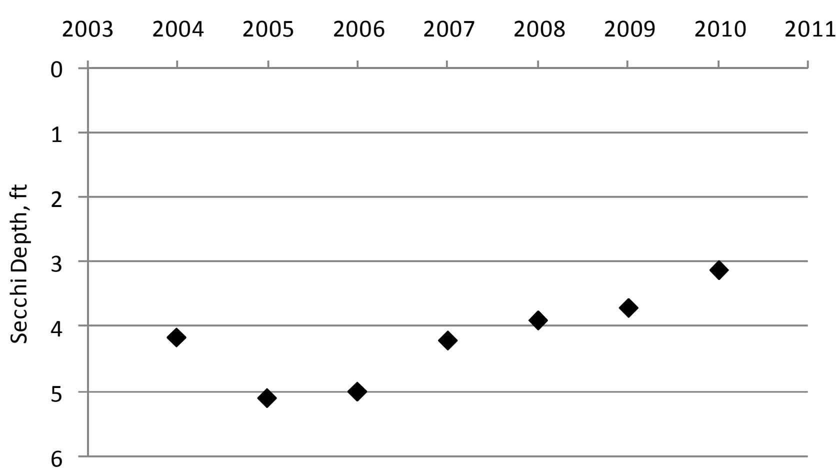
As part of the 2009 aquatic plant survey, depths throughout the lake were recorded and a new bathymetry map was developed (Appendix A).

## Water Quality

Water quality sampling for water clarity, chlorophyll *a*, total phosphorus, temperature and dissolved oxygen has been performed for several years by citizen monitors at the deepest point of the lake. This monitoring is done as part of the Department of Natural Resources Citizen Lake Monitoring Network program.

A Secchi disc, which is used to measure water clarity, is an 8-inch disc that is painted black and white. It is lowered into the water until it disappears from sight, then raised until it becomes visible – that depth is recorded as the water clarity reading. Materials suspended (especially algae) and dissolved in the water will impact the water clarity of a lake. Water clarity measurements can indicate the overall water quality of a lake. Chart 1 displays the average water clarity readings which have been measured since 2004. Lower Spring Lake's average summer (July-August) water clarity measurements range from 3.14 feet to 5.1 feet. The average of all summer measurements is 4.18 feet.

Chart 1. Average Summer Water Clarity Measurements for Lower Spring Lake



Chlorophyll *a* is the photosynthetic pigment found in plants. When filtered from lake water, it will signify the lake's algae biomass with higher concentrations indicating algal blooms. For most Wisconsin lakes, concentrations less than 7 µg/l indicate good water quality. Lower Spring Lake's average summer (July-August) chlorophyll *a* concentrations from 2005 through 2010 range from 2.69 µg/l to 39 µg/l. The average of all summer measurements is 12.65 µg/l.

Phosphorus is a nutrient that is often referred to as the "limiting nutrient" because its concentration in the water will affect the amount of algae and plant growth more than nitrogen. One pound of phosphorus delivered to a lake can produce up to 500 pounds of algae. Sources of phosphorus include runoff from farmland, animal lots, construction sites, and lawns, as well as shoreline erosion. Phosphorus mostly is held in insoluble particles with calcium, iron, and aluminum. Phosphorus is released from particle form when the water is anoxic (has no oxygen). From 2005 to 2010, average summer (July-August) phosphorus concentrations in Lower Spring Lake ranged from 28 µg/l to 69.5 µg/l. The 6-year average is 47.01 µg/l.

By determining a lake's trophic state, its water quality can be characterized as eutrophic, mesotrophic, or oligotrophic. These trophic states are based on water clarity, total phosphorus concentration, and chlorophyll *a* concentration.

Oligotrophic lakes are clear, deep, and are mostly free of aquatic plants or large algae blooms. They contain low amounts of nutrients and therefore do not support large fish populations. However, they can develop a food chain capable of sustaining a desirable fishery of large game fish. Mesotrophic lakes have moderately clear water. They can have deep waters that are low in dissolved oxygen during the summer, and as a consequence, can limit cold water fish and cause phosphorus release from the bottom sediments. Eutrophic lakes are high in nutrients and support a large biomass that includes dense aquatic plants, or frequent algae blooms, or both. Rough fish, such as carp, are often common in eutrophic lakes.

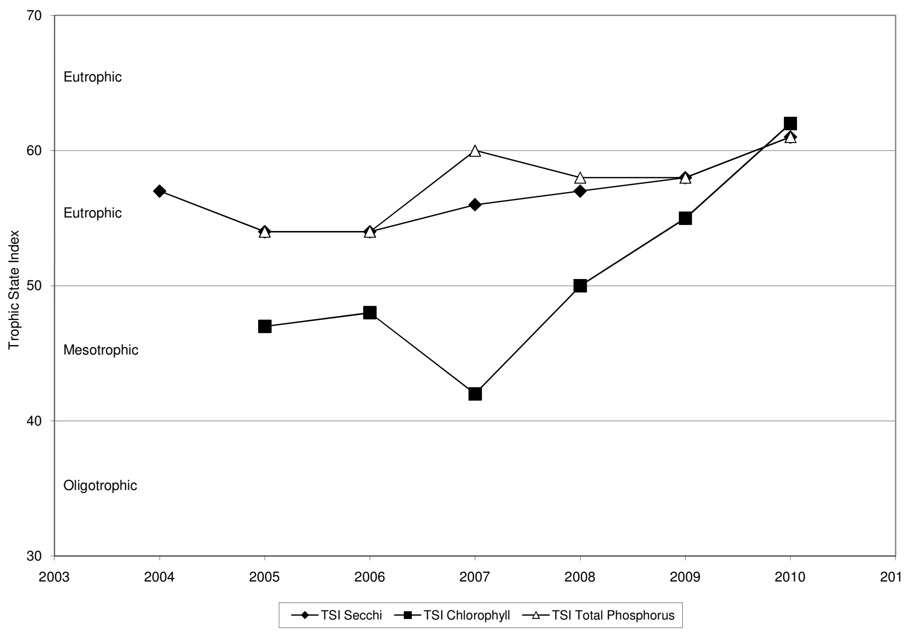
A natural aging process occurs in all lakes to shallower and more eutrophic lakes. It is important to point out that this aging process is accelerated by human activities that increase sediment and nutrient delivery to our lakes. These activities include agriculture, existing and new development, fertilizers, storm drains, etc.

The Trophic State Index (TSI) is determined using mathematical formulas that convert water clarity, total phosphorus, and chlorophyll *a* measurements into a TSI score on a scale of 0 to 110. Lakes that are less fertile have a low TSI. The scale is described in Table 2.

Table 2. Description of the Trophic State Index Scale

| TSI Score | Description |
|---|---|
| TSI < 30 | Classical oligotrophic: clear water, many algal species, oxygen throughout the year in bottom water, cold water, oxygen-sensitive fish species in deep lakes. Excellent water quality. |
| TSI 30-40 | Deeper lakes still oligotrophic, but bottom water of some shallower lakes will become oxygen-depleted during the summer. |
| TSI 40-50 | Water moderately clear, but increasing chance of low dissolved oxygen in deep water during the summer. |
| TSI 50-60 | Lakes becoming eutrophic: decreased clarity, fewer algal species, oxygen-depleted bottom waters during the summer, plant overgrowth evident, warm-water fisheries (pike, perch, bass, etc.) only. |
| TSI 60-70 | Blue-green algae become dominant and algal scums are possible, extensive plant overgrowth problems possible. |
| TSI 70-80 | Becoming very eutrophic. Heavy algal blooms possible throughout summer, dense plant beds, but extent limited by light penetration (blue-green algae blocks sunlight). |
| TSI > 80 | Algal scums, summer fish kills, few plants, rough fish dominant. Very poor water quality. |

Chart 2. Trophic State Index for Lower Spring Lake
(Note: This chart does not contain the entire Trophic State Index scale. Not shown is classic oligotrophic of 0-30 and eutrophic scales of 70 and greater.)




The Trophic State Index for Lower Spring Lake over time is displayed in Chart 2. It represents average July and August measurements of water clarity, total phosphorus, and chlorophyll *a*. Lower Spring Lake is characterized as a mesotrophic lake in terms of chlorophyll and a eutrophic lake in terms of water clarity and phosphorus. The chlorophyll data reveals that Lower Spring Lake is dominated by plants instead of algae. In addition, it shows the importance of protecting and enhancing native plant species as the exotic species are targeted for control. If the native plants are not protected, then the amount of algae in the lake will likely increase.

Chlorophyll increased in 2009 and 2010. The 2009 increase may be explained by the increased sediment and associated phosphorus that was delivered to the lake after the Upper Spring Lake dam failed in 2008. During 2010, there were higher than average precipitation events that delivered higher than average amounts of nutrients into the water. Along with the hotter weather which provides ideal growing conditions, the nutrients caused more algae growth. During 2010, filamentous algae was noted at nuisance levels in lakes throughout the region, including Lake Ripley and Rock Lake.

A water quality index was developed for Wisconsin lakes using data collected in July and August (Lillie and Mason 1983). Table 3 shows this index and contains the average summer values for Lower Spring Lake.

Table 3. Water Quality Index for Wisconsin Lakes with the summer averages from Lower Spring Lake Indicated (adapted from Lillie and Mason 1983)

| Water Quality Index | Secchi Depth (feet) | Chlorophyll a (ug/l) | Total Phosphorus (ug/l) |
|---|---|---|---|
| **Excellent** | > 19.7 | < 1 | < 1 |
| **Very Good** | 9.8-19.7 | 1-5 | 1-10 |
| **Good** | 6.6-9.8 | 5-10 | 10-30 |
| **Fair** | 4.9-6.6 | 10-15<br>Lower Spring = 12.65 | 30-50<br>Lower Spring = 47.01 |
| **Poor** | 3.3-4.9<br>Lower Spring = 4.18 | 15-30 | 50-150 |
| **Very Poor** | < 3.3 | > 30 | > 150 |

## Fish and Wildlife

The 2008 aquatic plant survey noted the presence of freshwater sponges in Lower Spring Lake. Freshwater sponges are aquatic animals that feed by filtering small particles from the water. They are thought to be sensitive indicators of pollution.

The following information on freshwater sponge identification is from the DNR:

- Size can vary from marble-sized to elongated masses; can be thin or thick encrusting layers
- Surface may be smooth, textured or wavy, or have finger-like projections
- Color may be green (because of algae that live inside their cells) or may be beige to brown or pinkish
- Feel delicate to very firm, but are not slimy or filmy

The best time to look for sponges is in late summer and early fall because they die back in the winter and begin a new growth cycle in the spring, and grow through the summer.

In the late summer, the sponges form gemmules which are small spherical protective structures that contain cells from which the new sponges will grow in the spring.  The gemmules are approximately the size of poppy seeds and are tan in color.  In addition, the sponges grow in shallow water.  Some sponges prefer the underside of logs and sticks.

The DNR reports that the fish population in Lower Spring Lake includes smallmouth bass (abundant), largemouth bass (common), and bluegill (common).  Other fish species include northern pike, rock bass, black crappie, golden shiner, carp, white sucker, lake chubsucker, black bullhead, green sunfish, and grass pickeral.

# AQUATIC PLANTS

Aquatic plants are a vital part of a healthy lake ecosystem. In fact, 90% of a lake's ecosystem depends of what happens in the vegetated shallow areas. Some valuable characteristics of aquatic plants are the following:

- Aquatic plants create a thriving habitat supplying food, shade, and shelter for a large variety of aquatic and terrestrial animals.
- Fruits and tubers of aquatic plants provide food for mammals, waterfowl, insects and fish.
- Aquatic plants are essential to the spawning success of many fish species.
- Aquatic plants photosynthesize, creating oxygen for the animals that live in the shallow area.
- Aquatic plants filter runoff from uplands to protect lake water quality.
- Plant roots create networks that stabilize sediments at the water's edge where waves might otherwise erode the lakeshore.
- Submersed plants absorb phosphorus and nitrogen over their leaf surface and through their roots.
- Plant use nutrients, making them less available for nuisance algae.
- Native aquatic plants can limit growth of exotic plants.

There have been four different aquatic plant surveys in Lower Spring Lake: 1993, 2005, 2008, and 2009. The surveys performed in 1993 and 2005 used a transect survey approach to sampling. The 2008 and 2009 surveys used the point intercept method that is now the DNR-recommended survey approach (Hauxwell et al. 2010). Samples of pressed aquatic plants from the 2009 lake survey were also given to the Wisconsin State Herbarium.

During the 2008 flooding events, the dam at Upper Spring Lake was compromised on June 9 and the entire Upper Spring Lake impoundment was drained through Lower Spring Lake. It took more than 2 weeks for the water levels to get back to normal (and rain events didn't help the matter). Citizens noted that a large amount of sediment was deposited on the east side of the lake, and sediment settled out in other parts of the lake. One citizen estimated that 4 inches of sediment was deposited by his pier.

It is significant to note that the 2008 plant survey was performed on June 18 and 19, 2008 after the extreme flooding event and upper dam failure.

### Aquatic Plant Species

The species reported in all of the aquatic plant surveys on Lower Spring Lake are contained in Table 4. It is important to note that the 1993 and 2005 surveys probably under-reported the actual number of species in the lake because those surveys used a transect method instead of the point-intercept method that was used in 2008 and 2009. The number of points sampled in the 1993 and 2005 surveys were 26 and 41 points respectively, while the 2008 and 2009 surveys included 220 and 226 point respectively.

Table 4. Aquatic Plants Identified in Surveys on Lower Spring Lake

| **Aquatic Plant** | **1993** | **2005** | **2008** | **2009** |
|---|---|---|---|---|
| *Carex comosa*, bristly sedge | | | X | X |
| *Carex hystericina,* bottlebrush sedge | | | X | |
| *Ceratophyllum demersum*, coontail | X | X | X | X |
| *Chara spp.*, muskgrass | X | X | X | X |
| *Elodea canadensis,* common waterweed | X | X | X | X |
| *Iris pseudacorus*, yellow iris | | | X | |
| *Iris sp.,* blue flag iris | | | X | X |
| *Lemna minor*, small duckweed | X | X | X | X |
| *Lemna trisulca*, forked duckweed | | X | X | |
| *Lythrum salicaria,* purple loosestrife | X | | X | |
| *Myriophyllum heterophyllum,* various-leaved water milfoil | | | X | |
| *Myriopyllum spicatum,* Eurasian water milfoil | X | X | X | X |
| *Najas flexilis,* slender naiad/bushy pondweed | X | X | X | X |
| *Nelumbo lutea*, American lotus | X | | | |
| *Nuphar microphyllum,* spatterdock | X | | | |
| *Nymphaea odorata*, white water lily | X | X | X | X |
| *Potamogeton amplifolius*, large-leaf pondweed | X | X | X | X |
| *Potamogeton crispus,* curly-leaf pondweed | | X | X | X |
| *Potamogeton friesii,* Fries pondweed | | | X | |
| *Potamogeton gramineus,* variable pondweed | | X | | |
| *Potamogeton illinoensis,* Illinois pondweed | | X | X | X |
| *Potamogeton nodosus*, long-leaf pondweed | | | X | X |
| *Potamogeton pusillus*, small pondweed | | | | X |
| *Potamogeton richardsonii*, clasping-leaf pondweed | | X | | |
| *Potamogeton zosterformis*, flat-stemmed pondweed | X | | | X |
| *Ranunculus aquatilis,* stiff water crowfoot | | | X | |
| *Sagittaria sp.*, arrowhead* | | | X | X* |
| *Spirodela polyrhiza*, large duckweed | X | | X | X |
| *Stuckenia pectinata*, sago pondweed | X | X | X | X |
| *Typha sp.* | X | | X | |
| *Utricularia vulgaris*, common bladderwort | X | | X | X |
| *Vallisneria Americana,* wild celery | X | X | | X |
| *Wolffia columbiana*, common watermeal | | | X | X |
| **Species Total** | 17 | 15 | 26 | 22* |

*The 2009 survey identified two species of arrowhead: *Sagittaria latifolia*, common arrowhead; and *Sagittaria cuneata*, arum-leaved arrowhead.

The 1995, 2008, and 2009 plant surveys also identified filamentous algae in the lake. The 2008 survey identified freshwater sponges in the lake. The Wisconsin State Herbarium also indicated that two specimens found in 2009 are likely *Phalaris arundinacea*, reed canary grass; and *Glyceria grandis*, American manna grass.
It is important to note that just because a plant was not documented in a survey does not mean that it is not found in the lake. In addition, aquatic plants can change from

year to year and be more abundant one year, and less abundant the next and visa versa.

## Aquatic Plant Survey Data

The species found in Lower Spring Lake in 2008 and 2009 are listed in Table 5 with a description of their ecological significance. Species maps produced with the 2009 data are contained in Appendix B. These maps indicate the points where plants were identified on a rake pull and their density rating on a scale of 1-3. It should be noted that visual observations of plants are not included on the maps. In addition, there were non-navigable locations that were not sampled: the east end of the lake and one of the southern bays where the depths were very shallow and the areas were populated by white water lilies.

Table 5. Ecological Significance and Coefficient of Conservatism for Lower Spring Lake Aquatic Plants Identified in 2008 and 2009.

| **Aquatic Plant**<br>*Species name*<br>Common name | **Plant Type** | **Coefficient of Conservatism** | **Ecological Significance** |
|---|---|---|---|
| *Potamogeton friesii*<br>Fries' pondweed | S | 8 | A food source for ducks and geese. Also eaten by muskrat, deer, and beaver. Food source and cover for fish. |
| *Ranunculus aquatilis*<br>Stiff water crowfoot | S | 8 | Fruit and foliage are eaten by waterfowl. Stems and leaves are valuable invertebrate habitat. |
| *Chara spp.*<br>Muskgrass | S | 7 | A favorite food of waterfowl. Provides cover and food to young trout, largemouth and smallmouth bass. |
| *Myriophyllum heterophyllum*<br>Various-feaved water milfoil | S | 7 | Fruit and foliage are eaten by waterfowl. Foliage traps detritus for food and provides invertebrate habitat. Offer shade, shelter, and foraging for fish. |
| *Potamageton amplifolius*<br>Large-leaf pondweed | S | 7 | The broad leaves offer shade, shelter and foraging opportunities for fish. Valuable waterfowl food. |
| *Potamogeton nodosus*<br>Long-leaf pondweed | S | 7 | Offers invertebrate habitat and foraging opportunities for fish. Ducks eat the fruit. |
| *Potamageton pusillus*<br>Small pondweed | S | 7 | Locally important food source for ducks and geese. It is also grazed by muskrat, deer, beaver and moose. Food and cover for fish. |
| *Sagittaria cuneata*<br>Arum-leaved arrowhead | E | 7 | Highly valued aquatic plant for wildlife. Waterfowl depend on the high-energy tubers during migration. Beds offer shade and shelter to young fish. |
| *Utricularia vulgaris*<br>Common bladderwort | S | 7 | Provides food and cover for fish. |
| *Lemna trisulca*<br>Forked duckweed | FF | 6 | Food source for waterfowl. Provides cover for fish and invertebrates. |

| **Aquatic Plant**<br>*Species name*<br>Common name | **Plant Type** | **Coefficient of Conservatism** | **Ecological Significance** |
|---|---|---|---|
| *Najas flexilis*<br>Slender naiad/Bushy pondweed | S | 6 | One of the most important plants for waterfowl. Ducks eat the stems, leaves and seeds. Important to marsh birds and fish. |
| *Nymphaea odorata*<br>White water lily | FL | 6 | Provides shade and cover for fish and invertebrates. A food source for waterfowl, muskrat, and beaver. |
| *Potamogeton illinoensis*<br>Illinois pondweed | S | 6 | Ducks and geese eat the fruit. Provides excellent shade and cover for fish and invertebrates. |
| *Potamogeton zosteriformis*<br>Flatstem pondweed | S | 6 | Food source for waterfowl and wetland mammals. Provides cover for fish and invertebrates. Supports insects valuable as food source for fish and waterfowl. |
| *Vallisneria Americana*<br>Wild celery | S | 6 | Premiere source of food for waterfowl. All portions of plant are consumed. Good fish habitat providing shade, shelter and feeding opportunities. |
| *Carex comosa*<br>Bristly sedge | E | 5 | Nutlets are eaten by a variety of waterfowl. |
| *Iris versicolor*<br>Northern blue flag/Iris | E | 5 | Grazed by muskrats and waterfowl. Good cover for wildlife and waterfowl. |
| *Spirodela polyrhiza*<br>Large duckweed | FF | 5 | Provides food for waterfowl, muskrat and fish. Rafts of duckweed offer shade and cover for fish and invertebrates. |
| *Wolffia columbiana*<br>Common watermeal | FF | 5 | Ducks, geese, muskrats, and some fish eat this plant. A large floating mat can prevent mosquito larvae from reaching the surface for oxygen. |
| *Lemna minor*<br>Small duckweed | FF | 4 | Important food source for ducks and geese. Consumed by muskrats, beaver, and fish. Provides shade and cover for fish and invertebrates. Extensive mats of duckweed can inhibit mosquito breeding. |
| *Carex hystericina*<br>Bottlebrush sedge | E | 3 | Nutlets are eaten by a variety of waterfowl. |
| *Ceratophyllum demersum*<br>Coontail | S | 3 | Provides good shelter for young fish, supports insects valuable as food for fish and ducklings, and fruits are eaten by waterfowl. |
| *Elodea canadensis*<br>Common waterweed | S | 3 | Offers valuable shelter and grazing opportunities for fish. Also provides food for muskrats and waterfowl that eat the plant itself or the wide variety of invertebrates that use the plant as habitat. |

| **Aquatic Plant**<br>*Species name*<br>Common name | **Plant Type** | **Coefficient of Conservatism** | **Ecological Significance** |
|---|---|---|---|
| *Sagittaria latifolia*<br>Common arrowhead | E | 3 | Highly valued aquatic plant for wildlife. Waterfowl depend on the high-energy tubers during migration. Beds offer shade and shelter to young fish. |
| *Stuckenia pectinata*<br>Sago pondweed | S | 3 | Fruits and tubers are a very important food source for a variety of waterfowl. Supports insects that are eaten by game fish and also provides cover for young game fish. |
| Filamentous algae | S | | Provides habitat for many micro and macro invertebrates which are in turn used as food by fish and other wildlife species. |
| *Iris pseudacorus*<br>Yellow iris | E | | Grazed by muskrats and provides food for a variety of waterfowl. Provides cover for wildlife and waterfowl. |
| *Lythrum salicaria*<br>Purple loosestrife<br>- Exotic species - | E | | Little wildlife value: The seeds are low in nutrition, and the roots are too woody. The flowers are attractive to insects and produce nectar, regularly visited by honeybees. |
| *Myriophyllum spicatum*<br>Eurasian water milfoil<br>- Exotic species - | S | | Waterfowl graze on fruit and foliage to a limited extent. Habitat for insects but not as good as other plants. |
| *Potamogeton crispus*<br>Curly-leaf pondweed<br>- Exotic species - | S | | Provides winter and spring habitat for fish and invertebrates. Mid-summer die-off releases nutrients which may trigger algae blooms and create turbid water conditions. |
| *Typha sp.*<br>cattail | E | | Nesting habitat for many marsh birds. Shoots and rhizomes are consumed by muskrats and geese. Submersed stalks provide spawning habitat and shelter for fish. |

Key:
E = Emergent – plants with leaves that extend above the water surface
FL = Floating Leaf – plants with leaves that float on the water surface
FF = Free Floating – plants that float freely on the water surface
S = Submersed – plants with most of their leaves growing below the water surface

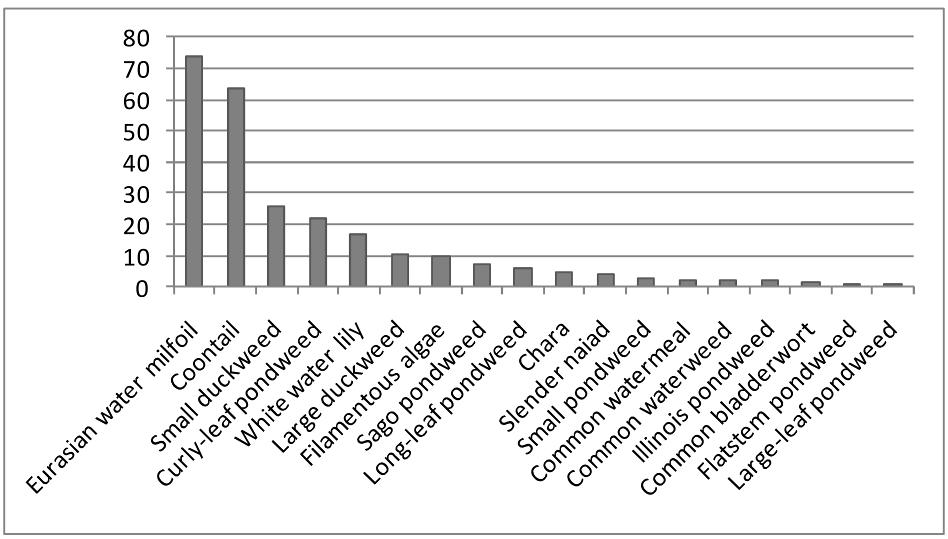
There are several ways to analyze aquatic plant data for a lake. These include the coefficient of conservatism, the floristic quality index, the frequency of occurrence, the relative frequency of occurrence, and the Simpson Diversity Index.

The Coefficient of Conservatism is a number on a scale from 0 to 10 that represents an estimated probability that a plant species is likely to occur in a lake unaltered from what is believed to be pre-settlement conditions. A Coefficient of 10 indicates the plant is almost certain to be found in an un-degraded natural community, and a Coefficient of 0 indicates the probability is almost 0. Introduced plants were not part of the pre-settlement flora, so no coefficient is assigned to them. Table 5 lists the species from highest coefficient to lowest. The average Coefficient of Conservatism for Lower Spring Lake is 4.91.

The floristic quality index (FQI) is used to assess a lake's quality using the aquatic plants that live in it. Developed by Stan Nichols (WI Geological and Natural History Survey), the floristic quality index is the average coefficient of conservatism multiplied by the square root of the number of plants in the lake. The FQI varies around Wisconsin but ranges from 3.0 to 44.6 with a median of 22.2. Generally, higher FQI numbers mean better lake quality. The floristic quality index for Lower Spring Lake is 23.0.

The frequency of occurrence for a plant species is the number of times a species is observed, divided by the total number of sampling points contained within the area shallower than the maximum depth of plants in a lake. The maximum rooting depth of Lower Spring Lake is 9.5 feet. The frequency of occurrence is expressed as a percentage and the results from the 2009 are displayed in Chart 3. The frequency of occurrence does not factor in plant species that were visually noted in the survey and not sampled with the rake.

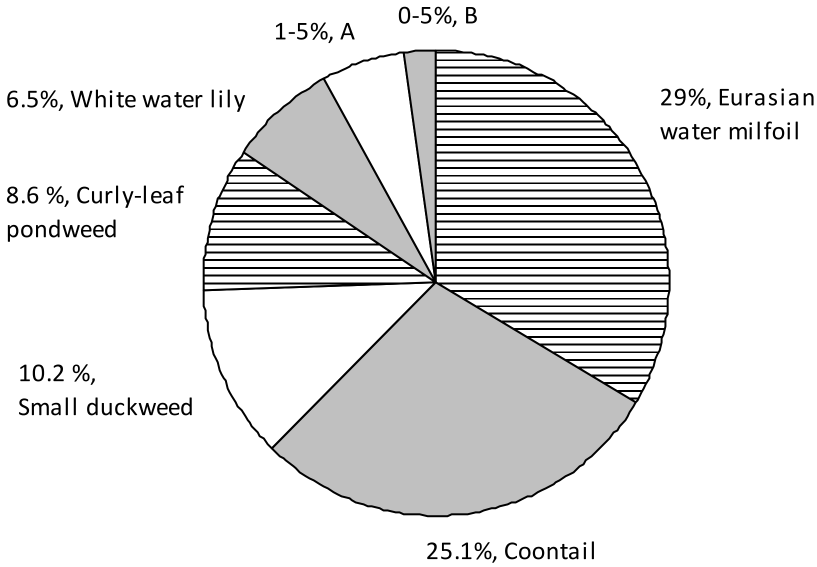
Chart 3. Frequency of Occurrence of Plants in Lower Spring Lake, 2009




The relative frequency of occurrence gives an indication of how the plants occur throughout a lake in relation to each other. It is the frequency of a species divided by the sum of the frequencies of all species. The sum of the relative frequencies should be equal to 100%. The data from the 2009 survey is displayed in Chart 4.

Based on the Simpson Diversity Index (one minus the sum of the relative frequencies squared) for the community, the closer the index value is to one, the greater the diversity within the lake. The Simpson Diversity Index for Lower Spring Lake is 0.83.

Chart 4. Relative Frequency of Plants in Lower Spring Lake, 2009




A = large duckweed, filamentous algae, sago pondweed, long-leaf pondweed, chara, slender naiad
B = small pondweed, watermeal, elodea, Illinois pondweed, bladderwort, flatstem pondweed, large-leaf pondweed, arrowhead

**Summary of Aquatic Plant Surveys**

The results from the 2008 and 2009 surveys indicate the following:

- Eurasian water milfoil and coontail are the most frequently occurring plants in the lake
- Two exotic species are contained in the lake: Eurasian water milfoil and curly-leaf pondweed
- There is a good population of native plants found in the lake

**Data Comparison**

A comparison of information from all the aquatic plant surveys is contained in Table 6. The data from the 2008 and 2009 surveys are very similar. It is not surprising that the data from 1993 and 2005 contain less species identified due to the fact that far less points were sampled. Therefore, because the data for 2008 and 2009 is more extensive, some of the data comparison with the earlier years should be done very cautiously.

Another data comparison that can be made is information on the exotic species present in the lake. During the 2008 and 2009 surveys, information on the depth of the exotic plants and the visual density of the plants at the sampling point was collected. This information was not part of the protocols during the time of the 1993 and 2005 surveys. Table 7 provides the collected data for Eurasian water milfoil, and Table 8 provides the same information for curly-leaf pondweed.

Table 6. Summary of Data from All Aquatic Plant Surveys in Lower Spring Lake

| | 1993 | 2005 | 2008 | 2009 |
|---|---|---|---|---|
| Total # points sampled | 26 | 41 | 220 | 226 |
| Total # sites with vegetation | 24 | 41 | 160 | 170 |
| Total # of sites shallower than maximum depth of plants | | 41 | 214 | 217 |
| Maximum depth of plants | 9.1 feet | 9 feet | 10 feet | 9.5 feet |
| Average # of all species per site (shallower than max depth) | | 3.2 | 1.69 | 1.97 |
| Average # of all species per site (vegetated sites only) | 2.6 | 3.2 | 2.26 | 2.54 |
| Average # of native species per site (shallower than max depth) | 2.0 | 1.6 | 1.06 | 1.23 |
| Average # of native species per site (vegetated sites only) | | | 2.34 | 2.07 |
| Frequency of occurrence at sites shallower than maximum depth of plants | | | 74.77 | 78.34 |
| Simpson Diversity Index | | | 0.84 | 0.83 |
| Average Coefficient of Conservatism | 4.47 | 4.6 | 4.38 | 4.91 |
| Average Floristic Quality Index | 18.4 | 17.8 | 22.3 | 23.0 |
| Total number of species | 17 | 15 | 26 | 22 |

Table 7. Eurasian Water Milfoil Data for 2008 and 2009

| | 2008 | 2009 |
|---|---|---|
| # of points where plants are at surface | 30 | 50 |
| # of points where plants within 1 ft of surface | 20 | 34 |
| # of points where plants are > 1 ft from surface | 80 | 52 |
| # of points where density is sparse | 39 | 25 |
| # of points where density is dense | 11 | 37 |
| # of points where density is unknown | 80 | 74 |

Table 8. Curly-Leaf Pondweed Data for 2008 and 2009

| | 2008 | 2009 |
|---|---|---|
| # of points where plants are at surface | 4 | 15 |
| # of points where plants within 1 ft of surface | 9 | 11 |
| # of points where plants are > 1 ft from surface | 10 | 23 |
| # of points where density is sparse | 13 | 19 |
| # of points where density is dense | 0 | 7 |
| # of points where density is unknown | 10 | 23 |

It is important to note that the differences between the two sampling years for both exotic species could be due to changes in the species population, but the data could also be impacted by the use of the harvester. In addition, the 2008 survey was performed when water levels were higher than normal.

# PUBLIC INPUT

It is vital to have public input regarding aquatic plant management not only to determine the level of public acceptance for various control techniques but also to determine which areas of the lake are used or wanted to be used for different types of recreation.

### October 2009 Meeting

On October 24, 2009, the Land and Water Conservation Department and the Lower Spring Lake Protection and Rehabilitation District invited citizens to a meeting to discuss the future of Lower Spring Lake recreation and aquatic plant management.

Table 9 contains a list of recreational activities and the current location in which the activity occurs, and the area that was identified as a desired location for the activity. It is important to note that desired locations for certain activities may not be achievable due to a variety of factors including depth, permit conditions, and laws.

Table 9. Public Input on Lake Use

| **Activity** | **Current Use Area** | **Future Wanted Use Area** |
|---|---|---|
| Access to lake from properties with piers in bays containing shallow water and water lilies | 2 properties on the south side of the lake | Same +<br>1 property on northeast side of lake for future pier |
| Boat access within lake | - north of small island west of boat landing when traffic south of the island is heavy | Same |
| Fast Boating | middle of lake | Same |
| Fishing | - throughout the lake<br>- along Hwy 59<br>- edge of shallow bays | Same |
| Paddling | - throughout the lake<br>- north of island east of boat launch<br>- east side of lake to the river entering lake | Same |
| Swimming | - at Village Park<br>- throughout the lake where there is adequate depth<br>- in front of residential properties | Same +<br>Wanted in the southeast corner of the bay east of Willow St |
| Habitat & Wildlife Viewing | - in southern bay containing water lilies<br>- east side of lake<br>- north of island that is east of boat landing | Same +<br>Increase area on east side of lake |
| Winter Recreation | - motorcycles<br>- ATVS<br>- snowmobiles | May want to look into rules that would ensure safety of participants and residents |

During the discussion on boating, it was also noted that boating access is sometimes limited in the bay east of Willow Street. In addition, it is important that boat access to the lake is maintained at the DNR boat landing on the north side of the lake.

When talking about the boat launch, it was noted that there is no charge for use of the boat landing, and around 3-4 boats/day use the launch. During the winter, the lake also attracts ice fisherman.

During the public discussion, there was an idea to explore the placement of a fishing platform on the lakeshore adjacent to Hwy 59. Currently, the entire stretch of shoreline is mowed. This leaves the lake susceptible to runoff pollution from the highway. Native shoreline vegetation along this area could stop some of the road pollution (oil, grease, etc.) from entering the lake. Because this area is used by fisherman, a fishing platform could be built in order to accommodate fishermen. The Jefferson County Zoning Department and the Department of Natural Resources should be contacted for permit information for a fishing platform if this idea is pursued. The Jefferson County Land and Water Conservation Department should also be contacted regarding potential funding available to offset the costs of planting native vegetation along the lake.

In summary, the public expressed concerns about access to the lake from their properties in order to participate in a variety of recreational activities. They want the aquatic invasive plants controlled in such a way as their use of the lake is not impaired by the exotic plants. Based on their input on fishing and wildlife viewing, the public was interested in maintaining and increasing the characteristics of the lake that support a good fishery and wildlife.

## February 2010 Meeting

At the February 27, 2010 meeting of the Lower Spring Lake Management District, there was a discussion about future chemical treatment to control exotic aquatic plants. The group decided to move forward with a restoration approach to exotic plant management. The following excerpt is from the minutes:

> "Greg Smith made a motion: For 2011 Full chemical treatment of the lake pending approval of the grant money. Seconded by Carol Dixon. Vote taken: All in favor-16 /0 none opposed. Motion passed, a footnote added: Curly leaf pondweed and Eurasian water milfoil will be included for treatment in the grant proposal. We will apply for the grant money this August 1 and if not approved we will again apply next February 1st as well."

# PREVIOUS AQUATIC PLANT CONTROL

## Harvesting

The Lower Spring Lake Protection and Rehabilitation District has used mechanical harvesting for many years. They own theharvester and work with the Village of Palmyra to hire someone to operate the harvester during the summer. The harvester is docked at the boat launch during the summer.

In 2006, the Department of Natural Resources issued a harvesting permit to the Lower Spring Lake District. The permit expires on December 31, 2010. On Lower Spring Lake, harvesting has been a useful tool to ensure control of exotic aquatic plants in areas where the water depths are conducive to active recreational activities.

In 2009, some items in the harvesting permit were clarified. A map (Appendix C) shows the location of permitted harvesting areas. The harvester is not allowed in less than 3 feet of depth because it would disturb bottom sediments. Disturbed bottom sediments have the potential to release phosphorus into the water column which could lead to increased algae blooms.

Table 10 shows the approximate amount of vegetation removed from the lake with the harvester. In 2010, the harvester was deployed less because of the successful 25 acre chemical treatment (see below). Therefore, there was a significant decrease in the amount of plants harvested and the amount of time the harvester was deployed on the water.

Table 10. Vegetation Removed with the Harvester

| Year | Vegetation Removed |
|---|---|
| 2005 | 810,000 lbs |
| 2006 | 396,000 lbs |
| 2007 | 756,000 lbs |
| 2008 | 499,000 lbs |
| 2009 | 461,610 lbs |
| 2010 | 62,440 lbs |

## Chemical Treatment

When Lower Spring Lake first started to use chemical treatment, areas along residential properties were targeted. Later, a 5-acre section that is south and west of the boat landing was added for a total of 15 acres of treatment. A granular formulation of the chemical 2, 4-D (Navigate) was used. These treatments occurred in late May or early to mid June. It is important to note that these treatments took place during a time when native plants were actively growing and likely had a detrimental impact on the natives. In addition, since there was probably more plants killed, the decomposition likely resulted in algal blooms.

In 2010, the Lower Spring Lake District decided to expand the 5-acre area in the middle of the lake to a 15 acre area plus the 10 acres adjacent to riparian lots. On May 4, 2010, Marine Biochemists treated 25 acres of Lower Spring Lake with the liquid formulation of 2, 4-D using a dosage of 1.5 ppm to control the Eurasian water milfoil. The water temperature at time of treatment was 64°F a 2 feet below the water surface. The intent of the treatment was that the chemical would mix evenly throughout the lake to selectively kill the exotic species, Eurasian water milfoil. The treatment was intentionally implemented when water temperatures were less than 65°F because most native plants are not actively growing. In order to determine the effectiveness of the treatment, a pre-treatment and a post-treatment plant survey was performed. The pre-treatment survey was done on May 3, 2010. A total of 61 points were sampled which included locations within the treatment area as well as locations outside of the treatment area. The post-treatment survey was performed on July 1, 2010 and included 62 total points also in locations within and outside of the treatment area. The results of the surveys are show in Table 11.

Table 11. Pre and Post Treatment Aquatic Plant Survey, 2010

| **Species** | **Number of Sites where Plants were Found** | |
|---|---|---|
| | **Pre-treatment survey 5-3-10** | **Post-treatment survey 7-1-10** |
| *Myriopyllum spicatum,* Eurasian water milfoil | 35 | 8 |
| *Potamogeton crispus* Curly-leaf pondweed | 18 | 4 |
| *Ceratophyllum demersum* Coontail | 27 | 36 |
| *Chara spp.* muskgrass | 6 | 6 |
| *Elodea Canadensis* common waterweed | 3 | 7 |
| *Nymphaea odorata* white water lily | 0 | 7 |
| *Potamogeton nodosus*, long-leaf pondweed | 0 | 5 |
| *Lemna minor* small duckweed | 0 | 3 |

It is clear from the data that there was a decrease in Eurasian water milfoil, the target species at the points sampled. Eurasian water milfoil can overwinter and growth starts early in the spring when the water temperatures are about 59°F. In addition, curly-leaf pondweed will start growing under the ice. Coontail will overwinter and start growing in the early spring. Therefore it was not surprising that milfoil, curly-leaf, and coontail were present during the pre-treatment survey. Most native species typically start their growth after early spring and thus were not expected to be present during the pre-treatment survey.

The decrease in curly-leaf pondweed during the post-treatment survey is not related to the chemical control. The chemical used does not impact curly-leaf pondweed. Instead, the life cycle of curly-leaf pondweed is such that it starts to die-off when water temperatures rise at the end of June and beginning of July. Visual observations during the post-treatment survey indicated that the east side of the lake (east of the boat launch) included a large population of Eurasian water milfoil.

In conjunction with the US Army Corps of Engineers, lake district volunteers collected water samples after the 2010 chemical treatment to analyze them for chemical residuals. The goal was to determine the amount of chemical and the length of time that the chemical was still active in the water. Because the physical and chemical characteristics of each lake are different, this sampling is beneficial to determining future treatment regimes. This information can help to determine the future dosage of chemicals that should be used to treat exotic plants in Lower Spring Lake. In addition, the location of the treatment could be adjusted to achieve more coverage of the chemical given the water flow through the system.

The residual sampling was done both within and outside of the treated area (map located in Appendix D). Water samples were collected at mid depth for all locations. Following completion of each sample interval, 2-3 drops of muriatic acid were added to the sample to fix the herbicide.

The target application rate was 2,000 ug/L ae in the target area and 333 ug/L ae lake wide assuming herbicide dissipation throughout the lake. Mean 2, 4-D concentrations at sample sites in treated areas (424 ug/L ae) were similar to concentrations at sample sites (404 ug/L ae) downstream of the treated area 3 to 6 hours after treatment (HAT) (Chart 5). The mean concentration in the treated and downstream sites was 268 ug/L ae from 0 to 7 days after treatment (DAT). Concentrations at all sites were less than 100 ug/L (irrigation restriction limit) by 7 DAT, which is more rapid than other large scale 2, 4-D treatments. Dissipation down stream was probably responsible for the relatively short exposure time as water temperatures remained less than 20$^{o}$C (68°F) for the first 7 DAT (Chart 6). Herbicide residual data indicate some dissipation to upstream locations occurred, particularly to site 7 and site 8. Based on data from other lakes, Eurasian water milfoil control may have occurred around site 7. Herbicide concentrations at site 9 were at or near the detection limit. Based on the concentrations and exposure times in the treated areas, downstream areas, and site 7, Eurasian water milfoil control in these areas was probably good. As was noted in the post-treatment plant survey, the presence of a large density of Eurasian water milfoil was noted in the area that contains sites 7, 8, and 9.

Chart 5.  Lower Spring Lake 2, 4-D Residual Concentrations, 2010

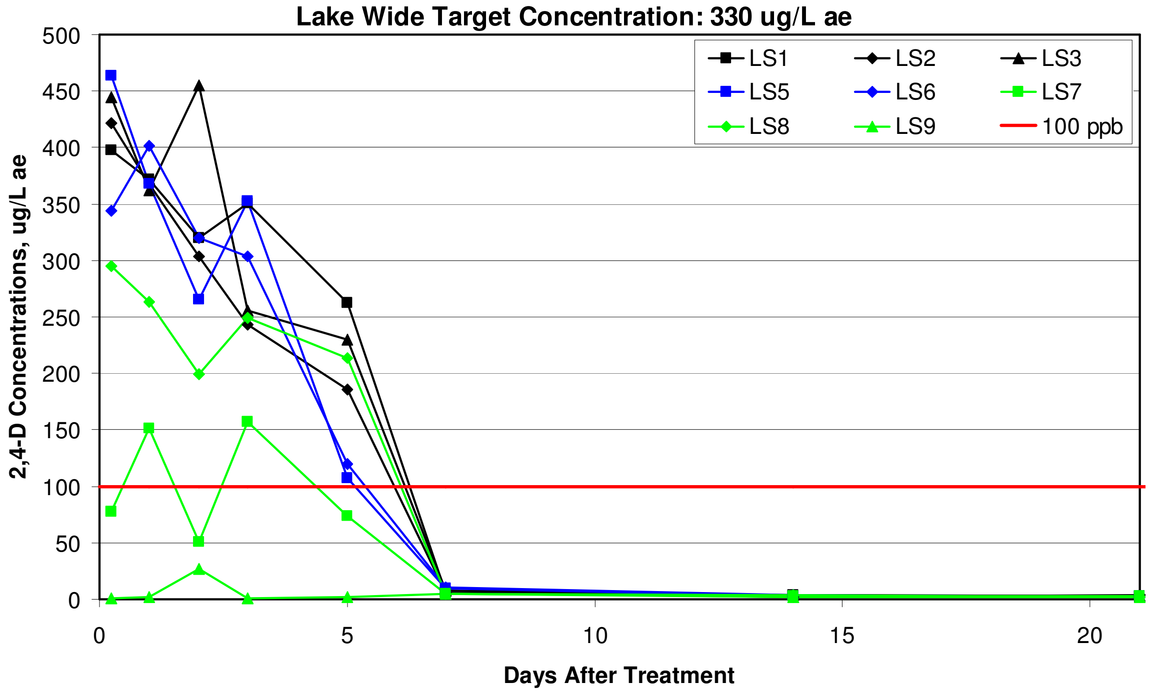
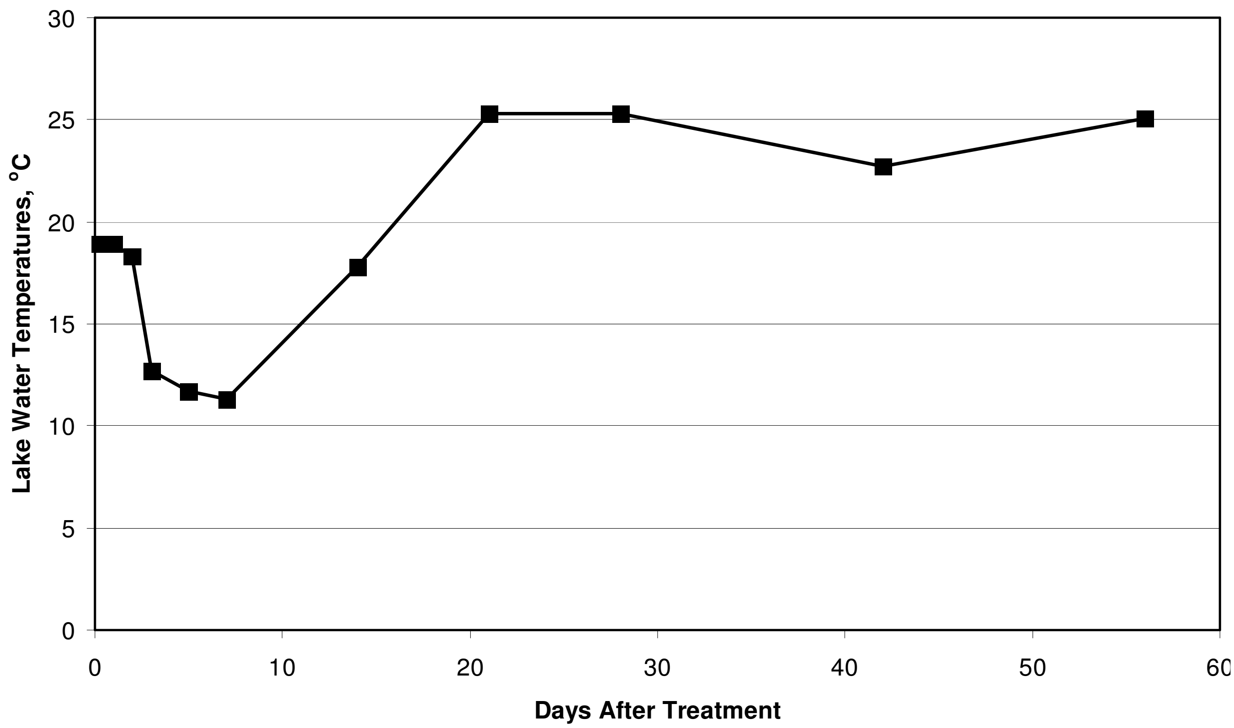



Chart 6.  Lower Spring Lake Water Temperatures, 2010



# AQUATIC PLANT MANAGEMENT – RECOMMENDATIONS

## Problem Identification & Benefits of Plant Management

The Lower Spring Lake Protection and Rehabilitation District is concerned about nuisance levels of exotic species that have been an impediment to recreational use of the lake and is adversely impacting the native plant population, the fish and wildlife, and water quality. A management plan to control the exotic species and foster native plant growth could lead to protection and enhancement of the lake ecosystem and improvement of recreational uses.

Eurasian water milfoil and curly-leaf pondweed grow to the surface of the water (and the milfoil continues to grow across the surface). This can significantly hamper boat passage and other recreational activities such as swimming. The recreational benefits of exotic plant management in the lake could include more areas open to navigation, motors tangled less often with plants, and more areas open for swimming (given adequate depth).

Both Eurasian water milfoil and curly-leaf pondweed can out-compete native plant species and form dense beds. These growth patterns negatively impact the native plants that provide many benefits to the lake. By reducing exotic species in the lake, the native plants should “take back” their areas of coverage. As a result, the biological health of the system will improve.

Fish are also impacted by the growth patterns of exotic species because the dense beds of exotic species prevent fish passage and do not supply ideal fish habitat. With the switch to native plant populations, the fish will have more rearing and refuge areas available to them.

Curly-leaf pondweed complete their life cycle in June and July when they die off. The decaying plant matter releases phosphorus into the water, resulting in algae blooms and sometimes decreases in oxygen. By reducing the population of curly-leaf, these impacts will be lessened.

More information on aquatic exotic species and their impacts on recreation and lake ecology can be found at the following DNR website: http://dnr.wi.gov/invasives/aquatic/.

Ensuring that native plants are not impacted by chemical, mechanical, and manual control techniques is integral to ensuring that the benefits of plant management are achieved. If native are not protected in the lake, then one of the outcomes would be increased algal blooms. In each section on management techniques below, the steps for protecting native species are detailed.

## Plant Management Goals

<u>Goal</u>: The Lower Spring Lake Protection and Rehabilitation District has decided to manage the plants in the lake with a goal of restoration. This means that not only will

the Eurasian water milfoil and curly-leaf pondweed be targeted for control in the entire lake, but also the native plants will be protected.

Current guidance on chemical treatment by the Department of Natural Resources is to have an annual goal of 50% reduction of the target species annually. In addition, if 50% reduction is not reached given proper implementation of the chemical treatment, then it is likely the case that the reduction of exotic species is not achievable in the lake.

This plan recommends the following annual goal for management of exotic species:
- 50% reduction of Eurasian water milfoil (measured with frequency of occurrence)
- 50% reduction of curly-leaf pondweed (measured with frequency of occurrence)

The long term objective of exotic species management in Lower Spring Lake is to achieve a maintenance level of exotic species in the lake of 10% coverage (measured with frequency of occurrence).

Another long term objective is to have a healthy native plant population which will benefit recreational uses, and the functioning of the lake ecology.

There are many variables that can impact the success of aquatic plant control in any given lake. These include: timing of chemical application, residence time of chemical, and inputs such as introductions of exotic species through recreational activities and upstream sources. To the extent possible, the exotic species shall be kept to a minimum so as not to impede navigation or adversely impact native plant species and the lake's ecology. The recommendations below address some of these variables that can impact the success of restoration.

## Chemical Management

The control of aquatic plants through chemicals is regulated by the Department of Natural Resources through Administrative Code NR 107. Among other things, an annual permit for chemical control is required through the DNR.

It is recommended that exotic plants be treated chemically through adaptive management of whole lake treatment followed by spot treatment where exotic species are starting to be re-established. The annual goal is 50% reduction of each exotic species. It should be noted that whole lake treatment of both Eurasian water milfoil and curly-leaf pondweed is expensive and therefore is most likely to be implemented by obtaining a DNR grant. Less then whole lake treatment options may be necessary until a grant is available. Treatment options without a grant should be determined through consultation with the DNR, US Army Corps of Engineers, and LWCD.

The following are the steps necessary for working toward whole-lake restoration of the aquatic plant community. These steps are a summary of the protocol established by the DNR. If the protocols are amended, then the new one should be followed.

1. Baseline information on the plant community – Completed in 2009
   - A whole-lake survey of the plant community using the point/intercept survey method is required. This survey was performed both in 2008 and 2009.
   - Eurasian water milfoil and curly-leaf pondweed have been confirmed as present in the lake by the DNR.
   - Maps of exotic species and native species, including their densities, are included in Appendix B.

2. Dosage of chemicals and area to be treated
   - Determine the dosage of chemicals to be used
   - Determine the area that will be chemically treated

3. Pre-treatment plant survey – spring prior to treatment
   - Obtain pre-treatment survey points from DNR
   - Verify that EWM and CLP are growing and note the locations.
   - Information should be reported to those involved in the chemical treatment.

4. Pre-treatment water monitoring
   - The citizen water quality monitor should take temperature readings (at 2 foot depths) at several locations throughout the lake in the weeks leading up to treatment.
   - This data should be reported to those involved in the chemical treatment.

5. Conduct Treatment
   - Treatment should occur prior to May 31st or before the water temperatures reach 65°F taken 2 feet below the water surface at treatment sites. (permit requirement)
   - Follow all other permit requirements.

6. Post treatment water quality sampling
   - For 4 weeks following the treatment, the citizen water quality monitor should measure water clarity and dissolved oxygen concentrations through out the lake.
   - This information should be shared with those involved in the chemical treatment.

7. Post treatment plant survey
   - Following whole lake treatment: Point-intercept survey of the entire lake
   - Following partial lake treatment: Obtain map of points from DNR. Likely protocol: Sample at least 100 points. Sample a minimum of 4 and a maximum of 10 points per treated acre.
   - Map density of aquatic exotic species
   - Map density of native plants as appropriate
   - Report on frequency of occurrence for all species
   - Complete the pre and post data worksheet to compute results of treatment
   - Create bar graph showing pre and post treatment results for all species
   - Create bar graph showing rake fullness of pre and post treatment results for exotic species

- Summarize results to evaluate the effectiveness on target plants, evaluate any harm or benefit to native plants, and revisit goals and recommendation of aquatic plant management plan
- Identify treatment area for targeting exotic species in the next year

8. Repeat steps above for future years of treatment
    - If the same areas will be treated in the future, then the post-treatment survey for the prior year can be used as the pre-treatment survey – especially when a whole lake P/I survey is conducted.

Changes to this protocol may happen in the future. Therefore, it is important to be in contact with the DNR prior to implementing the main steps of the protocol.

With any large-scale chemical treatment, there is the possibility of unintended adverse impacts. One risk is that native plants could be killed during the treatment. To determine if there are impacts to native plants, it is important to perform pre and post treatment monitoring. Protecting native plants from the chemical treatment is essential to achieving the goals of the treatment. Therefore, the chemicals should be applied in the spring when water temperatures are less than 65°F. During this time, the chemicals will impact only the actively growing plants which are predominantly exotics, and therefore there will be less biomass killed. As a result, there will be fewer decaying plants which will mean fewer algae produced and less oxygen depletion than what would occur following a chemical treatment later in the year.

**Mechanical Removal of Aquatic Plants: Harvesting**

The control of aquatic plants through use of a harvester is regulated by the Department of Natural Resources through Administrative Code NR 109. A DNR permit for mechanical control is required. The current DNR harvesting permit for Lower Spring Lake will expire on December 31, 2010. The District should work with the DNR to submit a new 5-year permit application to cover the period 2011-2015.

In 2009 and 2010, the DNR and the Lower Spring Lake Protection and Rehabilitation District worked together to identify the areas of the lake where harvesting is permitted. A harvesting map (Appendix C) was the result of this work.

Mechanical harvesting should be used as a management tool. However, it is important to understand that mechanical harvesting could lead to adverse impacts if not implemented properly. Native plants could be harvested – which impedes the success of the plant management goals because native plants need to be able to grow and expand into areas that were once populated by exotic plants. In addition, exotic plant fragments that are not captured by the harvester could take root and maintain the density of exotics in the lake. Native plants should be protected from harvesting in order to achieve the goals of exotic species control. The guidelines listed below are meant to protect native plant species.

It is recommended that mechanical harvesting of plants be done when the density of the plants start hindering recreational uses of the lake. The harvester should be used for control of nuisance plants given these guidelines:

- After chemical control, district representatives will regularly assess the growth of Eurasian water milfoil and curly-leaf pondweed
- If populations of Eurasian water milfoil and curly-leaf pondweed are expanding into harvestable areas at nuisance levels, then the harvester can be deployed for control of those areas
- Coontail can also reach nuisance levels and the harvester can be deployed for control of this plant too.
- There should be no harvesting in areas with less the 3 feet of water depth.
- The harvester, according to the DNR, should not be operated north of the two islands located in the lake.
- The harvester should only be operated in the designated areas identified in the harvesting map included in Appendix C.
- Any plants floating in the water after the cutting should be collected by the harvester to prevent these plants from re-rooting and continuing to grow in the lake.
- District representatives should monitor the harvesting operations to ensure that the permit conditions are being followed.

In 2010, the chemical treatment of the lake was so successful that the use of the harvester was significantly decreased from previous years. This situation should continue with adaptive plant management.

There are some areas that used to be harvested in previous years that the public indicated a desire for future harvesting to continue. However, after a review of the rules for harvesting, it was determined that some of these areas were not allowed to be harvested because of water depths less than 3 feet, or the need to protect native plant populations in order to protect and enhance habitat for fish and aquatic life.

As this plan is an adaptive management plan, the District should update the Department of Natural Resources and the Jefferson County Land and Water Conservation Department when they see improvements or problems with the aquatic vegetation in any area of the lake. If there are concerns about navigation in areas not permitted for harvesting, then the District should contact the DNR to inquire about possible amendments to their plan and harvesting permit.

## Shallow Areas in front of Developed Lots

The public expressed concerns about the ability to swim in front of their lake properties. Because of the shallow water depth, the harvester is not allowed by the DNR permit to operate in these areas. Historically, the areas in front of developed properties have had chemical treatments. These treatments should continue as part of future early season chemical treatment if Eurasian water milfoil and curly-leaf pondweed are found during the pre-treatment surveys.

Another available option is the manual removal of exotic species. A DNR permit is not required for the manual removal of aquatic plants provided that the removal meets ALL of the following:

- Removal of native plants is limited to a single area with a maximum width of no more than 30 feet measured parallel to the shoreline. Any piers, boatlifts, swim rafts, and other recreational and water use devises must be located within that 30 foot wide zone.
- Removal of nonnative plants designated by the DNR (such as Eurasian water milfoil, curly-leaf pondweed) is allowed when performed in a manner that does not harm the native aquatic plant community
- Removal of plants from the water is required. This is very important because some plants can effectively re-root if they are left to float in the water.
- The location is NOT in a sensitive area or in an area known to contain threatened or endangered resources. Sensitive areas in Lower Spring Lake have not been designated by the DNR.
- The removal does not interfere with the rights of other lakeshore owners.

A permit is required from the Department of Natural Resources if the manual removal does not adhere to all of the requirements listed above.

Manual removal of plants other than Eurasian water milfoil and curly-leaf pondweed is not recommended. If native plants are removed from an area, that location will be prone to colonization by Eurasian water milfoil and curly-leaf pondweed. The growth of these two exotic species is much more of a nuisance than native plants because of their tendency to grow in dense populations and to grow to the surface of the water. In Lower Spring Lake, coontail is a native plant that some believe to be at nuisance levels. However, this plant is preventing the colonization of the exotic species, and should not be manually removed by landowners.

If landowners are not sure which plants are exotic and which are native, they can contact the LWCD or the DNR for identification information for Eurasian water milfoil and curly-leaf pondweed.

## Funding

Aquatic invasive species control grants may be available from the DNR for an adaptive management approach to controlling exotic plant species and enhancing native plant species in the lake. Grant applications are due twice a year on February 1 and August 1. The Lower Spring Lake Protection and Rehabilitation District should submit a grant application to implement this plan on August 1, 2010. If for some reason the grant is not funded, the grant can be resubmitted (with perhaps some alterations to the application) by the February 1, 2011 deadline. If the grant is approved with either submission, then the plan can start being implemented during 2011.

## Other Recommendations

### Communication and Education

It is important to keep the public informed about aquatic plant management on Lower Spring Lake. Therefore, it is recommended that the Lower Spring Lake District include time at their Board meetings to inform the public about the goals of the plan and the progress for achieving the plan goals. These meetings are an important opportunity for the public to share their perspectives. In addition, if the goals or plans of aquatic plant management are updated, they should be presented to the public for their input.

District meetings are only one way to educate citizens about the aquatic management plan and other lake issues or concerns. Other possibilities include local and regional newspapers, newsletters or e-mail newsletters to district members and interested citizens, and information posted on a local cable access station. In addition, the District could consider hosting an evening event where an expert speaker(s) is invited to give a presentation. Bait shops in town also may be interested in informational handouts for fisherman.

Another important area of education is to make sure those directly involved in the various aspects of the aquatic plant control have the information they need to do the best job. It is recommended that the District ensure that those involved in the manual, chemical, and mechanical control of aquatic exotic plants be educated on the following:

- Identification of target aquatic exotic plants
- The approved techniques and permits required for manual, mechanical, and chemical control
- The importance of a healthy native plant population

### Filamentous Algae

In the past couple years, there have been complaints about the presence of filamentous algae on Lower Spring Lake. During the 2008 plant survey, the frequency of occurrence within vegetated areas of filamentous algae was 16.25% and in 2009 it was 9.41%. The frequency could have been higher in 2008 because the breach of the Upper Spring Lake dam delivered sediment and nutrients into the lake that caused an algae bloom. In 2010, many lakes throughout the region (including Rock Lake and Lake Ripley) were also experiencing higher-than-normal amounts of filamentous algae due to significant rain fall events and warm temperatures.

The presence of filamentous algae should continue to be monitored in future years. It should be noted that the amount of algae and aquatic plants in a lake can vary from year to year. The best option for reduction of filamentous algae in the lake is to control nonpoint sources of pollution. Please see section on “Other Factors Impacting Lake Quality” below.

## Upper Spring Lake and the Scuppernong River

The Scuppernong River flows into Upper Spring Lake before it flows into Lower Spring Lake. Because of the proximity of Upper Spring Lake, the Lower Spring Lake Protection and Rehabilitation District should pursue opportunities to work cooperatively with the owners of the dam at the outlet of Upper Spring Lake. Topics of concern to both lakes are similar and include nonpoint source runoff, the quality of the Scuppernong River, and aquatic exotic species. There also might be an opportunity to work with the owners of the Upper Spring Lake dam to regulate the water flow out of the dam during the time of chemical treatment. In the same sense, the outlet dam for Lower Spring Lake could also be regulated during chemical treatment. However, the ability to do this at both dams should be researched to ensure that the DNR rules regulating the operation of the dams are followed.

Periodically, the Lower Spring Lake District should determine what exotic species have been documented in the Scuppernong River. The flow of the river is such that species found upstream of the lake will likely make it to Upper and Lower Spring Lake. Therefore, it is good to be prepared and look for the species that are in the Scuppernong River that may soon infest Upper and Lower Spring Lakes. More information on monitoring is contained in the section below. More information on aquatic exotic species, including maps showing where different aquatic exotic species are found are located on the DNR website at: http://dnr.wi.gov/invasives/aquatic/.

## Exotic Species Monitoring

Lower Spring Lake is a lake vulnerable to introductions of new aquatic exotic species. As the District is working on controlling the existing, established exotic species, they should also be monitoring for the presence of new aquatic exotic species. It is much less expensive and more effective to control a new, small infestation of a nuisance species than to try to combat a species that is established throughout the lake.

Some citizens of Lower Spring Lake attended an aquatic exotic species monitoring workshop in 2009 given by the Jefferson County Land and Water Conservation Department. The District should encourage these citizens to start periodic monitoring for exotic species.

The following is a list of potential invaders that citizen volunteers should search for in the lake: rusty crayfish, red swamp crayfish, zebra mussels, quagga mussels, mystery snails, spiny and fishhook waterfleas, freshwater jellyfish, hydrilla, and New Zealand mudsnail. If any suspicious species are found, then a sample should be collected, the location marked, and the sample given to the Jefferson County Land and Water Conservation Department and/or the Department of Natural Resources to confirm the identification of the species.

If a new exotic species is found in the lake, the LWCD and DNR can assist with steps for controlling the new infestation, including a DNR rapid response grant if expenditures are needed to address the infestation. Control options for new species introductions will vary depending on the species found. Options could include hand-pulling, chemical treatment, placement of benthic barriers, dredging, or trapping if the species is an animal. It should be noted that DNR permits will likely be necessary for these control options.

Though purple loosestrife has been identified along the shoreline of Lower Spring Lake, its exact locations and densities are not known. It is advisable for monitors to document the location and density of purple loosestrife. There is a very effective biological control (a beetle) for large populations of purple loosestrife. Citizens across the state, including school groups, scouts, and lake organizations, have worked to raise the beetles, and place them in infested areas to control the loosestrife populations. For small populations of purple loosestrife, the most effective control is manual and chemical control. Prior to seed production, the stems should be cut and bagged. The remaining stalk is then treated with a chemical such as rodeo that is suitable for near-water application.

**Clean Boats, Clean Waters**

The Clean Boats, Clean Waters volunteer watercraft inspection program assists Wisconsin residents in stopping the spread of exotic species. The Wisconsin DNR, UW-Extension, and Wisconsin Association of Lakes have put together a workshop to train volunteers to implement a boater education program in their community. Volunteers then educate boaters at the boat landing on how exotic species can be spread via boats and bait. They also check boats and trailers for exotic species, distribute informational pamphlets, and provide boaters with information on infested waters.

Though the boat launch at Lower Spring Lake reportedly receives low traffic, it still remains a point of entry for new exotic species to the lake. The Lower Spring Lake Protection and Rehabilitation District should search for citizens willing to go through the Clean Boats, Clean Waters training and spend some time volunteering at the boat launch. Patricia Cicero with the Jefferson County Land and Water Conservation Department has been taught to provide the Clean Boats, Clean Waters training. In addition, trainings are sometimes held in other near-by counties. For more information or to inquire about area trainings, please contact:

Erin (Henegar) McFarlane
Aquatic Invasive Species Volunteer Coordinator
Phone: 715-346-4978
E-mail: erin.mcfarlane@uwsp.edu

**Other Factors Impacting Lake Quality**

The quality of a lake is not only related to a balanced aquatic plant community, but also to a variety of factors including agricultural runoff, pollution entering through storm drains, construction site erosion, shoreline erosion, and shoreland habitat. As the Lower Spring Lake Rehabilitation and Protection District moves forward on protecting the lake, they should consider taking steps toward improving these factors also.

Other lake districts, including the Lake Ripley Management District, have budgeted money to help defray the costs of conservation practices for landowners who want to control nonpoint source pollution from agricultural and residential lands.  In addition, the Jefferson County Land and Water Conservation Department can assist with addressing nonpoint source pollution through technical expertise and various cost-share programs available from the county, state, and federal governments.  The Lower Spring Lake District would certainly benefit from finding out more about these programs.

Construction site erosion can be a major source of sediment and nutrient pollution to the lake.  Both the Village and Town of Palmyra have hired building inspectors whose job is to ensure that erosion control is installed prior to land disturbance and maintained until the site is vegetated.  It is a good idea for the Lake District to find out more about the laws associated with erosion control and communicate the importance of construction site erosion control and enforcement to the Village and Town of Palmyra.

Shoreland areas are an integral part of a vital lake ecosystem.  Over-development or inappropriate development of the shoreland area can impact plant growth and degrade habitat and water quality.  When native vegetation is replaced by lawns, the result can be shoreland erosion, near shore algal blooms, and loss of habitat.  The Lake District should encourage landowners to install native vegetation next to the lake.  The Jefferson County Land and Water Conservation Department can assist landowners with technical expertise as well as cost-sharing to defray the costs of implementing a native restoration.  Please also see the public discussion regarding the lakeshore adjacent to Hwy 59 found on page 18.

# REFERENCES

Hauxwell, Jennifer, Susan Knight, Kelly Wagner, Alison Mikulyuk, Michelle Nault, Megan Porzky, and Shaunna Chase. March 2010. Recommended Baseline Monitoring of Aquatic Plants in Wisconsin. Madison, WI: Department of Natural Resources.

Environmental Horizons, Inc. September 2005. An Aquatic Plant Management Plan for Lower Spring Lake. Racine, WI.

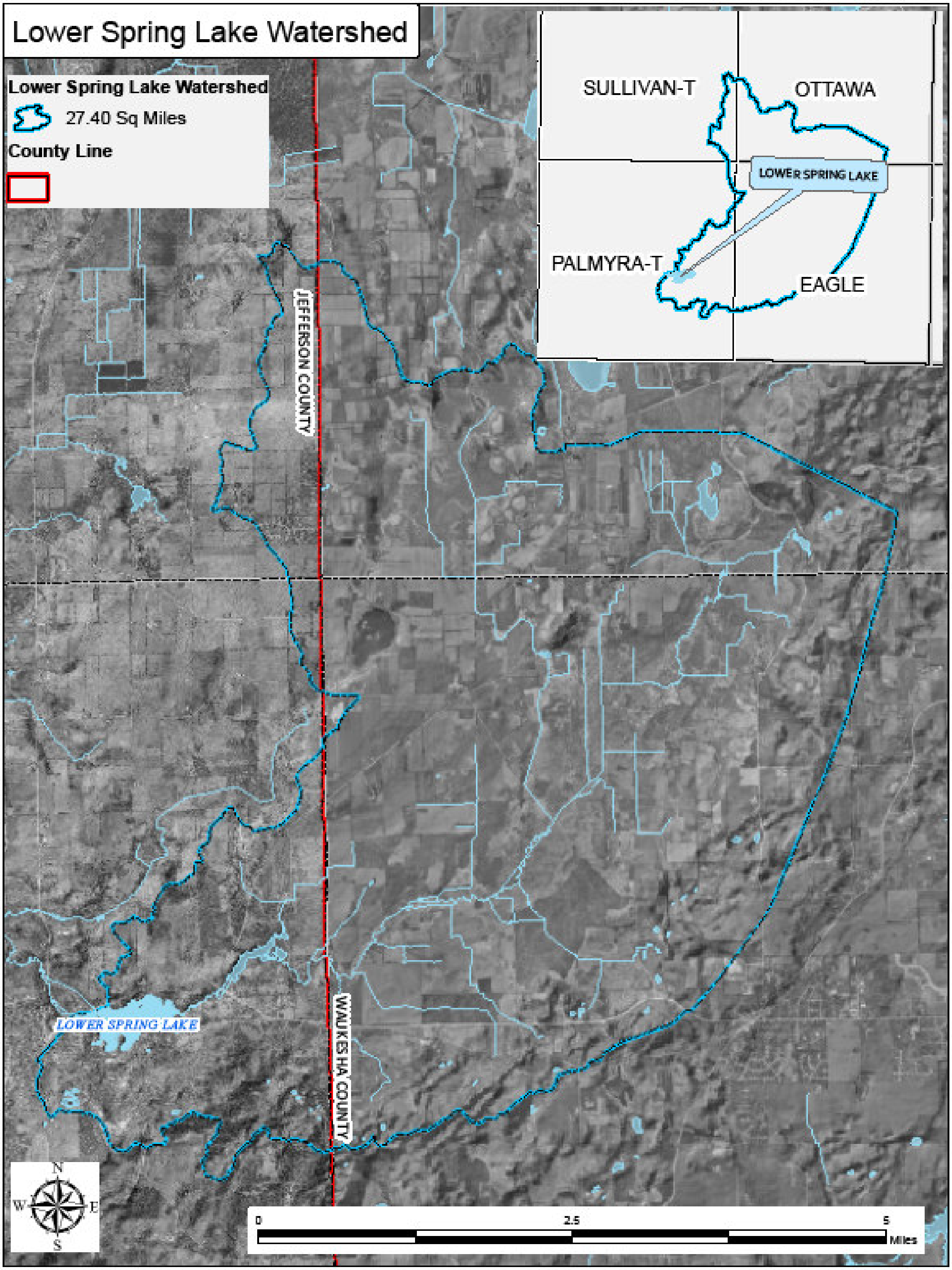
Northern Environmental. January 25, 1994. Aquatic Macrophyte Survey: Lower Spring Lake. Mequon, WI.

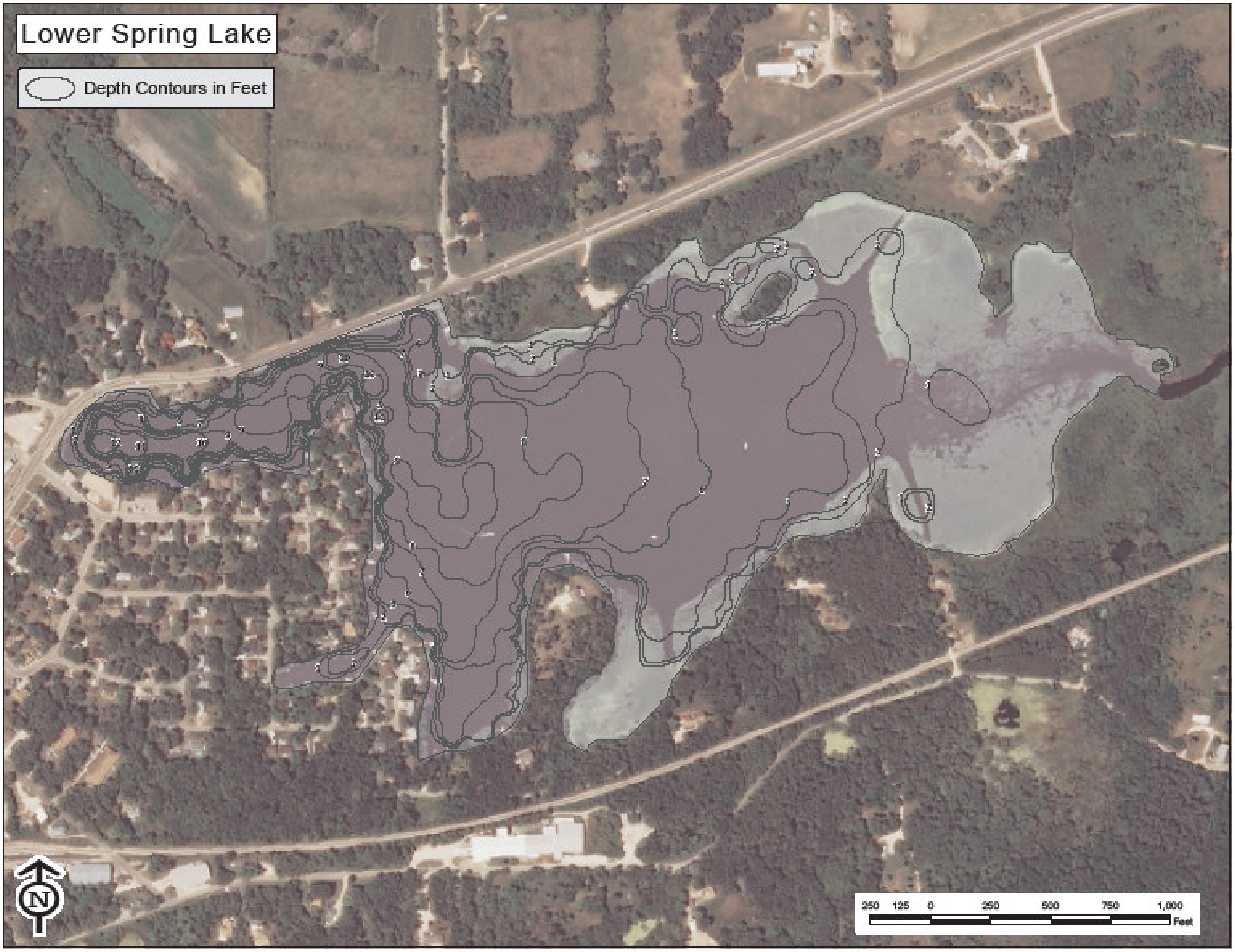
Skogerboe, John. US Army Corps of Engineers. 2010. Herbicide Residual Summary. (not published)

# APPENDIX A.

# LAKE CHARACTERISTICS MAPS


59
MILL RD
ZION RD
ANEMONE AVE
SHORE DR
HILLCREST DR
GROVE AVE
GERANIUM AVE
SPRING VALLEY CT
LOCUST ST
VIOLET AVE
ZINNIA AVE
330 165 0 330 660 990
Feet
Map compiled by the Jefferson County Land & Water Conservation Dept
Color Ortho Photo Source: NAIP July 2008

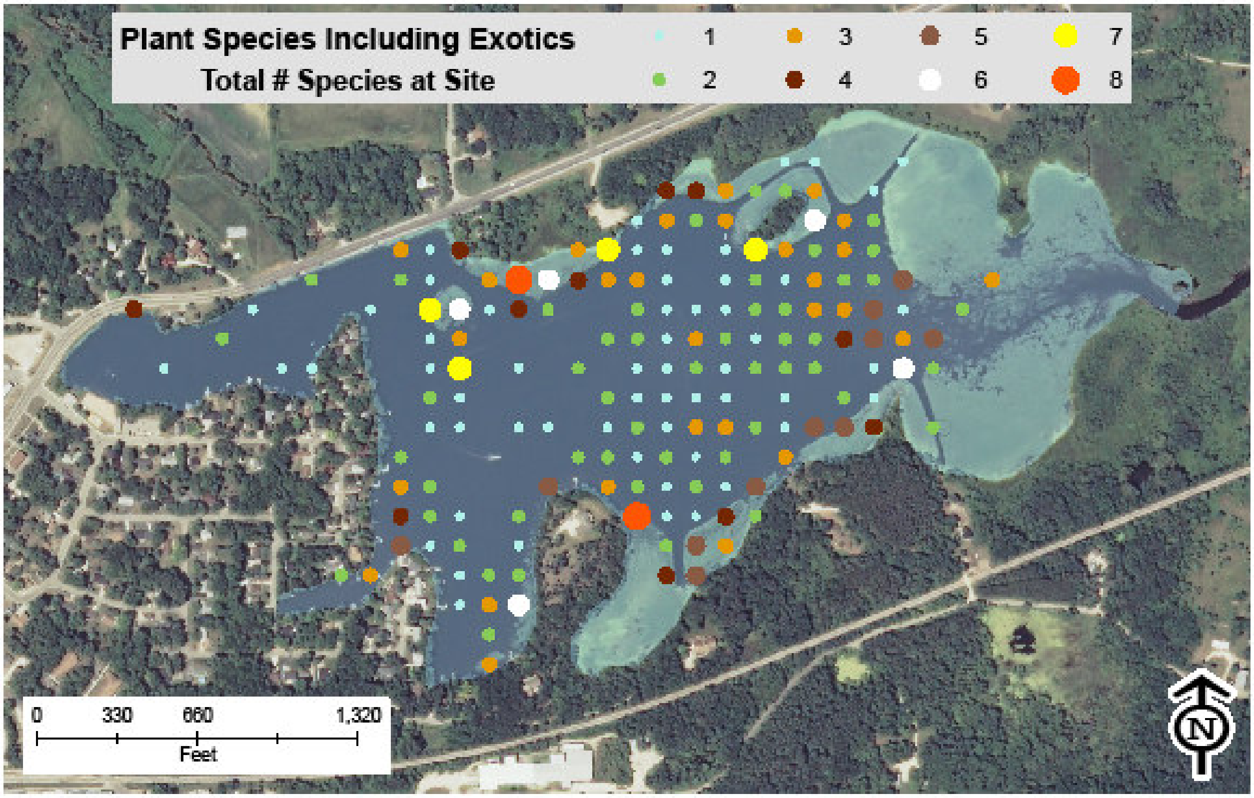

Lower Spring Lake Watershed
Lower Spring Lake Watershed
27.40 Sq Miles
County Line
SULLIVAN-T
OTTAWA
LOWER SPRING LAKE
PALMYRA-T
EAGLE
JEFFERSON COUNTY
WAUKESHA COUNTY
LOWER SPRING LAKE
N
W
E
S
0
2.5
5
Miles

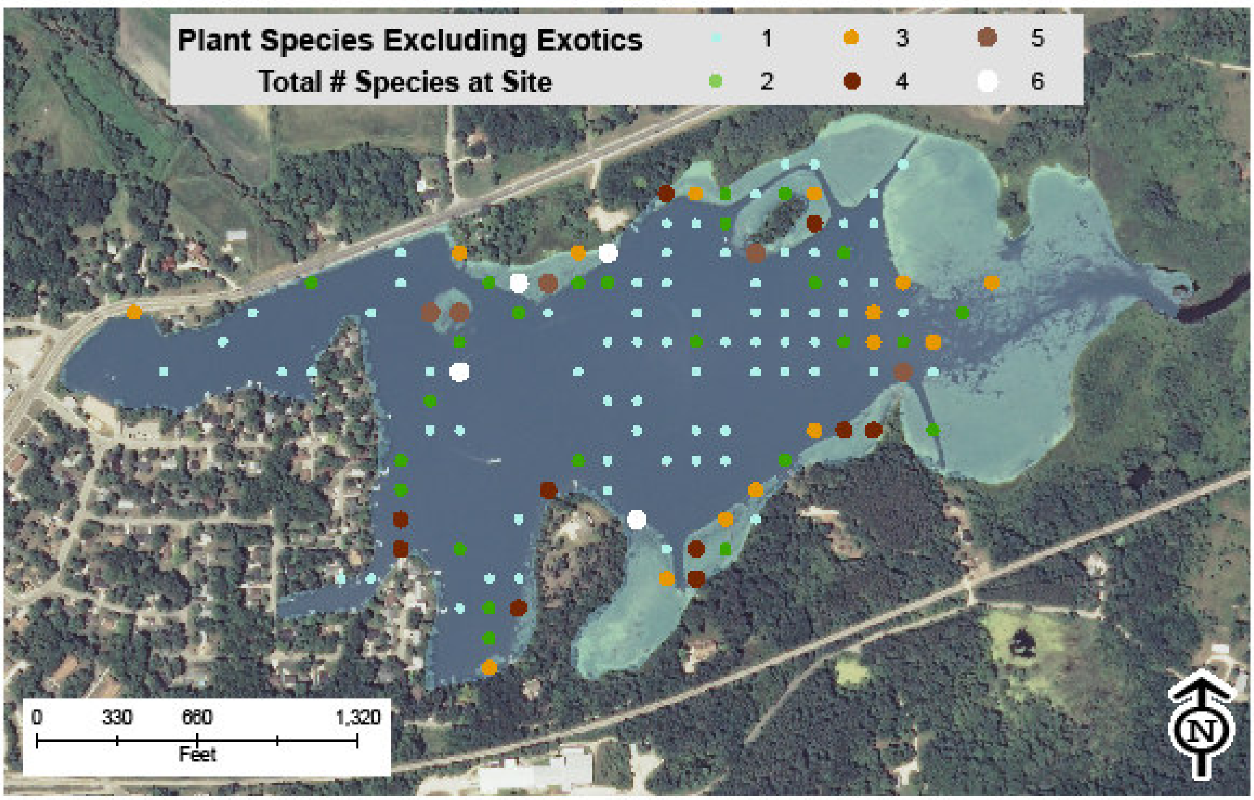

Lower Spring Lake
Depth Contours in Feet
250 125 0 250 500 750 1,000
Feet
N

# APPENDIX B.

# AQUATIC PLANT SPECIES MAPS

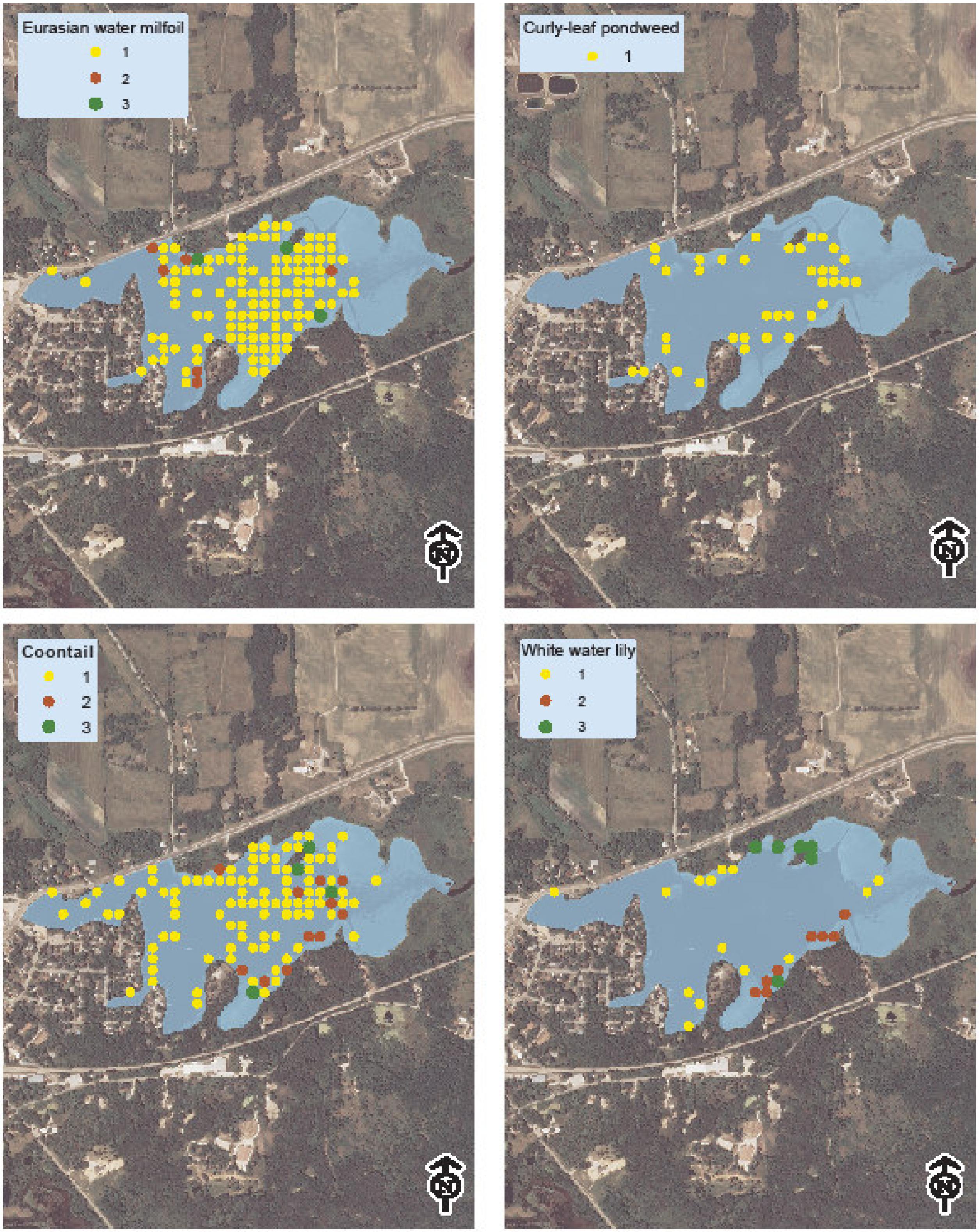
## Lower Spring Lake Total Number of Plant Species



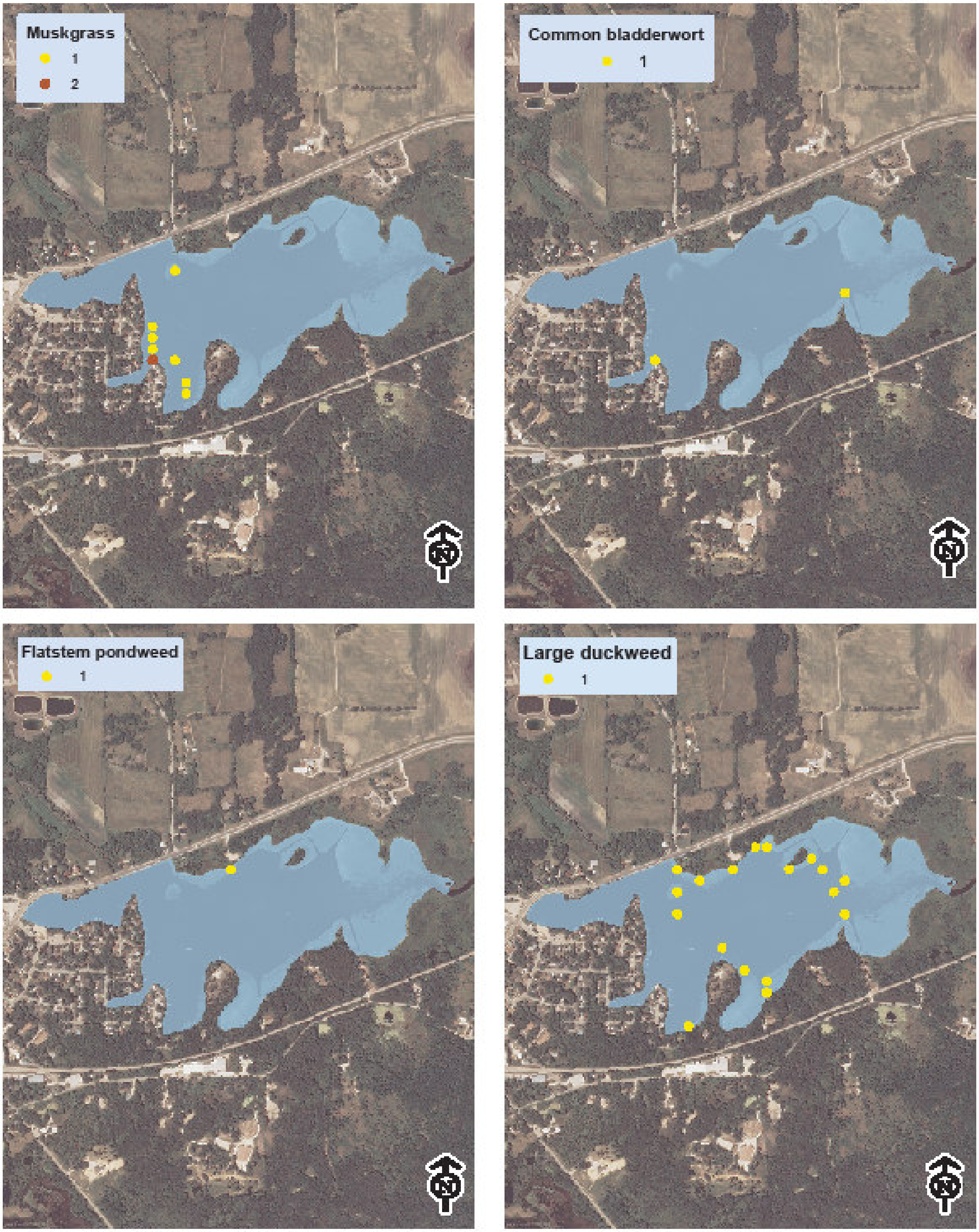
# Aquatic Plant Densities

Rake Sampling Plant Density
1 = Few Plants on Rake
2 = Rake head 1/2 - full
3 = Rake overflowing



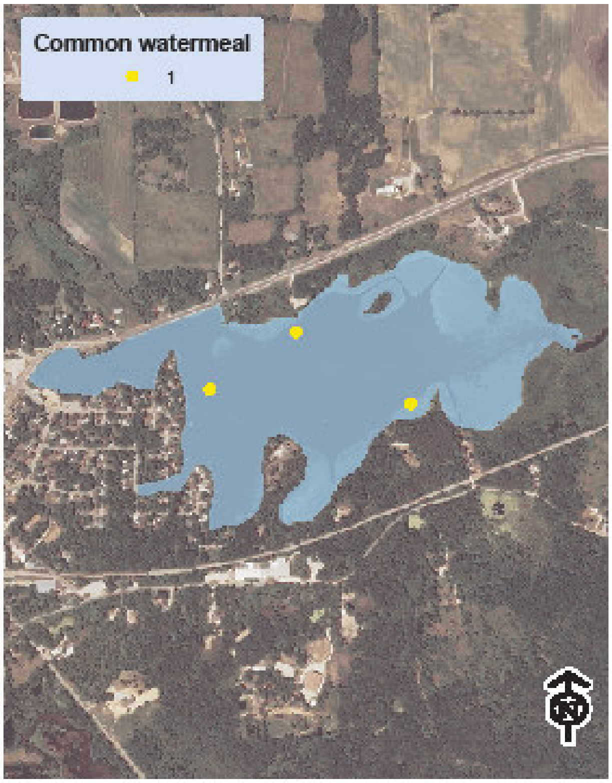
# Aquatic Plant Densities

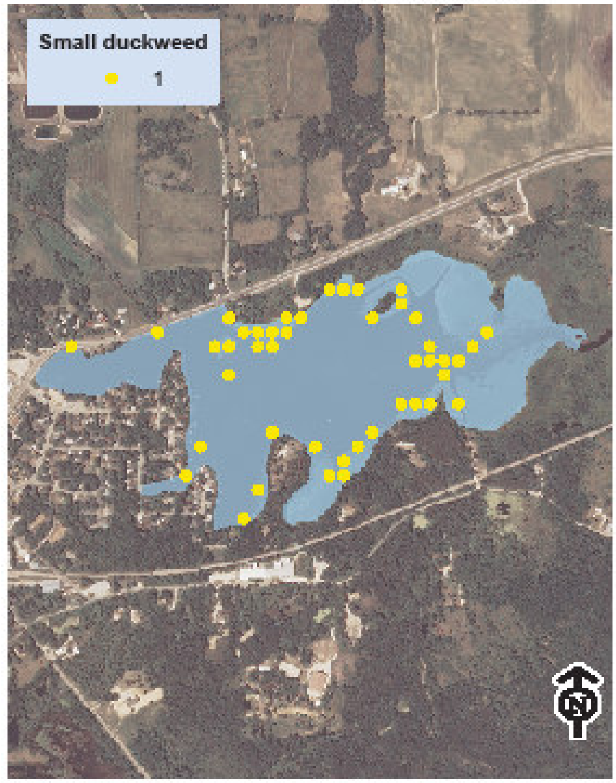
Rake Sampling Plant Density
1 = Few Plants on Rake
2 = Rake head 1/2 - full
3 = Rake overflowing



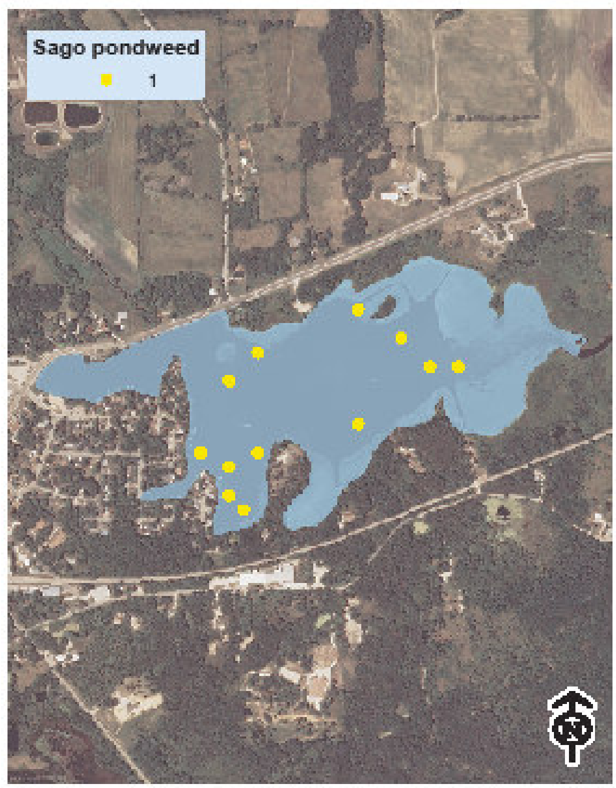
## Aquatic Plant Densities

Rake Sampling Plant Density
1 = Few Plants on Rake
2 = Rake head 1/2 - full
3 = Rake overflowing



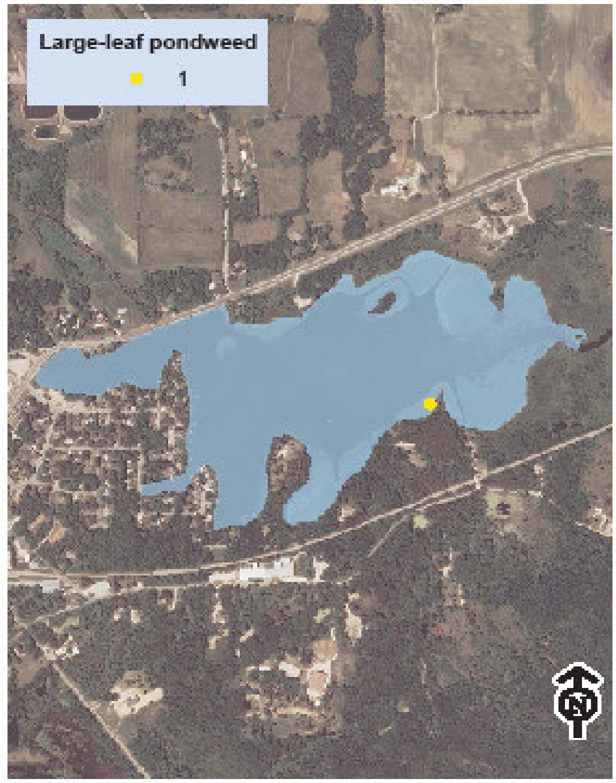





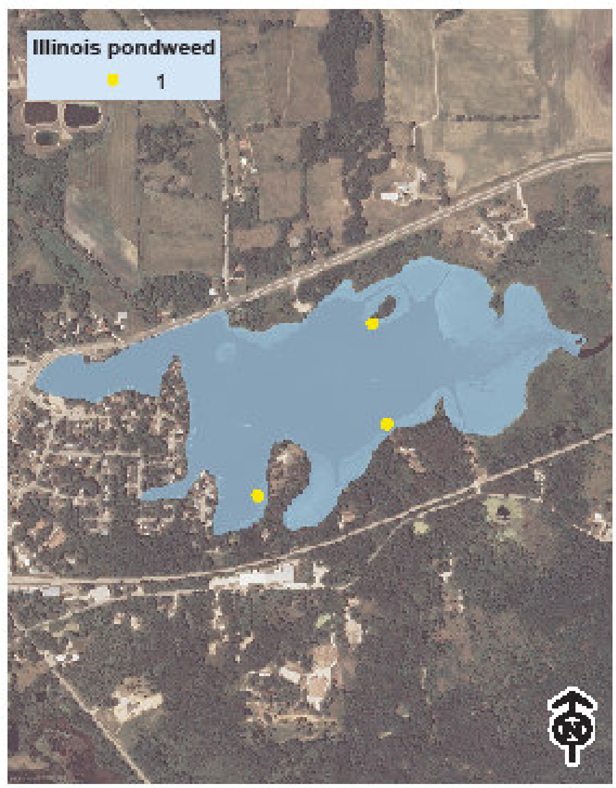


## Aquatic Plant Densities

Rake Sampling Plant Density
1 = Few Plants on Rake
2 = Rake head 1/2 - full
3 = Rake overflowing



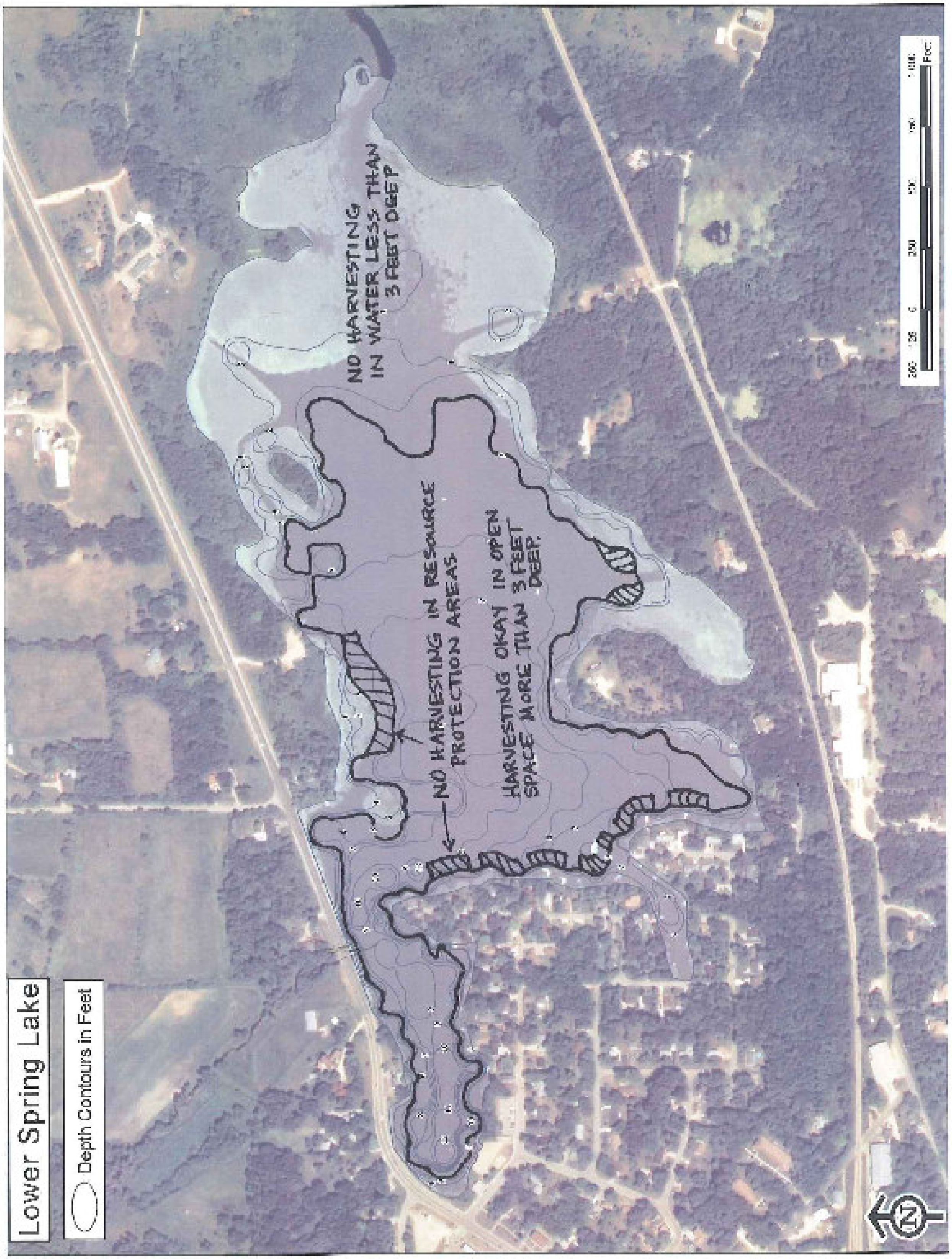


# Aquatic Plant Densities

Rake Sampling Plant Density
1 = Few Plants on Rake
2 = Rake head 1/2 - full
3 = Rake overflowing

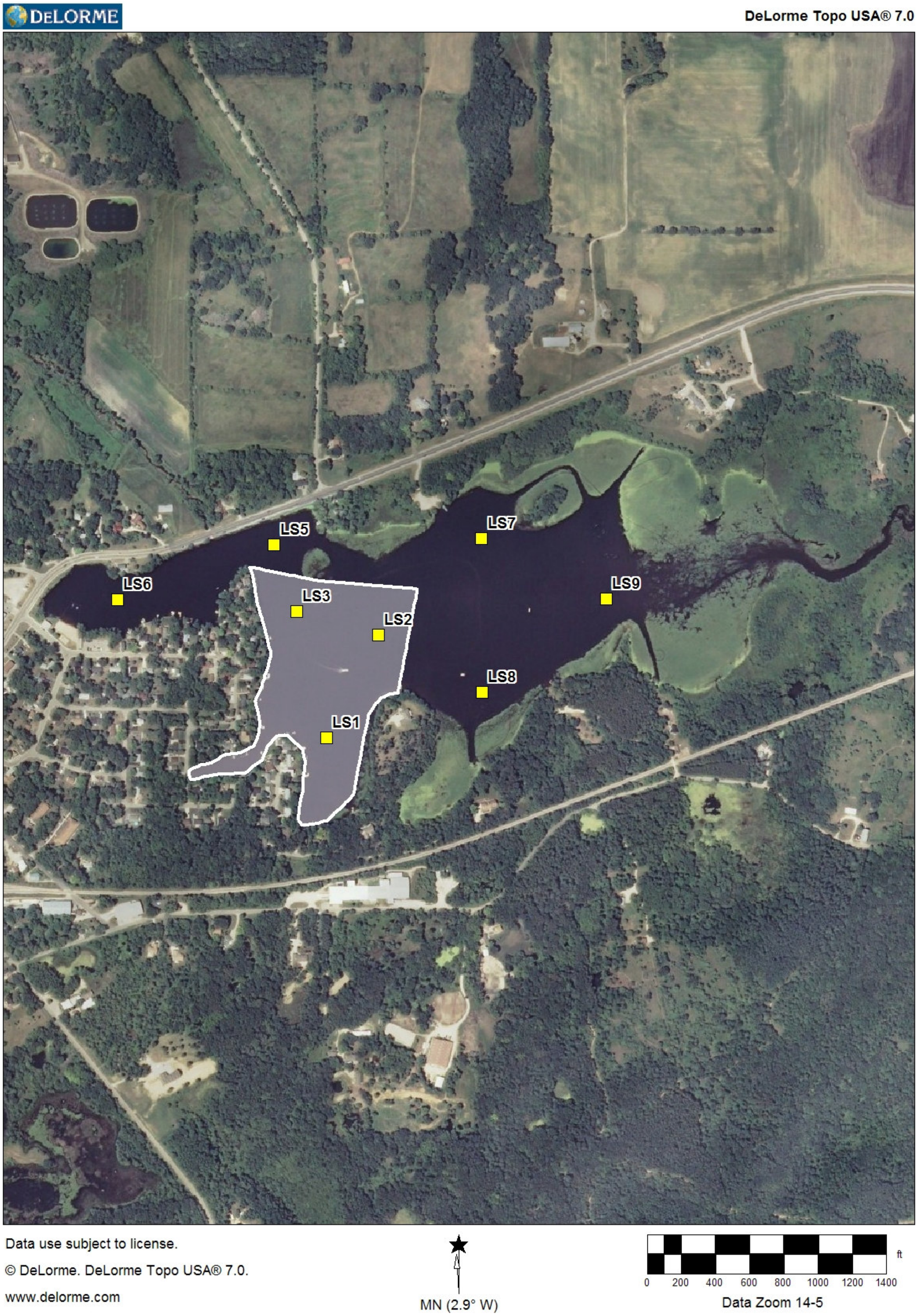

# APPENDIX C.

## HARVESTING PERMIT MAP


Lower Spring Lake
Depth Contours in Feet
NO HARVESTING IN WATER LESS THAN 3 FEET DEEP
NO HARVESTING IN RESOURCE PROTECTION AREAS
HARVESTING OKAY IN OPEN SPACE MORE THAN 3 FEET DEEP

# APPENDIX D.

## CHEMICAL RESIDUAL SAMPLING POINTS


DELORME
DeLorme Topo USA® 7.0
LS5
LS7
LS6
LS3
LS9
LS2
LS8
LS1
Data use subject to license.
© DeLorme. DeLorme Topo USA® 7.0.
www.delorme.com
MN (2.9° W)
0
200
400
600
800
1000
1200
1400
ft
Data Zoom 14-5