# Comprehensive Lake Management Plan
## for Chute Pond, Oconto County, Wisconsin

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# Executive Summary

A thorough study of Chute Pond, Oconto County, Wisconsin was conducted in 2012. Project elements focused primarily on the aquatic plant community of Chute Pond, and water quality parameters. This project was funded by the Wisconsin DNR's Lake Planning Grant program and the property owners and members of the Chute Lake Protection and Rehabilitation District.

Results of this study include:

- The most abundant plant species encountered in Chute Pond were coontail (*Ceratophyllum demersum*), common waterweed (*Elodea canadensis*), forked duckweed (*Lemna trisulca*) and wild celery (*Vallisneria americana*). Native aquatic plants often reach nuisance levels in the lake. The District has operated mechanical harvesters for a number of years to facilitate recreational use of the lake.
- Eurasian watermilfoil (*Myriophyllum spicatum*) and curly-leaf pondweed *(Potamogeton crispus*) were first identified on Chute Pond in the summer of 2007. A proactive approach to management these species including annual surveys and herbicide treatments have taken place since 2008. The nature of Chute Pond has made it difficult to manage these species on a large scale.
- Analysis of plant data via the Simpson Diversity Index, the Coefficient of Conservatism and the Floristic Quality Index indicated that the quality of the aquatic plant community of Chute Pond is at or above average for flowages in the State.
- Chute Pond has moderate water quality, and would be categorized near the lower boundary of a eutrophic lake with some summer nutrient, chlorophyll and clarity data at undesirable levels.
- Dissolved oxygen measurements indicate sufficient levels of oxygen were present down to at least 7 feet in Chute Pond throughout the growing season. Data also indicate the lake stratifies in the deepest locations during the summer months.
- The watershed of Chute pond is 180.4 square miles. A majority of the watershed is forest and wetland. A small portion of the watershed is agriculture and urban areas. Areas of significant disturbance were not found within the watershed.
- In April and October 2002, WDNR staff conducted fish surveys of Chute Pond using fyke nets and electroshocking, respectively. Chute Pond is scheduled to be surveyed again in 2013. Overall, results of the 2002 surveys indicate Chute Pond is capable of maintaining a quality size fishery with comparable growth rates for northeast Wisconsin.
- Over 44,400 walleye (*Sander vitreus*), and approximately 2,900 muskellunge (*Esox masquinongy*) were stocked in Chute Pond from 1972 to 1977 and from 2003 to 2011.

# Introduction

## Project Area

Chute Pond is a flowage located in northwest Oconto County within the Chequamegon-Nicolet National Forest near the Town of Mountain (**Figure 1**). It has a surface area of 433 acres, maximum depth of 18 feet and is fed by the North Branch of the Oconto River (**Figure 2**). It contains approximately 2,759 ac-ft of water. An Oconto County park with a swimming beach, campground, public fishing pier and boat landing are located on the northeast shore of the lake. There is an additional boat launch on the south shore and two additional public access sites. Chute Pond has approximately 10 miles of shoreline. Approximately 70% of this shoreline is developed. The remaining 30% is in public ownership by the National Forest and Oconto County. The dam on Chute Pond was installed in 1937 and maintains a 13-foot head during the summer months. In the winter, the water is routinely lowered one foot. The Flowage receives heavy recreational use in the summer by anglers, skiers and boaters.

Chute Pond is a unique artificial water body with shallow water, numerous stumps and rocks, over-abundant native plant growth and wide-spread aquatic invasive species.

Chute Pond contains a diverse assemblage of native aquatic plants. The dominant species include coontail (*Ceratophyllum demersum*), common waterweed (*Elodea canadensis*), forked duckweed (*Lemna trisulca*) and wild celery (*Vallisneria americana*). Eurasian watermilfoil (*Myriophyllum spicatum*) and curly-leaf pondweed (*Potamogeton crispus*) are two exotic invasive species that are also present in large quantities in Chute Pond.

The lake contains a variety of panfish species, largemouth bass (*Micropterus salmoides*), northern pike (*Esox lucius*), muskellunge (*Esox masquinongy*), walleye (*Sander vitreus*), and trout (*Oncorhynchus* spp.). Fish stocking was conducted on Chute Pond extensively in the 1970's and to a lesser extent in between 2003 and 2011. The Wisconsin Department of Natural Resources (WDNR) conducted fish surveys in 1988 and 2002.

The Chute Lake Protection and Rehabilitation District is the principle management unit representing the interests of riparian property owners and other lake users. In 2007, the District sponsored an aquatic plant survey of the lake, and the development of an aquatic plant management plan. Given the multitude of issues at hand, it was decided that a management plan update was in order. In 2012, The Chute Lake P & R District received a Lake Planning Grant from the Wisconsin DNR to develop a lake management plan.

A study of Chute Pond was conducted in 2012. The purpose of this study was to address the District's concerns regarding invasive species proliferation and spread, as well as water quality, fishery quality, scenic beauty and recreation. The results of this study are presented in this report. It also includes interpretation and implications of these results, as well as an analysis of management options. This report will be used as a basis for an update to the District's current management plan.

**Recent Management Activities**

**2007**

Like many Wisconsin lakes, Chute Pond has experienced the invasion of Eurasian watermilfoil and curly-leaf pondweed. Both of these species have the potential to create negative ecological and recreational use of a lake. In the summer of 2007 Northern Environmental Technologies, Inc. surveyed Chute Pond as part of a study leading to an aquatic plant management plan for the District. During this survey, both Eurasian watermilfoil and curly-leaf pondweed were identified. Neither of these species had been documented in Chute Pond prior to 2007. All plant survey maps from 2007 to 2012 are found in **Appendix A**.

**2008**

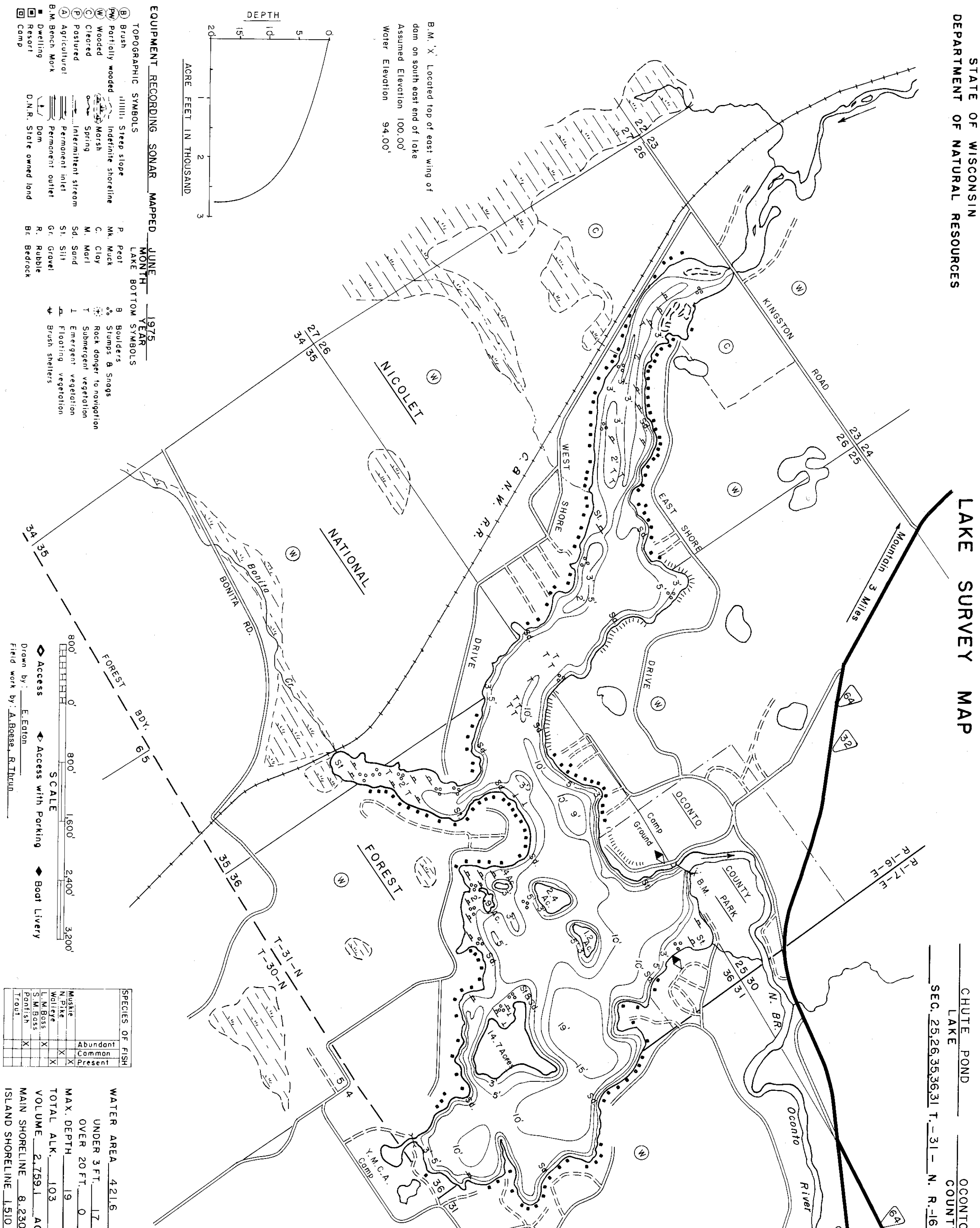
In 2008, Northern Environmental Technologies, Inc. completed the management plan for Chute Pond. Because Eurasian watermilfoil and curly-leaf pondweed were known to expand quickly, chemical treatments for these two species began in the spring of 2008. On May 15, 2008, Cason & Associates staff surveyed Chute Pond to map the distribution of exotics. Results indicated nearly 53 acres of curly-leaf pondweed and approximately nine acres of Eurasian watermilfoil were growing in the lake at the time of the survey. On May 22, 2008 the full distribution of curly-leaf pondweed was treated on Chute Pond with Aquathol K® (liquid endothall) at a rate of 1.0 gal/ac-ft (1.5 ppm). A month later, on June 18, Eurasian watermilfoil was treated with Navigate® (granular 2,4-D) at a rate of 150 lbs/acre. These were the first treatments of their kind on Chute Pond.

**2009**

On May 15, 2009, 10.5 acres of Eurasian watermilfoil were mapped in Chute Pond. Most of these locations were found outside of the previously treated areas from 2008. Cason & Associates, LLC staff treated these areas on June 9, 2009 with Navigate® at 150 lbs/acre (estimated whole-lake concentration following treatment was 0.06 ppm 2,4-D a.i.). At the time of treatment, additional locations of milfoil were found. Again these areas were outside previously treated or mapped locations. In total, an additional 20.6 acres of milfoil were identified. On June 25, 2009, these newly discovered areas were treated in the same manner as the previous treatment (estimated whole-lake concentration following treatment was 0.11

**Figure 1. Area surrounding Chute Pond, Oconto County, Wisconsin.**

**Figure 2. Bathymetric map of Chute Pond, Oconto County, Wisconsin (1975).**



ppm 2,4-D a.i.). Treatments for curly-leaf pondweed were suspended due to the increased urgency in milfoil management as well as budgetary considerations. During the 2009 season, weed harvesting took place on Chute Pond, but only in a limited fashion. Weed harvesting can contribute to the spread of Eurasian watermilfoil. As a result, maps of the known milfoil distribution were provided to the harvester operators with the understanding that they were not to operate within or adjacent to the areas indicated.

A post-treatment survey of Chute Pond was conducted on October 13, 2009 to assess the effectiveness of the treatments. This survey was also used to document additional areas in need of treatment. Because of the threat posed by Eurasian watermilfoil, a more detailed survey was conducted. This survey utilized the point-intercept map provided by the Wisconsin DNR (**Figure 3**). At each location, the presence or absence of exotic species, namely Eurasian watermilfoil, was determined using surface observations and rake tows.

Areas of milfoil identified between sample points were also noted and used to delineate larger beds of milfoil where appropriate. There were a total of 109.4 acres of milfoil mapped during this survey. This was predominantly a new infestation. In previously treated areas, either no milfoil or sparse milfoil was found.

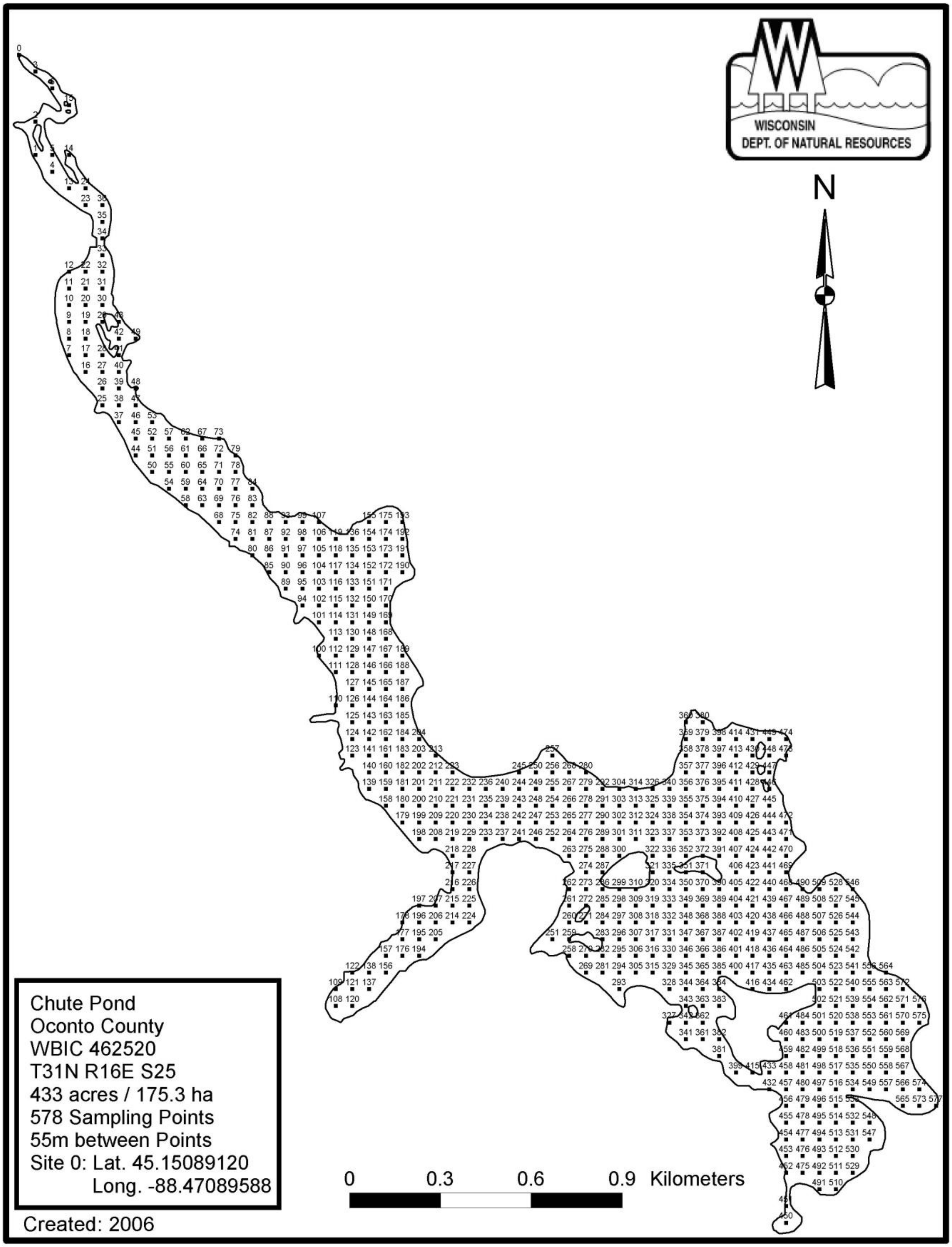
**2010**

Over the winter of 2009/2010, the District decided on chemical treatment as the most feasible management approach. On May 18, 2010, all 109 acres of Eurasian watermilfoil were targeted using Navigate® at a rate of 100 lbs/acre. This should have resulted in a theoretical concentration of 0.40 ppm 2,4-D (a.i.). At the same time, 27 acres of curly-leaf pondweed using Aquathol K®. Prior to treatment, the water level was lowered and the dam was closed to minimize dilution and increase the chemicals' contact time. During the summer, all cutting activities were suspended in order to minimize the spread of milfoil. A post-treatment aquatic invasive species mapping survey of Chute Pond was conducted on October 19, 2010. A total of 77.8 acres of Eurasian watermilfoil were mapped. A majority of the surviving milfoil was found in the upper stretches of the lake where the water was shallowest and where tree stumps made it difficult to navigate during treatment. The density of milfoil in the areas indicated, varied from sparse to very dense. In previously treated areas, such as the southwestern part of the lake, either no milfoil or very sparse milfoil was found. In some newly identified areas, such as beds C and E, milfoil was dense enough to interfere with navigation.

**2011**

In February 2011, the District, with the assistance of Cason & Associates, applied for and received a three-year Aquatic Invasive Species (AIS) grant from the Wisconsin DNR to continue to manage Eurasian watermilfoil and curly-leaf pondweed in Chute Pond. The grant includes annual (2011-2013) reimbursements of over $57,000 for chemical control of these species as well as pre- and post-treatment monitoring. On May 25 and 26, 2011, the 77.8 acres of milfoil and 27 acres of curly-leaf pondweed were treated in the same manner as previous treatments.

**Figure 3. Aquatic plant survey map for Chute Pond provided by the Wisconsin DNR.**



The lake-wide concentration of 2,4-D was expected to be a 0.29 ppm a.i. At the time of the treatments, it was noted that the distribution of curly-leaf pondweed had expanded greatly; possibly lake-wide. Water levels were not lowered as they had been in 2010 in order to maintain sufficient depth for navigation in the upper stretches of the lake.

During the annual meeting of the Chute Lake P & R District in the summer of 2011, District members reiterated herbicide treatments were effective at controlling milfoil in the areas treated. They also noted an abundance of native plant growth during the summer months. These native plants were causing impairments to navigation and recreation and becoming an aesthetic nuisance by washing up on shore in great quantities. Prior to the meeting, Chad Cason, of Cason & Associates, LLC, joined members of the Lake District on a boat tour of Chute Pond. During this trip, very little milfoil was found. However, Eurasian watermilfoil began to regrow in the fall. A post-treatment point-intercept survey of Chute Pond was conducted on October 3-4, 2011. There were a total of 123.9 acres of milfoil mapped during this survey. The density of milfoil in the areas indicated, varied from sparse to very dense. Milfoil was found throughout the littoral area of the lake. Again, a large amount of milfoil was found in the upper stretches of the flowage.

**2012**

In February 2012, a meeting was held between the Chute Lake P & R District, the Wisconsin DNR and Cason & Associates, with input from the US Army Corps of Engineers. Until this point, Eurasian watermilfoil treatments had relied on the use of granular 2,4-D. These treatments did not provide the desired results, so it was decided a different approach would be used. In the past few years, whole-lake low-dose liquid 2,4-D treatments have gained favor within the DNR. Although Chute Pond is a relatively large lake, the District, facing 123 acres of Eurasian watermilfoil in need of treatment, decided to conduct this type of treatment. Most recently the target concentration for whole-lake 2,4-D treatments in Wisconsin has been 0.25 to 0.40 ppm 2,4-D. Knowing Chute Pond is a flowage and that the inflowing Oconto River would quickly dilute the herbicide, a whole-lake concentration of 0.40 ppm 2,4-D a.i. was chosen. In addition, it was speculated that shifting product upstream would help offset this dilution. As a result, the seven northern-most beds equalling approximately 58.4 acres were treated at a rate of 2.13 gal/ac-ft (3.0 ppm) while the remaining beds (65.5 acres) were treated at a rate of 0.86 gal/ac-ft (1.21 ppm). Just prior to treatment, the river flow was measured at 119.6 $ft^3$/sec by the Wisconsin DNR.

In order to monitor the movement of 2,4-D in Chute Pond after treatment, John Skogerboe, of the US Army Corps of Engineers, devised a monitoring program. Results of this monitoring can be found in **Appendix B**. Samples were collected at 10 locations at intervals of approximately 0.25, 3, 4, 7, 10, 14, 21 and 28 days after treatment. Results from the northern five sites indicate the concentration of 2,4-D peaked within 3 days, but dropped off quickly. The two northern most sites (where a majority of the persistent milfoil was found) showed very low concentrations throughout the study indicating these sites were highly influenced by dilution from the inflowing river. In the southern sites, concentrations peaked around 4-5 days after treatment, but remained elevated longer. This is to be expected since these sites were all outside the main river channel within the flowage. Note, the target concentration in the report by John Skogerboe was listed at 0.3 ppm or 300 ug/L, when, in fact, it was 0.40 ppm or 400 ug/L.

Results of the fall 2012 survey showed 106.9 acres of Eurasian watermilfoil. However, a majority of the plants were identified in the upper most section of the lake where the highest level of dilution likely took place. Most of the main body of the lake, outside the river channel was free of Eurasian watermilfoil.

**2013**

In 2013, the same general approach to the treatment was devised with a few exceptions. At the request of the Wisconsin DNR, a two-stage treatment of liquid 2,4-D was planned. Beds were to be treated twice, 48 hours apart. The northern-most beds were to be treated at a total of 4 ppm (2 ppm applied twice). The remaining beds would not be treated. Normal dispersion of the herbicide was expected to target the remaining beds. The staggered approach was expected to provide a longer herbicide contact time. The total lake-wide concentration after treatment was expected to be 0.48 ppm. It was later determined by the Wisconsin Department of Agriculture that this approach is in violation of the label of liquid 2,4-D; that the label does not allow for consecutive treatments of this type. This was regardless of the fact the combined application rate was within labeled rates. It was decided that endothall would instead be applied during a second treatment. On May 29, 2013 DMA4® was applied at a rate of 2.0 ppm as planned. A week later on June 5, 2013, Aquathol K® was applied at 0.97 gal/ac-ft (1.5 ppm) to the same beds. Although not ideal, this approach had the advantage of not only targeting the Eurasian watermilfoil, but also curly-leaf pondweed.

A post-treatment survey of Chute Pond took place on October 13 – 14, 2013. Although this survey shows there is still significant Eurasian watermilfoil growth in the northern portion of the lake, this species was reduced by 37% as compared to the fall 2012 survey data. The remaining milfoil was again located in the uppermost portion of the lake where flow and dilution are greatest. Approximately 78% of the remaining Eurasian watermilfoil was categorized as either scattered or highly scattered.

# Methods

## Aquatic Plant Assessment

On July 2 and 3, 2012, a submergent aquatic plant survey was conducted utilizing methods developed by the WDNR. The Department's Bureau of Research developed plant survey maps for Chute Pond. A series of 578 grid points were mapped across the lake (**Figure 3**). At each of these locations, aquatic plant samples were collected from a boat with a single rake tow. Following WDNR guidelines, the rake used consisted of two short-toothed garden rake heads welded together. At each sample point, the rake was briefly dragged along the bottom to collect plants. All plant samples collected were identified to *genus* and *species* whenever possible, and recorded. An abundance rating was given for species collected using the criteria described in **Figure 4**. This rating was also used as a tool to map plant abundance within Chute Pond. Data collected was used to determine species composition and diversity, percent frequency and floristic quality.

## Exotic Plant Distribution Mapping

In order to best manage aquatic invasive species in Chute Pond, detailed mapping surveys were conducted in 2012. Spring and fall *focused-point intercept* surveys of Chute Pond were conducted. This focused-point intercept survey approach has been employed on Chute Pond for a number of years. These are aquatic invasive species mapping surveys designed to document the extent of the aquatic invasive species Eurasian watermilfoil and curly-leaf pondweed. throughout the lake. Utilizing the point-intercept map provided by the Wisconsin DNR, the presence or absence of these species is determined at each location using surface observations and rake tows. An abundance rating is given for these species based on the density of plants at a given location. Areas of plant growth between sample points were also noted and used to delineate larger beds where appropriate. Although, the point-intercept map is utilized, these surveys are not intended to collect the same types of data collected during a full, summer, point-intercept survey. The point intercept points are used as a means to ensure systematic coverage of the entire lake; a more thorough approach than a meandering boat survey.

Cason & Associates staff and members of the District monitored the results of previous treatments and identified the locations where these species were in need of further treatment. Care was taken to accurately document the distribution and density of these species during each survey in order to track the progress made by management efforts.

The spring survey was conducted on April 25-27, 2012 and served to best identify the distribution and treatment needs of curly-leaf pondweed while the fall survey, conducted on October 17-18, 2012, focused primarily on Eurasian watermilfoil. These surveys utilized the point-intercept map provided by the Wisconsin DNR (**Figure 3**). At each location the presence or absence of these species were determined using surface observations and rake tows. The abundance of these species was also recorded following the same guidelines used during the summer plant survey and detailed in **Figure 4**. Areas of exotics identified between sample points were also noted.

**Figure 4. Plant abundance rating criteria used in submergent aquatic plant surveys.**

| Fullness Rating | Coverage | Description |
|---|---|---|
| **1** |  | Only few plants. There are not enough plants to entirely cover the length of the rake head in a single layer. |
| **2** |  | There are enough plants to cover the length of the rake head in a single layer, but not enough to fully cover the tines. |
| **3** |  | The rake is completely covered and tines are not visible. |

## Water Quality Assessment

Chute Pond was sampled four times. Samples were collected from the deepest point of the lake on April 25, July 2, August 8, and September 6, 2012. During each of these sampling events the following parameters were measured:

- pH, Conductivity, Alkalinity
- Total phosphorus
- Chlorophyll *a*
- Water transparency (Secchi depth)
- Dissolved oxygen profile
- Temperature profile

Water samples were sent to the State Lab of Hygiene for analysis. Measurements of water transparency, dissolved oxygen and temperature were collected on-site during each sampling event. Oxygen and temperature data were collected at two-foot intervals with the use of a YSI Dissolved Oxygen meter. Transparency data was collected with a standard Secchi disk. Previously collected water quality data, available through the WDNR's Surface Water Integrated Monitoring System (SWIMS) was gathered and compared to the newest sample results.

Chlorophyll *a*, total phosphorus and Secchi depth data collected during the summer months was used to quantify the productivity of the lake (Trophic State Index). Software available from the Wisconsin DNR entitled, Wisconsin Lake Modeling Suite (WiLMS), was used to predict the trophic state of Chute Pond given its size, watershed area, mean depth and eco-region. In addition, this software was used to predict the average total phosphorus concentration in Chute Pond. Comparisons were made between the predicted phosphorus and TSI values and those calculated from the phosphorus, chlorophyll and Secchi data collected during the study. The WiLMS program was also used to estimate the internal nutrient loading occurring in Chute Pond by incorporating nutrient and dissolved oxygen data. These analyses allowed for a more in-depth view of nutrient dynamics in Chute Pond.

## Watershed Assessment

Because much of what happens in the watershed surrounding a lake can impact the overall water quality and health of a lake, it is important to investigate and document aspects of the watershed which can have such an impact.

The boundary of the watershed of Chute Pond was delineated using topographic maps. Data obtained from the Wisconsin DNR's Bureau of Technology Services was used to quantify the land-use and vegetative cover types within the watershed. The percent cover for each of these categories was determined. The Wisconsin DNR website was consulted to determine if environmentally sensitive areas have been designated within the watershed. Land-use patterns, vegetative cover, potential nutrient loading sources, and environmentally sensitive areas were further assessed visually. Because Chute Pond is a flowage formed by the damming of the north branch of the Oconto River, the watershed is quite large. As a result, a visual assessment of the watershed was limited to the more immediate areas.

The WiLMS software was also used to estimate the external loading of runoff pollutants, namely phosphorus, into Chute Pond. The software uses export coefficients for various land-use and cover types as well as precipitation, point sources and septic systems to represent phosphorus loading into the lake from external sources. This software also takes in account lake morphology, watershed drainage area and net precipitation. This analysis will help determine the source of nutrients, namely phosphorus, into the lake.

Since a significant amount of nutrients and sediments can enter a lake from areas closest to the lake, it was important to also focus on the conditions of the lakeshore and identify potential areas of concern. Areas of disturbance, high erosion, or generally poor riparian health was assessed and documented in the same manner as described above. Areas identified were presented with management recommendations for remediation or improvement.

# Citizen Participation

The DNR wants assurance that the project elements and management recommendations fit the concerns of the lake residents. Therefore, a survey of property owners on Chute Pond was conducted by the District Board and lake volunteers. This survey evaluated the health and usage of the lake and helped identify issues to be addressed as part of the larger project. Over 100 surveys were returned to the District. This equates to approximately one third of those sent out to all taxpayers on record within the District. Volunteers analyzed the results and produced the report found in **Appendix C.** Results of this survey was used to direct future management of Chute Pond.

# Results and Discussion

## Aquatic Plant Communities

A total of 34 submergent, emergent and floating-leafed aquatic plant species were found during the 2012 survey (**Table 1**). This is above the state-wide average of 13 species. Chute Pond is in the Northern Lakes and Forests regions of Wisconsin (**Figure 5**). The average number of species found in flowages in these regions is 23.5 species (Nichols, 1999). The most abundant plant species encountered in Chute Pond were coontail, common waterweed, forked duckweed and wild celery. These species were found at 53.8%, 43.5% and 42.5% of the sites within vegetated areas, respectively. **Figures 6-8** show the distribution and density of these species across Chute Pond at the time of the survey.

**Figure 5. Ecoregions of Wisconsin (after Omernick and Gallant, 1988)**

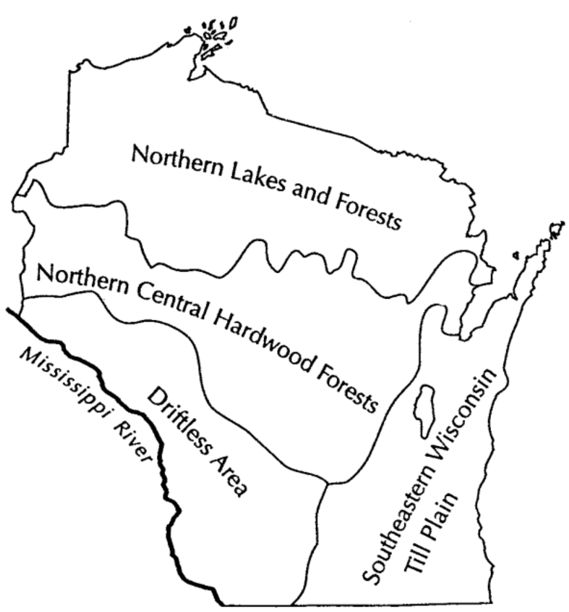



**Table 1** shows the frequency of occurrence for plant species in the lake. Percent frequency values reflect the relationship between the number of locations where a particular species was found versus the total number of locations sampled. Percent composition values reflect the abundance of a particular species in relation to all other species found.

**Table 1** also includes a summary of the plant survey data collected on July 23 and 24, 2007 by Northern Environmental Technologies, Inc. These data are being presented as a means to compare the numbers and relative abundance of aquatic plant species in the lake. In 2007, a total of 24 species were

**Table 1. Summary of aquatic plant survey data collected on July 2 - 3, 2012 and July 23 - 24, 2007 on Chute Pond, Oconto County, WI.**

| | | 2012 | | 2007 | |
|---|---|---|---|---|---|
| **Species common name** | **scientific name** | **Percent Frequency** | **Relative Frequency** | **Percent Frequency** | **Relative Frequency** |
| Coontail | *Ceratophyllum demersum* | 53.75 | 19.4 | 39.12 | 13.8 |
| Common waterweed | *Elodea canadensis* | 43.54 | 15.7 | 28.13 | 9.9 |
| Forked/star duckweed | *Lemna trisulca* | 42.50 | 15.3 | 38.68 | 13.7 |
| Wild celery | *Vallisneria americana* | 27.29 | 9.8 | 45.27 | 16.0 |
| Bushy pondweed | *Najas flexilis* | 25.00 | 9.0 | 20.66 | 7.3 |
| Flat-stem pondweed | *Potamogeton zosteriformis* | 12.29 | 4.4 | 35.60 | 12.6 |
| filamentous algae | -- | 11.88 | 4.3 | -- | -- |
| Northern water milfoil | *Myriophyllum sibiricum* | 10.83 | 3.9 | 26.37 | 9.3 |
| Eurasian water milfoil | *Myriophyllum spicatum* | 9.38 | 3.4 | 0.88 | 0.3 |
| Small pondweed | *Potamogeton pusillus* | 7.29 | 2.6 | 11.43 | 4.0 |
| Muskgrasses | *Chara* sp. | 6.46 | 2.3 | -- | -- |
| Curly-leaf pondweed | *Potamogeton crispus* | 5.21 | 1.9 | 10.55 | 3.7 |
| Stiff water crowfoot | *Ranunculus aquatilis* | 2.71 | 1.0 | 0.22 | 0.1 |
| Large Duckweed | *Spirodela polyrhiza* | 2.50 | 0.9 | -- | -- |
| moss | -- | 2.29 | 0.8 | 1.10 | 0.4 |
| Large-leaf pondweed | *Potamogeton amplifolius* | 2.29 | 0.8 | 3.96 | 1.4 |
| Sago pondweed | *Stuckenia pectinata* | 2.29 | 0.8 | -- | -- |
| Clasping-leaf pondweed | *Potamogeton richardsonii* | 2.08 | 0.8 | 2.64 | 0.9 |
| White water lily | *Nymphaea odorata* | 1.67 | 0.6 | 2.42 | 0.9 |
| Frie's pondweed | *Potamogeton friesii* | 1.67 | 0.6 | -- | -- |
| Spatterdock | *Nuphar variegata* | 1.46 | 0.5 | 3.08 | 1.1 |
| Ribbon-leaf pondweed | *Potamogeton epihydrus* | 1.04 | 0.4 | 0.88 | 0.3 |
| Water star-grass | *Heteranthera dubia* | 0.83 | 0.3 | 2.64 | 0.9 |
| Nitella | *Nitella* sp. | 0.42 | 0.2 | 2.42 | 0.9 |
| Needle spikerush | *Eleocharis acicularis* | 0.21 | 0.1 | -- | -- |
| Water marigold | *Megalodonta beckii* | 0.21 | 0.1 | 0.88 | 0.3 |
| Floating-leaf pondweed | *Potamogeton natans* | 0.21 | 0.1 | 0.22 | 0.1 |
| Small bladderwort | *Utricularia minor* | 0.21 | 0.1 | -- | -- |
| Common bladderwort | *Utricularia vulgaris* | 0.21 | 0.1 | -- | -- |
| Arrowhead | *Sagittaria* sp. | visual | -- | -- | -- |
| Bur-reed | *Sparganium* sp. | visual | -- | -- | -- |
| Broad-leaved cattail | *Typha latifolia* | visual | -- | -- | -- |
| Common watermeal | *Wolffia columbiana* | visual | -- | 0.44 | 0.2 |
| Marsh milkweed | *Asclepius incarnata* | visual | -- | -- | -- |
| Dwarf water milfoil | *Myriophyllum tenellum* | -- | -- | 1.98 | 0.7 |
| Water-thread pondweed | *Potamogeton diversifolius* | -- | -- | 3.52 | 1.2 |
| | *Simpson Diversity Index* | 0.90 | | 0.89 | |
| | *Coefficient of Conservatism* | 5.8 | | 6.3 | |
| | *Floristic Quality Index* | 31.2 | | 28.8 | |
| | *WI ave. 22.2, Region ave. 28.3)* | | | | |

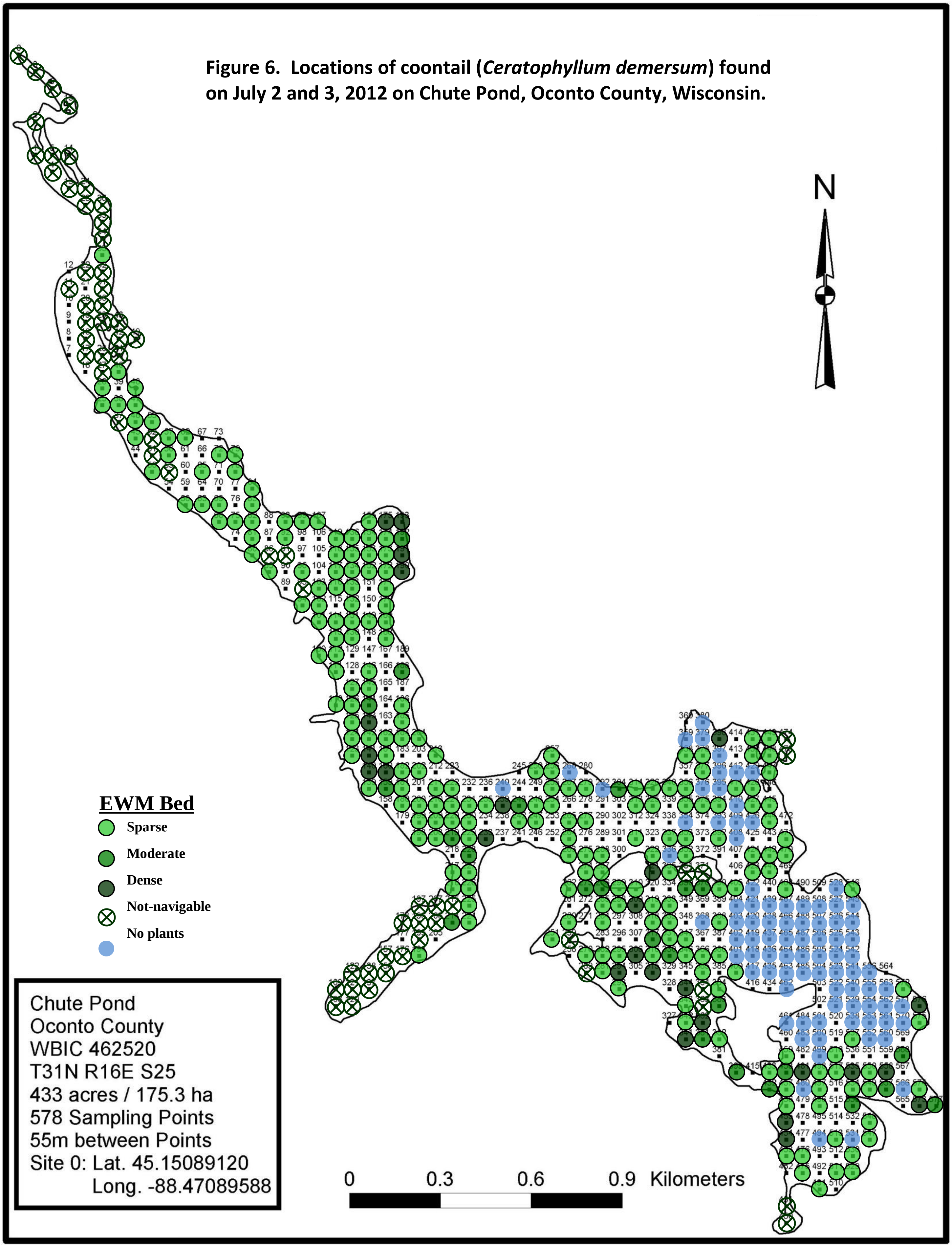



**Figure 6. Locations of coontail (*Ceratophyllum demersum*) found on July 2 and 3, 2012 on Chute Pond, Oconto County, Wisconsin.**

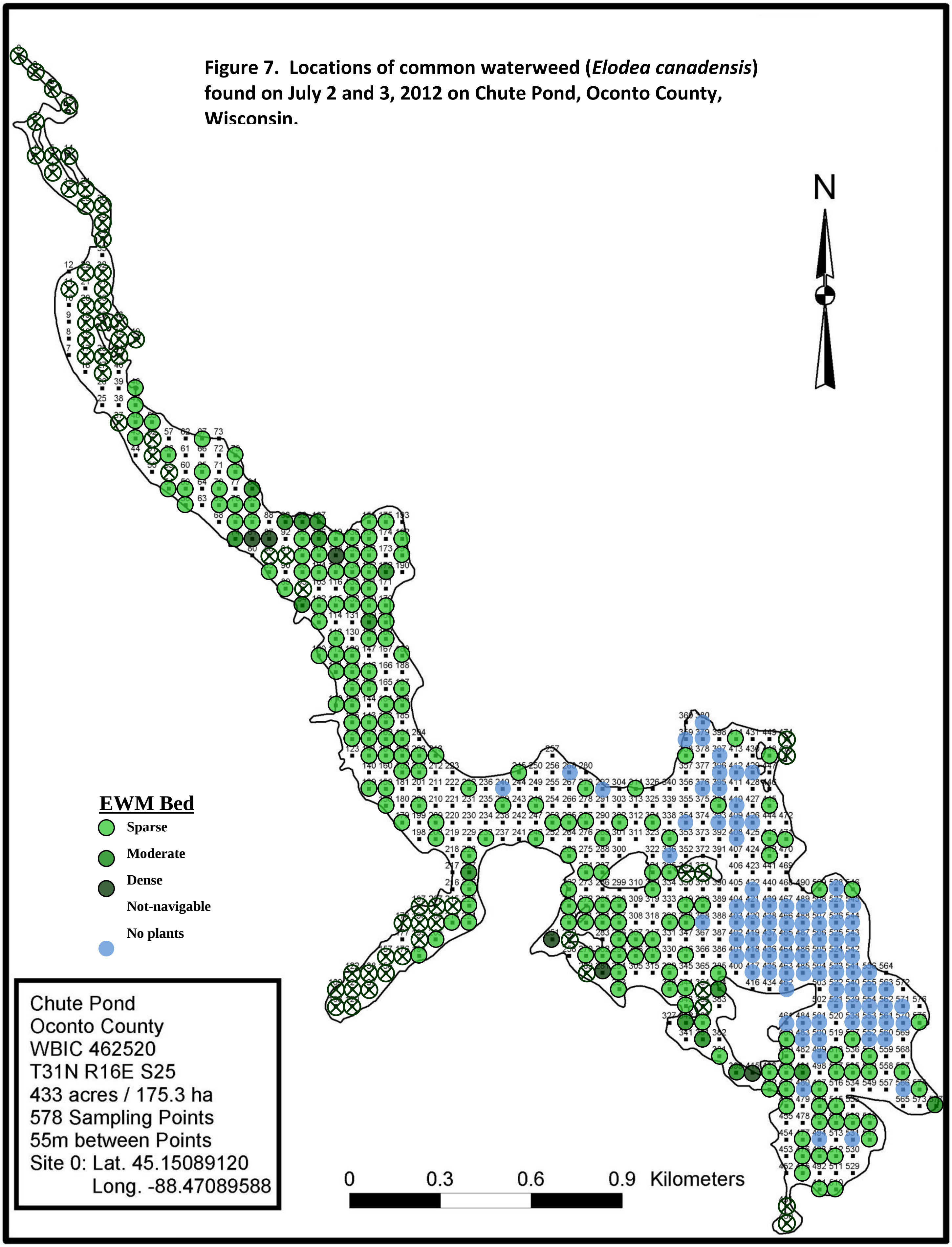



**Figure 7. Locations of common waterweed (*Elodea canadensis*) found on July 2 and 3, 2012 on Chute Pond, Oconto County, Wisconsin.**

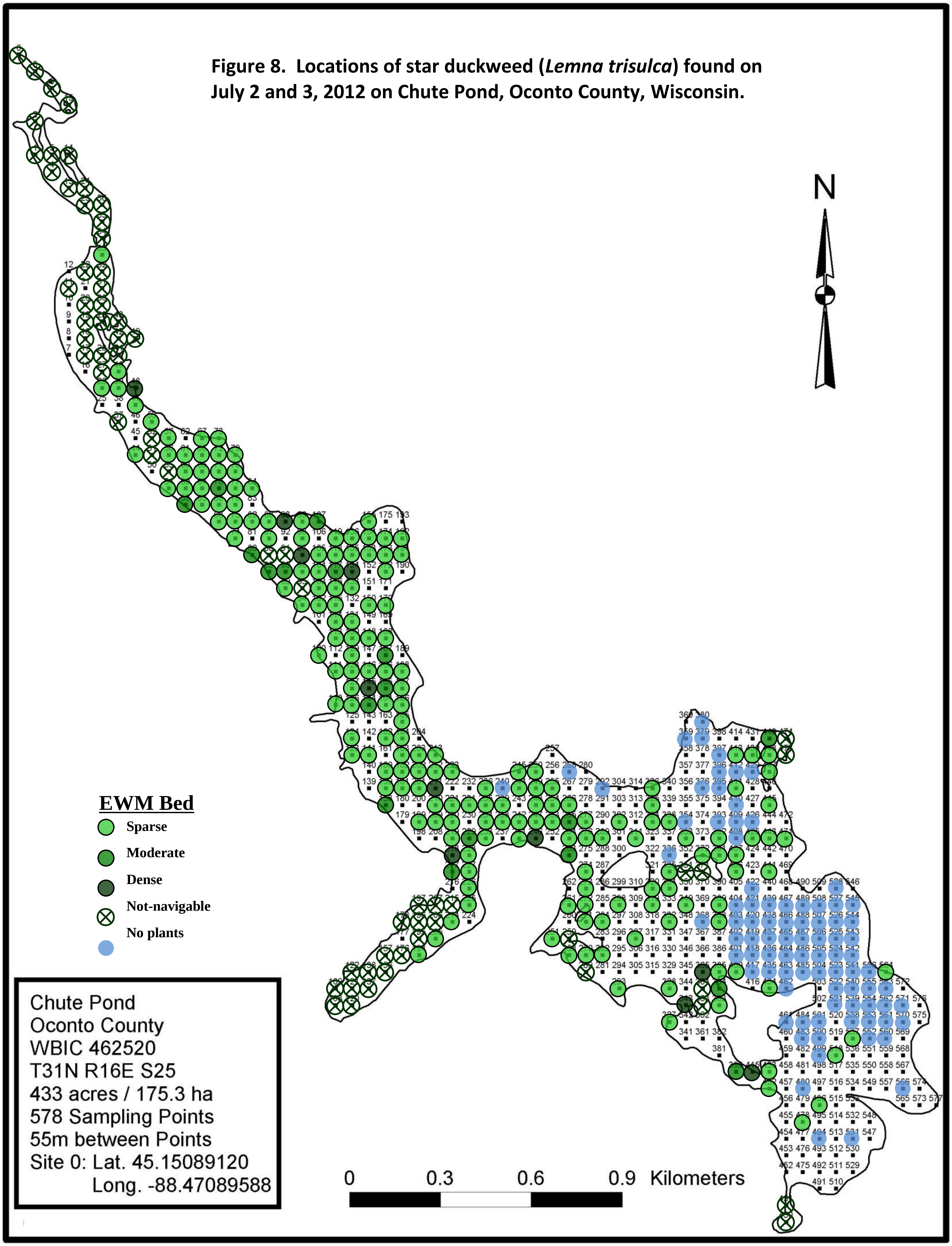


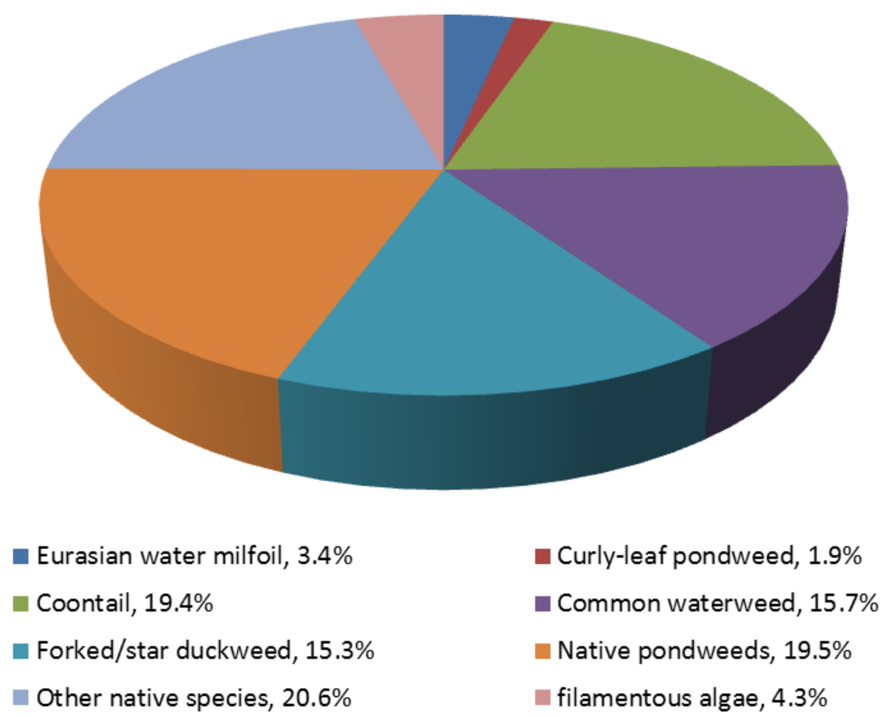

**Figure 8. Locations of star duckweed (*Lemna trisulca*) found on July 2 and 3, 2012 on Chute Pond, Oconto County, Wisconsin.**

identified. The species with the highest frequencies of occurrence in 2007 were wild celery, coontail, forked duckweed and flat-stem pondweed (*Potamogeton zosteriformis*). Although more species were found in 2012 than in 2007, the species composition was very similar.

**Figure 9** presents the relative abundance of submergent aquatic plant species found in Chute Pond at the time of the 2012 survey.

**Appendix D** contains the plant survey data collected for Chute Pond in 2012.

**Figure 9. Submergent aquatic plant community composition from July 2 - 3, 2012 in Chute Pond, Oconto County, WI.**




**Simpson Diversity Index**

The plant data collected from Chute Pond were used to calculate the Simpson Diversity Index. In order to estimate the diversity of the aquatic plant community, this index takes in account both the number of species identified (richness) and the distribution or relative abundance of each species. As these parameters increase, so does the overall diversity. With the Simpson Diversity Index (D), 1 represents infinite diversity and 0, no diversity. That is, the bigger the value of D, the higher the diversity. The value of D calculated for Chute Pond based on the 2012 data was 0.90. The value calculated from the 2007 data was 0.89.

**Assessment of Floristic Quality**

Plant survey data were also used to assess the "floristic quality" of Chute Pond. The method used assigns a value to each *native* plant species called a Coefficient of Conservatism (C). It does not take in account the presence of exotic species, mosses, sponges, or filamentous algae. Coefficient values range from 0 - 10 and reflect a particular species' likelihood of occurring in a relatively undisturbed landscape. Species with low coefficient values, such as coontail (C = 3), are likely to be found in a variety of habitat types and can tolerate high levels of human disturbance. On the other hand, species with higher coefficient values, such as Frie's pondweed (*Potamogeton friesii*) (C = 8), are much more likely to be restricted to high quality, natural areas. By averaging the coefficient values available for the submergent and emergent species found in Chute Pond, a lake-wide value of 5.8 (**Table 1**) was calculated. The average value for lakes in Wisconsin is 6.0 while the average for flowages in the Northern Lakes and Forests region is 6.2 (Nichols, 1999). In 2007, the coefficient value was 6.3.

By utilizing the Coefficients of Conservatism for the plant species found in Chute Pond, further assessment of floristic quality can be made. By multiplying the average coefficient values by the square root of the number of plant species found, a Floristic Quality Index (FQI) of 31.2 was calculated for Chute Pond (**Table 1**). In general, higher FQI values reflect higher lake quality. The average for Wisconsin lakes is 22.2. The average for flowages in the Northern Lakes and Forests region is 28.3 (Nichols, 1999). In 2007, the FQI value for Chute Pond was 28.8.

Both Coefficient of Conservatism and the Floristic Quality Index values suggest the quality of Chute Pond, specifically in terms of the plant community, is above average.

Aquatic plants serve an important purpose in the aquatic environment. They play an instrumental role in maintaining ecological balance in ponds, lakes, wetlands, rivers, and streams. Native aquatic plants have many values. They serve as buffers against nutrient loading and toxic chemicals, act as filters that capture runoff-borne sediments, stabilize lakebed sediments, protect shorelines from erosion, and provide critical fish and wildlife habitat. Therefore, it is essential that the native aquatic plant community within the lake be protected. **Appendix E** provides a list of the more abundant native aquatic plant species that were found during the 2012 survey. Ecological values and a description are given for each species.

**Exotic Species Surveys**

Eurasian watermilfoil and curly-leaf pondweed have been the main exotic species of concern in Chute Pond over the past ten years or so. In the introduction of this report, a detailed account of exotic species management since 2007 is given. **Appendix A** provides all Eurasian watermilfoil and curly-leaf pondweed maps developed since that time. This appendix also includes maps from surveys conducted in 2012. On April 25-27, 2012 a *focused-point intercept survey* was conducted on Chute Pond by Cason Associates staff and District volunteers. In total, 54.7 acres of curly-leaf pondweed were identified. Data from the July 2012 full point-intercept survey were used to develop a distribution map of Eurasian watermilfoil. A majority of the Eurasian watermilfoil at the time of this survey (48.6 acres) were found in the upper portion of the lake. Like in 2011, the remainder of the lake had very little Eurasian watermilfoil during this mid-summer event.

On October 17-18, 2012, a focused point-intercept survey of Chute Pond was conducted to further assess the results of the spring treatment. As was seen in 2011, Eurasian watermilfoil appeared to have rebounded over the summer and into the fall. At the time of the survey, the distribution of Eurasian watermilfoil had expanded to 106.9 acres. Again a vast majority of this was found in the narrower northern portion of the lake where flow of water is greatest.

Brenda Nordin, WDNR Water Resource Management Specialist, collected milfoil samples in 2012 for DNA analysis. Hybrid milfoil has been identified in a number of Wisconsin lakes. This strain is a cross between Eurasian watermilfoil and the native northern watermilfoil (*Myriophyllum sibiricum*). This hybrid shows characteristics of both parent species and has recently been found to be more challenging to control than Eurasian watermilfoil. Samples were sent to Grand Valley State University in Michigan for analysis. Results of DNA analysis showed that the milfoil sampled from Chute Pond was *not* a hybrid, but true Eurasian watermilfoil.

## Water Quality Analysis

**Water Chemistry**

Limited historic water quality data is available for Chute Pond. Previous data is available for May to August 1997 and September 2002. These data, found in **Table 2**, suggest the water quality of Chute Pond has fluctuated over the past fifteen years. However, because the data is limited, it is not possible to accurately assess trends in water quality.

**pH**

pH is a measure of a lake's acidity or alkalinity. It is the negative log of the hydrogen ion concentration in the water. Many factors influence pH including geology, productivity, pollution, etc. pH levels between seven and nine are not uncommon for lakes in Wisconsin. The 2002 and 2012 data for Chute Pond fell between 8.10 and 8.82.

**Conductivity**

Conductivity is the measure of the inorganic compounds in a body of water as determined by how well an electrical current is carried through a water sample. Conductivity is dependent upon the concentration of inorganic compounds suspended in the water column. High conductivity values may indicate contamination from septic systems, fertilizers, animal wastes or road salts. As a result, conductivity can be used to determine if human activities are influencing water quality. The recommended value for conductivity in lake samples is below 300 µmhos/cm. The data from Chute Pond in 2002 and 2012 were below 300 µmhos/cm, in the range of 240 to 269 µmhos/cm.

**Table 2. Water quality data from 1997, 2002 and 2012 for Chute Pond, Oconto County, WI.**

| DATE | Depth (m) | pH (SU) | Conductivity (mmhos/cm) | Alkalinity (mg/L) | Magnesium (mg/L) | Calcium (mg/L) | Color (SU) | Chlorophyll (ug/L) |
|---|---|---|---|---|---|---|---|---|
| 5/12/1997 | 1 | -- | -- | -- | -- | -- | -- | 7.4 |
| 6/19/1997 | 1 | -- | -- | -- | -- | -- | -- | 5.13 |
| 6/19/1997 | 6 | -- | -- | -- | -- | -- | -- | 2.13 |
| 7/25/97 | 1 | -- | -- | -- | -- | -- | -- | 14 |
| 7/25/97 | 5 | -- | -- | -- | -- | -- | -- | 69.2 |
| 8/27/97 | 1 | -- | -- | -- | -- | -- | -- | 10.7 |
| 8/27/97 | 5 | -- | -- | -- | -- | -- | -- | 3.81 |
| 9/13/02 | <1 | 8.37 | 245 | 112 | 13.1 | 28.3 | 30 | 15.4 |
| 4/25/12 | <1 | 8.10 | 256 | 119 | -- | -- | -- | 4.33 |
| 7/2/12 | <1 | 8.82 | 240 | 120 | -- | -- | -- | 30.9 |
| 8/8/12 | <1 | 8.79 | 251 | 125 | -- | -- | -- | 42.5 |
| 9/6/12 | <1 | 8.41 | 269 | 134 | -- | -- | -- | 3.92 |

| DATE | Depth (m) | Reactive Phosphorus (mg/L) | Total Phosphorus (mg/L) | Nitrates & Nitrites (mg/L) | Total Kjeldahl Nitrogen (mg/L) | BOD 5 Day (mg/L) | Total Suspended Solids (mg/L) | Secchi (ft) |
|---|---|---|---|---|---|---|---|---|
| 5/12/1997 | 1 | 0.011 | 0.037 | -- | -- | 1.53 | ND | -- |
| 6/19/1997 | 1 | 0.002 | 0.056 | -- | -- | -- | ND | -- |
| 6/19/1997 | 6 | 0.007 | 0.063 | -- | -- | -- | ND | -- |
| 7/25/97 | 1 | 0.004 | 0.021 | -- | -- | -- | 5 | -- |
| 7/25/97 | 5 | 0.004 | 0.072 | -- | -- | -- | 9 | -- |
| 8/27/97 | 1 | 0.002 | 0.037 | -- | -- | -- | <4.9 | -- |
| 8/27/97 | 5 | 0.009 | 0.051 | -- | -- | -- | <4.9 | -- |
| 9/13/02 | <1 | -- | 0.036 | ND | 0.49 | -- | -- | 7.9 |
| 4/25/12 | <1 | -- | 0.026 | -- | -- | -- | -- | 16.4 |
| 7/2/12 | <1 | -- | 0.040 | -- | -- | -- | -- | 16.5 |
| 8/8/12 | <1 | -- | 0.046 | -- | -- | -- | -- | 3.9 |
| 9/6/12 | <1 | -- | 0.034 | -- | -- | -- | -- | 6.3 |

## Alkalinity

Alkalinity is a measure of the amount of carbonates, bicarbonates and hydroxide present in water. Alkalinity is predominantly determined by soil and bedrock characteristics. Lakes and ponds fed by groundwater from limestone aquifers tend to have high alkalinity. High alkalinity can also be a result of high algae and aquatic plant production. Low alkalinity (< 25 mg/L) waters are susceptible to acid rain. Alkalinity levels above 25 mg/L in Chute Pond in 2002 and 2012 (112 to 134 mg/L) are indicative of a hard water system able to withstand acid rain conditions. These levels do not warrant concern.

**Phosphorus**

Phosphorus is one of the most important water quality indicators. Levels of phosphorus can determine the amount of algae growth in a lake. It can come from external sources within the watershed (fertilizers, livestock, septic systems) or to a lesser extent, from groundwater. Phosphorus can also come from within the lake through a process called internal loading. Internal loading occurs when plants and chemical reactions release phosphorus from the lake sediments into the water column.

The average phosphorus concentration for natural lakes in Wisconsin is 0.025 mg/L (Shaw, et al, 2004). Values above 0.05 mg/L are indicative of poor water quality. Chute Pond is classified as a reservoir. Since it does not thermally stratify, the total phosphorus criterion is 0.04 mg/L. Data in 1997 ranged from 0.021 to 0.072 mg/L. In September 2002, the concentration was 0.036 mg/L. The data for Chute Pond in 2012 ranged from 0.026 to 0.046 mg/L indicating moderate water quality.

**Chlorophyll**

Chlorophyll is the green pigment found in all green plants and algae and is the site in plants where photosynthesis occurs. Chlorophyll absorbs sunlight to convert carbon dioxide and water to oxygen and sugars. Chlorophyll data is collected to estimate how much phytoplankton (algae) there is in a lake. Generally, the more nutrients there are in the water and the warmer the water, the higher the production of algae and consequently chlorophyll.

Chlorophyll concentrations below 10 µg/L are most desirable for lakes. Six of the seven measurements in 1997 ranged between 2.13 to 10.7 µg/L. The final sample, collected in July 1997 at five meters had a concentration of 69.2 µg/L. The chlorophyll concentration in September 2002 was 15.4 µg/L. April and September 2012 were relatively low (less than 5 µg/L). July and August levels were both more than three times the desired levels.

**Secchi Transparency**

Water clarity is often used as a quick and easy test for a lake's overall water quality, especially in relation to the amount of algae present. There is an inverse relationship between Secchi depth and the amount of suspended matter, including algae, in the water column. The less suspended matter, the deeper the Secchi disc is visible. Secchi depths greater than six feet are generally indicative of good water quality. Secchi depths were not measured in 1997. Water clarity in April, July and September 2012 was greater than six feet (6.3 – 16.5 feet). In July the clarity was only 3.9 feet.

**Additional Water Quality Data**

**Table 2** includes data from additional water quality parameters measured in 1997. These parameters fall outside the scope of the current study and are from 15 years ago. As a result, these data are being presented as a means to document all existing historical data and facilitate any future data comparison efforts. In addition, the 1997 results are not cause for concern.

**Trophic State**

There is a strong relationship between levels of phosphorus, chlorophyll and water clarity in lakes. As a response to rising levels of phosphorus, chlorophyll levels increase and transparency values often decrease. The effect of this is viewed as an increase in the productivity of a lake.

Lakes can be categorized by their productivity or trophic state. When productivity is discussed, it is normally a reflection of the amount of plant and animal biomass a lake produces or has the potential to produce. The most significant and often detrimental result is elevated levels of algae and nuisance aquatic plants. Lakes can be categorized into three trophic levels:

- oligotrophic - low productivity, high water quality
- mesotrophic - medium productivity and water quality
- eutrophic - high productivity, low water quality

These trophic levels form a spectrum of water quality conditions. Oligotrophic lakes are typically deep and clear with exposed rock bottoms and limited plant growth. Eutrophic lakes are often shallow and marsh-like, typically having heavy layers of organic silt and abundant plant growth. Mesotrophic lakes are typically deeper than eutrophic lakes with significant plant growth, and areas of exposed sand, gravel or cobble-bottom substrates.

Lakes can naturally become more eutrophic with time, however the trophic state of a lake is more influenced by nutrient inputs than by time. When humans negatively influence the trophic state of a lake the process is called *cultural eutrophication*. A sudden influx of available nutrients may cause a rapid change in a lake's ecology. Opportunistic plants such as algae and nuisance plant species are able to out-compete other more desirable species of macrophytes. The resulting appearance is typical of poor water quality.

Total phosphorus, chlorophyll and Secchi depth are often used as indicators of the water quality and productivity (trophic state) in lakes. Values measured for these parameters can be used to calculate Trophic State Index (TSI) values (Carlson 1977). The formulas for calculating the TSI values for Secchi disk, chlorophyll, and total phosphorus are as follows:

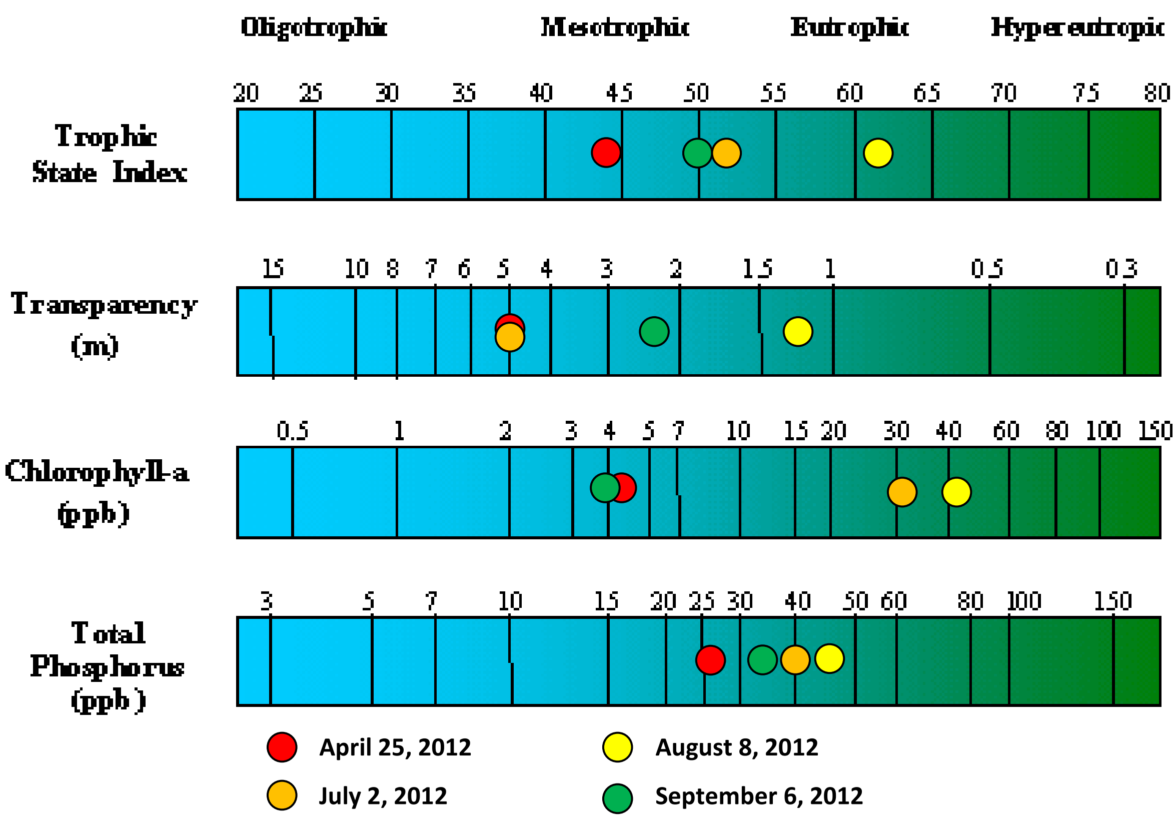
$$TSI = 60 - 14.41 \ln \text{Secchi disk (meters)}$$
$$TSI = 9.81 \ln \text{Chlorophyll } (\mu g/L) + 30.6$$
$$TSI = 14.42 \ln \text{Total phosphorus } (\mu g/L) + 4.15$$

The higher the TSI calculated for a lake, the more eutrophic it is. Classic eutrophic lakes have TSI values starting around 50 (**Figure 10**). Most of the TSI values calculated from Chute Pond's 2012 water quality data were between 36 and 68 (**Table 3**). TSI values indicate Chute Pond falls near the lower boundary of a eutrophic lake.

**Table 3. Trophic State Index data from 1997 to 2012 for Chute Pond, Oconto County, WI.**

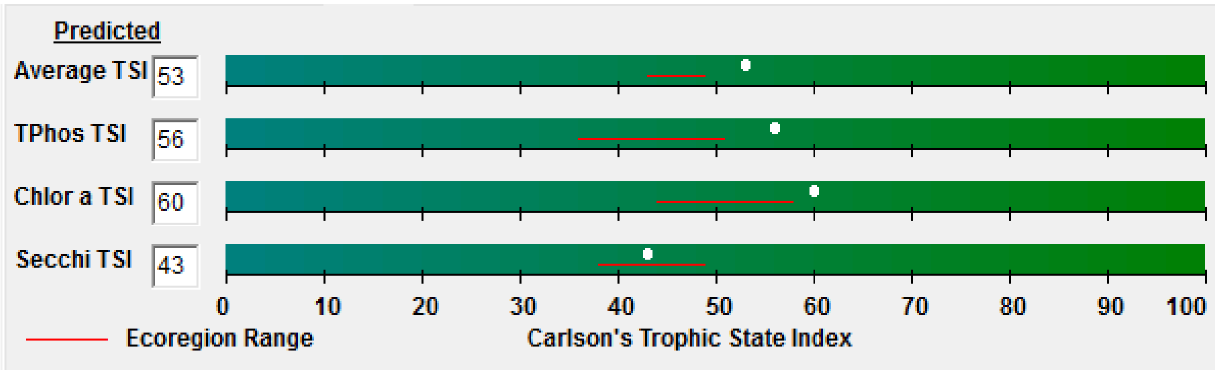
| DATE | Depth (m) | Chlorophyll (ug/L) | *Chlorophyll TSI* | Total Phosphorus (mg/L) | *Total Phosphorus TSI* | Secchi (m) | *Secchi TSI* | Ave. TSI |
|---|---|---|---|---|---|---|---|---|
| 5/12/1997 | 1 | 7.4 | *50.23* | 0.037 | *56.22* | -- | -- | 53.23 |
| 6/19/1997 | 1 | 5.13 | *46.64* | 0.056 | *62.20* | -- | -- | 54.42 |
| 6/19/1997 | 6 | 2.13 | *38.02* | 0.063 | *63.89* | -- | -- | 50.96 |
| 7/25/97 | 1 | 14 | *56.49* | 0.021 | *48.05* | -- | -- | 52.27 |
| 7/25/97 | 5 | 69.2 | *72.16* | 0.072 | *65.82* | -- | -- | 68.99 |
| 8/27/97 | 1 | 10.7 | *53.85* | 0.037 | *56.22* | -- | -- | 55.04 |
| 8/27/97 | 5 | 3.81 | *43.72* | 0.051 | *60.85* | -- | -- | 52.28 |
| 9/13/02 | 1 | 15.4 | *57.42* | 0.036 | *55.82* | 2.4 | *47.38* | 53.54 |
| 4/25/12 | 1 | 4.33 | *44.98* | 0.026 | *51.13* | 5.0 | *36.81* | 44.31 |
| 7/2/12 | 1 | 30.9 | *64.26* | 0.040 | *57.34* | 5.0 | *36.72* | 52.77 |
| 8/8/12 | 1 | 42.5 | *67.38* | 0.046 | *59.36* | 1.2 | *57.51* | 61.42 |
| 9/6/12 | 1 | 3.92 | *44.00* | 0.034 | *55.00* | 1.9 | *50.60* | 49.87 |

**Figure 10. Relationship between trophic state in lakes and parameters including Secchi transparency, chlorophyll, and total phosphorus overlaid with 2012 data from Chute Pond, Oconto County, WI.**



Results of the WiLMS modeling (**Figure 11**) found that the observed trophic state index values for Chute Pond fell above the predicted range of TSI values for phosphorus, chlorophyll and average TSI given the ecoregion where the lake exists. However, the observed Secchi data fell within the expected range. In other words, the water quality of Chute Pond based on these parameters was lower than expected for a lake of this size in northern Wisconsin.

**Figure 11. Results of Wisconsin Lake Modeling Suite (WiLMS) analysis in 2012 for Chute Pond, Oconto County, Wisconsin.**




**Dissolved Oxygen and Temperature**

Dissolved oxygen, temperature, and percent saturation data collected from Chute Pond in 2012 are presented in **Table 4** and **Figures 12 and 13**. Dissolved oxygen data show that surface levels of dissolved oxygen have consistently remained high in the lake throughout the season. The ideal level of oxygen needed for fish, such as bass, perch, and sunfish to survive and grow, is 5 mg/L or greater. Even at the warmest times of the year, sufficient levels of oxygen were present down to at least 7 feet in Chute Pond.

To better understand this data, it is important to first understand the relationship between dissolved oxygen and temperature. As a rule, colder water can hold more oxygen than warmer water. By utilizing this relationship, the level (or percent) of saturation of oxygen can be determined at a given temperature. Saturation levels from sampling at Chute Pond in 2010 can also be found in **Table 4**. Percent saturation values of 80-120% are considered to be excellent and values less than 60% or over 125% are of concern. A majority of the upper water column data collected in 2012 fell within the 80-120% range. Oxygen saturation levels above 100% are referred to as supersaturation. This effect is due to factors such as wind and wave action and biological processes. This commonly occurs under warm sunny conditions when higher levels of algae are likely to be present. Through photosynthesis, algae can produce high levels of oxygen under these conditions. The July and August 2012 data for Chute Pond show supersaturation at the surface.

When dissolved oxygen data is included in the WiLMS modeling for Chute Pond, results show a small amount of internal nutrient cycling took place in 2012. It is under oxygen-depleted conditions (anoxia) that phosphorus is readily released from the sediments of a lake. The data

**Table 4. Dissolved oxygen and temperature data collected in in 2012 on Chute Pond, Oconto County, WI.**

| | April 25, 2012 | | | July 2, 2012 | | |
|---|---|---|---|---|---|---|
| Depth (ft) | Temp (°F) | D.O. (mg/L) | % Sat. | Temp (°F) | D.O. (mg/L) | % Sat. |
| 0 | 48.8 | 11.83 | 101.7 | 82.3 | 10.07 | 120.3 |
| 1 | 53.7 | 10.37 | 96.4 | 82.2 | 9.93 | 126.2 |
| 2 | 53.8 | 10.42 | 96.8 | 81.6 | 9.85 | 126.3 |
| 3 | 53.8 | 10.36 | 96.4 | 81.4 | 9.70 | 122.9 |
| 4 | 53.8 | 10.34 | 96.2 | 81.1 | 9.55 | 119.5 |
| 5 | 53.8 | 10.26 | 95.3 | 78.8 | 8.15 | 101.0 |
| 6 | 53.7 | 10.30 | 95.8 | 77.0 | 5.85 | 71.3 |
| 7 | 53.7 | 10.23 | 94.9 | 76.4 | 5.75 | 68.7 |
| 8 | 53.6 | 10.14 | 94.0 | 74.3 | 2.80 | 32.2 |
| 9 | 53.6 | 10.13 | 94.2 | 71.8 | 0.90 | 9.8 |
| 10 | 53.6 | 10.10 | 93.7 | 71.2 | 0.61 | 7.0 |
| 11 | 53.5 | 9.97 | 92.4 | 69.9 | 0.36 | 4.0 |
| 12 | 53.5 | 9.96 | 92.2 | 69.2 | 0.35 | 3.9 |
| 13 | 53.4 | 9.99 | 92.4 | 68.2 | 0.35 | 3.9 |
| 14 | 53.2 | 10.00 | 92.3 | 65.9 | 0.37 | 3.9 |
| 15 | 53.2 | 9.96 | 92.1 | 64.7 | 0.36 | 3.8 |
| 16 | 53.1 | 9.32 | 85.9 | 63.6 | 0.36 | 3.8 |

| | August 8, 2012 | | | September 6, 2012 | | |
|---|---|---|---|---|---|---|
| Depth (ft) | Temp (°F) | D.O. (mg/L) | % Sat. | Temp (°F) | D.O. (mg/L) | % Sat. |
| 0 | 77.4 | 10.28 | 124.5 | 74.1 | 7.66 | 90.0 |
| 1 | 77.4 | 10.19 | 122.7 | 74.1 | 7.48 | 87.9 |
| 2 | 77.4 | 10.35 | 125.8 | 74.1 | 7.42 | 86.9 |
| 3 | 77.4 | 10.05 | 121.8 | 73.9 | 7.51 | 88.1 |
| 4 | 77.3 | 9.94 | 120.4 | 74.0 | 7.37 | 86.2 |
| 5 | 76.3 | 9.28 | 112.6 | 73.8 | 7.30 | 85.5 |
| 6 | 75.9 | 8.40 | 100.4 | 73.7 | 7.16 | 83.9 |
| 7 | 75.7 | 7.61 | 90.7 | 73.6 | 7.10 | 83.0 |
| 8 | 75.4 | 6.56 | 77.5 | 73.6 | 7.06 | 79.0 |
| 9 | 74.4 | 4.34 | 51.3 | 73.6 | 6.95 | 81.3 |
| 10 | 74.1 | 3.86 | 45.0 | 72.8 | 3.42 | 39.5 |
| 11 | 74.0 | 4.82 | 56.6 | 72.5 | 3.87 | 44.2 |
| 12 | 73.1 | 2.77 | 31.9 | 72.2 | 1.45 | 16.8 |
| 13 | 70.2 | 2.67 | 30.1 | 70.2 | 0.10 | 1.0 |
| 14 | 68.9 | 2.79 | 31.0 | 68.9 | 0.06 | 0.7 |
| 15 | 67.0 | 2.99 | 32.5 | 68.6 | 0.05 | 0.6 |
| 16 | 65.7 | 3.12 | 33.5 | 66.9 | 0.05 | 0.6 |

Figure 12. Dissolved oxygen data from 2012 for Chute Pond, Oconto County, WI.

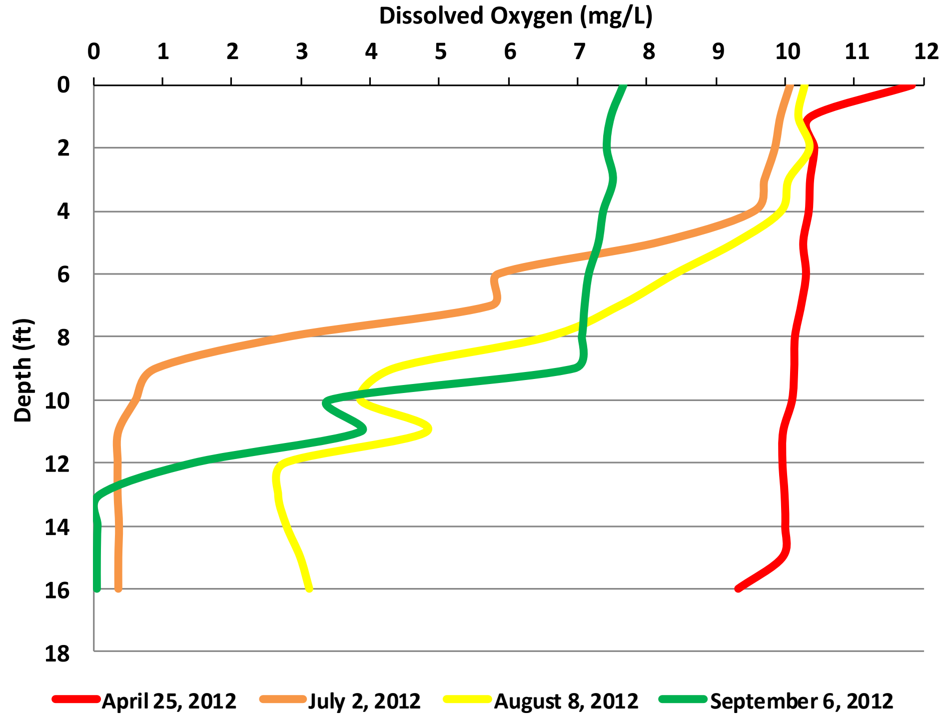
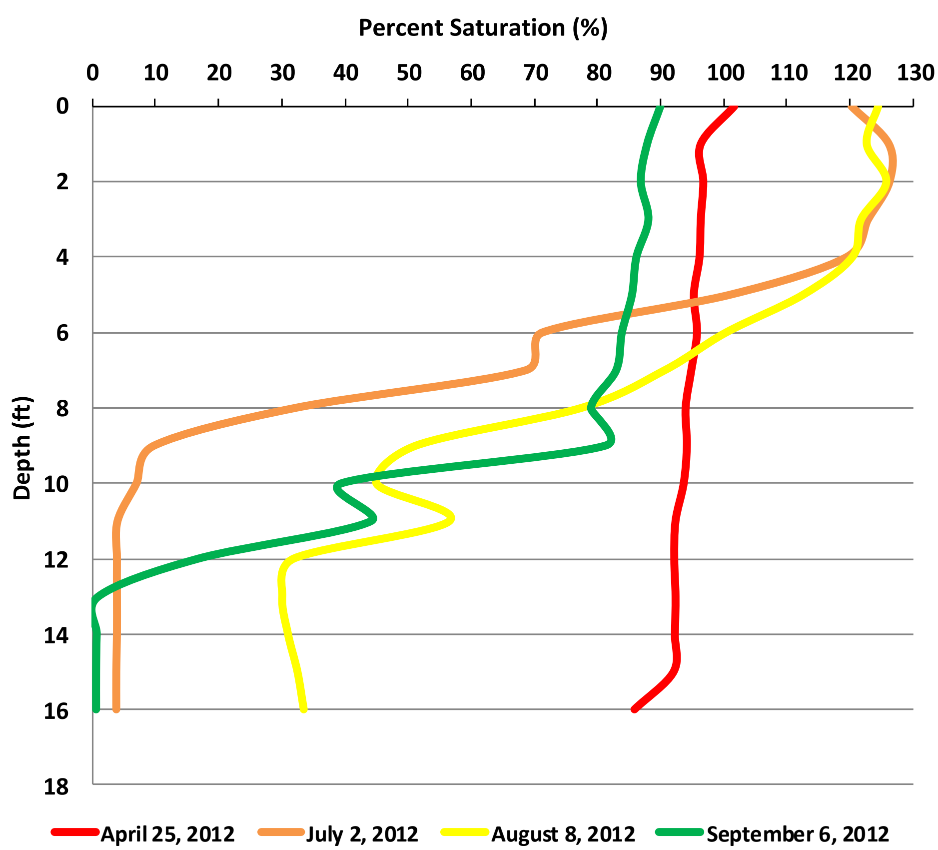



Figure 13. Percent Saturation data from 2012 for Chute Pond, Oconto County, WI.



showed that oxygen was present at sufficient levels as deep as eight to ten feet in July and August 2012. Anoxia at the bottom of the lake begins soon after the lake turns over in the spring. As the lake becomes stratified, oxygen is consumed below the thermocline and is not replenished until the fall turnover. A relatively small area, estimated at 50 acres in Chute Pond, became anoxic during the summer. The WiLMS modeling results suggest that internal nutrient release is minor in comparison to other nutrient sources. This is due primarily from the large watershed. Although the watershed is largely comprised of forests, wetlands and fallow fields, these areas do contribute small amounts of nutrients to the river. With over 180 acres within the watershed, these small amounts add up. In addition, inputs from human activities including septic systems, agricultural lands and urban setting contribute to the nutrient load in Chute Pond.

## Watershed Analysis

In August 2009, the watershed analysis of the Inland Lakes P & R District was conducted. **Figures 14 and 15** show the delineation of the watershed and the land-use types present. The survey and resulting analysis found that the watershed of Chute pond is 180.4 square miles. A majority of the watershed is within the Chequamegon-Nicolet National Forest. The Towns of Mountain, Lakewood, Townsend, Carter and Wabeno are all within the watershed, but make up a relatively small portion of the watershed. The North Branch of the Oconto River enters Chute Pond from the north. The main tributary to the North Branch of the Oconto River is McCaslin Brook which enters the River from the west between the Towns of Lakewood and Mountain.

The data for the land-use map (**Figure 15**) was provided by the Wisconsin DNR's Bureau of Technology Services. **Table 5** contains a breakdown of land-use and cover types within the watershed. Not surprisingly, the watershed as a whole is dominated by deciduous and coniferous forests (71.2%), wetland (11.5%), and general and row crop agriculture (11.3%) (**Table 5**).

During the on-site survey of the District's watershed, a number of observations were made.

- Upper portions of the watershed have a higher proportion of tamarack bogs and marshes which are the headwaters of the tributary streams feeding the North Branch of the Oconto River.
- There are a number of lakes and flowages within the watershed of Chute Pond. A majority of these waterbodies are connected to the North Branch of the Oconto River through tributaries. This includes the system of lakes which include Reservoir Pond, Townsend Flowage, etc. A few remaining waterbodies have their own separate watersheds. The most significant of these is Wheeler Lake. In **Figures 14 and 15**, Wheeler Lake's watershed is separated from the remaining watershed of Chute Pond.
- The southern portion of Chute Pond's watershed is narrowed due to the watershed of the South Branch of the Oconto River which joins with the North Branch downstream of Chute Pond. Many larger lakes in the region fall within the watershed of the South Branch.

- Many of the areas categorized as agricultural are not actively farmed in row crops. Instead, these areas are predominantly fallow or pasture. Areas in crop production make up a small portion and are primarily hay, alfalfa, and to a lesser extent, corn. Some fallow areas appear to have been in crop production at some point in the recent past. It is likely some of these areas have been placed under the Conservation Reserve Program (CRP). By taking land out of production, farmers help reduce soil erosion, improve water quality, increase wildlife habitat, and reduce damages caused by floods and other natural disasters.

**Figure 14. Watershed of the Chute Lake P & R District, Oconto, Langlade, Marinette and Forest Counties, Wisconsin.**

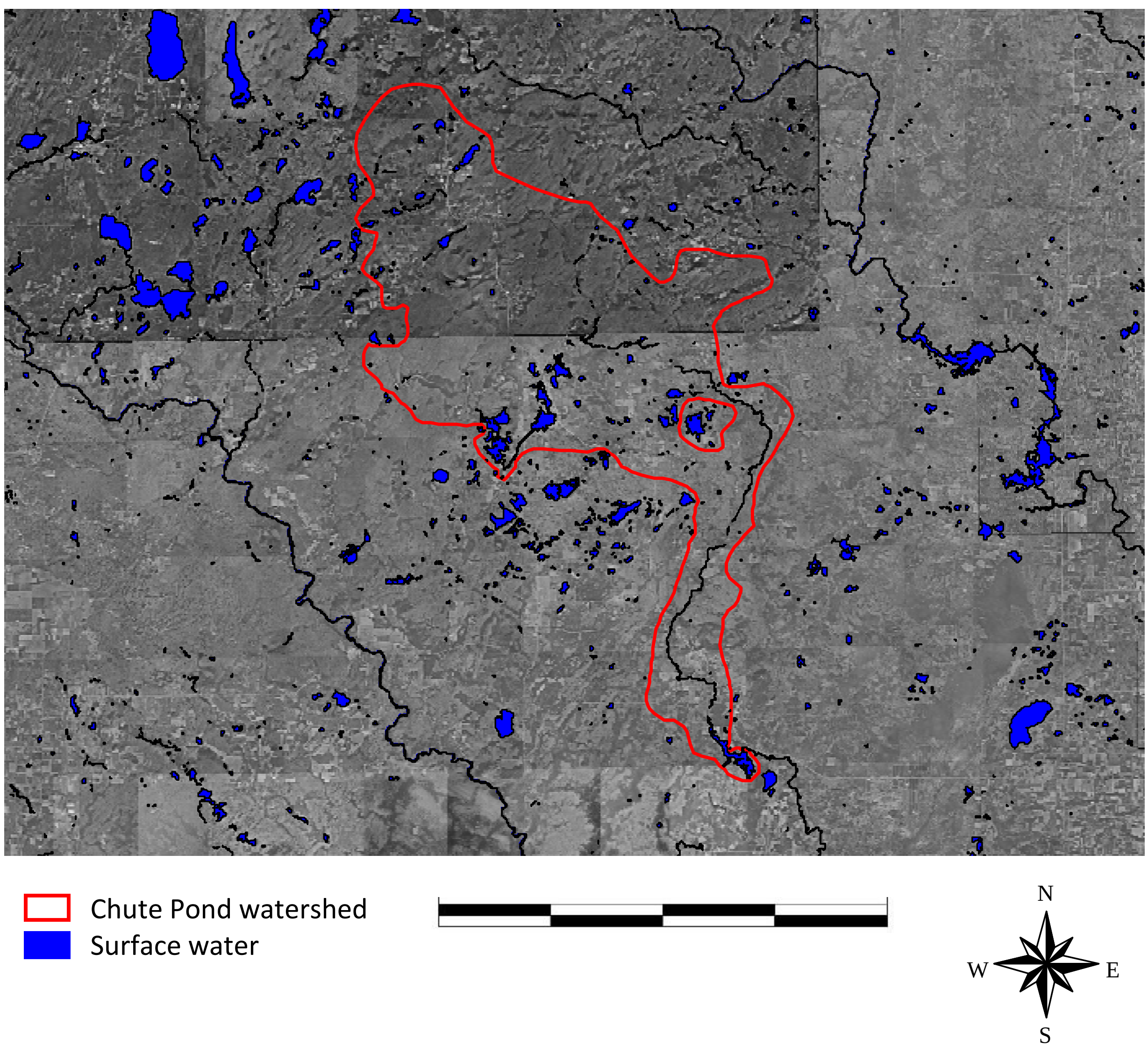


**Figure 15. Land cover types and watershed delineation for the Chute Lake P & R District, Oconto, Langlade, Marinette and Forest Counties, Wisconsin.**

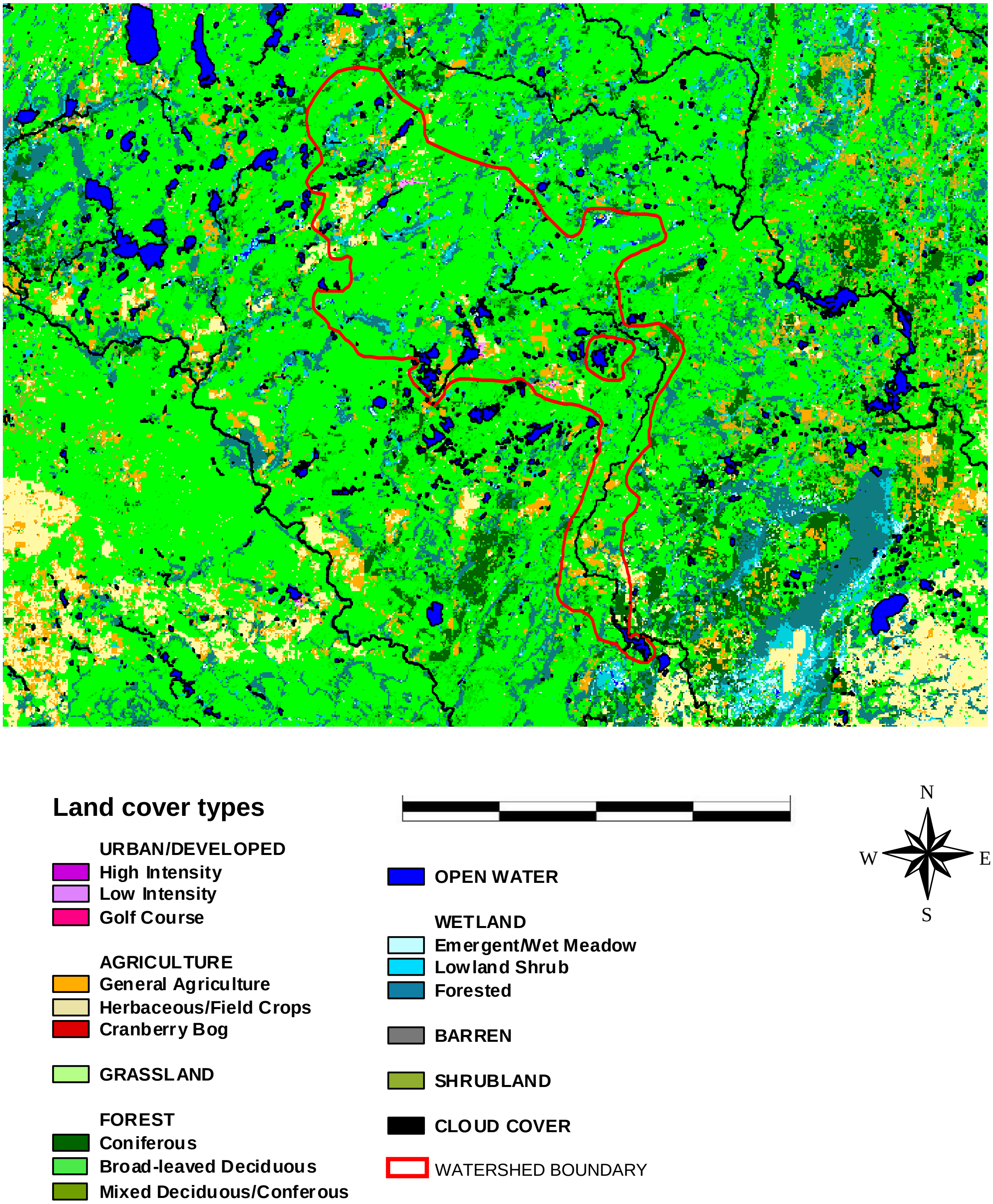


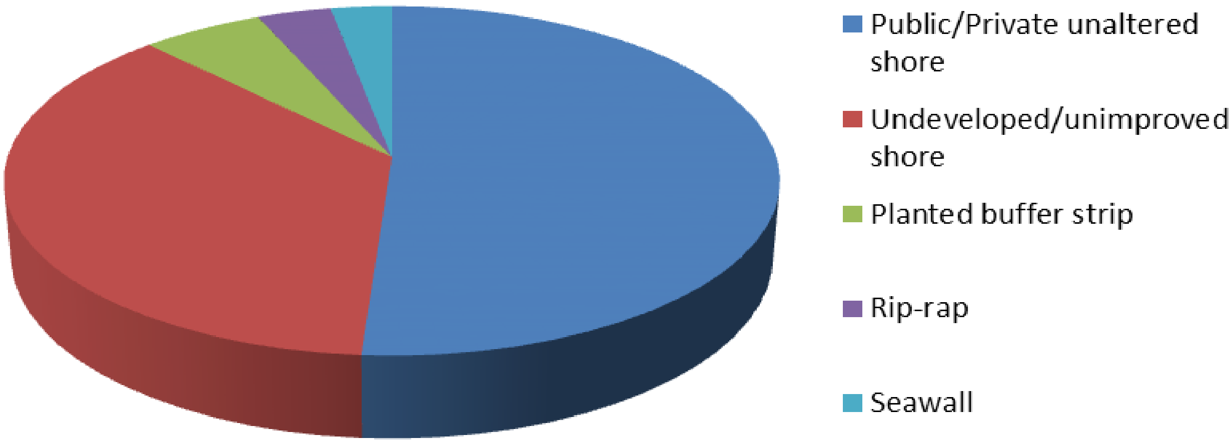
**Table 5. Land-use and cover types found within the watershed of Chute Pond, Oconto, Langlade, Marinette and Forest Counties, Wisconsin.**

| Land Type | % cover |
|---|---|
| Forest (coniferous/deciduous) | 71.2 |
| Wetland (forested/wet meadow) | 11.5 |
| Agriculture (general) | 7.2 |
| Agriculture (row crops) | 4.1 |
| Surface Water (not including Flowage) | 5.4 |
| Urban | 0.6 |

During the watershed assessment, no signs of significant runoff or erosion were found in the outlying areas. While approximately 200 homes can be found on the shore of Chute Pond, areas of significant erosion were not evident near shore either. The shoreline of the flowage contains a mix of homes with rip rap, sea walls, or undeveloped/ulaltered waterfronts with native shoreline vegetation (**Figures 16 and 17**). In addition, the steepness of shorelines varies throughout the system. Human activity can contribute to shoreline erosion. An increase in development translates to increases in the number of lawns, driveways and other hard surfaces which are known to contribute nutrients and sediments to a lake. Often it is those areas closest to the lakes which have the greatest influence on water quality.

**Figure 16. Shoreline images from Chute Pond, Oconto County, Wisconsin.**

**Figure 17. Composition of shoreline conditions on Chute Pond, Oconto County, Wisconsin.**




## Fishery Assessment

The assessment of the fishery of Chute Pond is an on-going process through the WDNR. In April and October 2002, WDNR staff conducted fish surveys of Chute Pond using fyke nets and electroshocking, respectively. Results of these surveys and surveys conducted in 1986 are included in the 2003 WDNR report in **Appendix F**. In general, the WDNR conducts these surveys on Wisconsin lakes on a ten-year rotation. Chute Pond is scheduled to be surveyed again in 2013. **Table 6** contains historic stocking data for Chute Pond provided by the WDNR. Results of the most recent surveys show:

- Largemouth bass growth rates to be similar to other northeast Wisconsin lakes for all ages sampled. In 2002, a largemouth bass population of 0.9 bass/acre was calculated.
- Northern pike also showed growth rates similar to neighboring lakes. However, the growth rate in 2002 was considerably faster than the 1986 growth rate. The 2002 population was estimated at 3.4 fish per acre. In 1986 this number was 6.4 fish per acre.
- Four large adult muskellunge were captured in the 2002 spring fyke nets. In the fall of 2002, 2 yearling muskies were captured. Between 2003 and 2011, 1,097 large fingerling muskies were stocked in Chute Pond.
- Only one 6-year old walleye was captured in 2002. In 2006, 363 large fingerling walleye were stocked in Chute Pond.
- Panfish in 2002 included bluegill, yellow perch, black crappie, pumpkinseed and rock bass. Bluegills were most abundant. No population estimates were made for panfish in 2002. Panfish growth rates in 2002 were above average for lakes in northeast Wisconsin.

Overall, results of the 2002 surveys indicate Chute Pond is capable of maintaining a quality size fishery with comparable growth rates for northeast Wisconsin.

**Table 6. History, WDNR-sponsored fish stocking data for Chute Pond, Oconto County, WI.**

| Year | Species | Strain (Stock) | Age Class | Number Fish Stocked | Avg Fish Length (IN) | Source Type |
|---|---|---|---|---|---|---|
| 1972 | WALLEYE | UNSPECIFIED | FINGERLING | 9,000 | 3 | DNR COOP PONDS |
| 1973 | MUSKELLUNGE | UNSPECIFIED | FINGERLING | 1,000 | 11 | DNR HATCHERY |
| 1974 | WALLEYE | UNSPECIFIED | FINGERLING | 12,600 | 3 | DNR COOP PONDS |
| 1976 | WALLEYE | UNSPECIFIED | FINGERLING | 22,500 | 3 | DNR COOP PONDS |
| 1977 | MUSKELLUNGE | UNSPECIFIED | FINGERLING | 800 | 9 | DNR COOP PONDS |
| 2003 | MUSKELLUNGE | UNSPECIFIED | LG FINGERLING | 497 | 10.9 | DNR HATCHERY |
| 2006 | WALLEYE | UNSPECIFIED | LG FINGERLING | 363 | 7 | PRIVATE HATCHERY |
| 2009 | MUSKELLUNGE | UPPER WI RIVER | LG FINGERLING | 200 | 10.5 | DNR HATCHERY |
| 2011 | MUSKELLUNGE | UPPER WI RIVER | LG FINGERLING | 400 | 9.3 | DNR HATCHERY |

# Lake Management Alternatives

## Management of Near-shore Vegetation

**Manual removal of vegetation**

Manual removal options include raking or hand-pulling aquatic plants. Individuals can remove aquatic vegetation in front of their homes, however, there are limitations as to where plants can be hand-pulled and how much can be removed. In most instances, control of native aquatic plants is discouraged and is limited to areas next to piers and docks. When aquatic vegetation is manually removed it is restricted to an area that is 30 feet or less in width along the shore. Exotic species (Eurasian watermilfoil, curly-leaf pondweed, and purple loosestrife) may be manually removed beyond 30 feet without a permit, as long as native plants are not harmed. Manual removal of native plants beyond the 30 foot area would require a Chapter 109 (Wisconsin Administrative Code - NR 109) permit. Benefits of manual removal include low cost compared to other control methods. However, raking or hand-pulling aquatic plants can be labor intensive.

**Herbicide treatment of navigation lanes**

In areas where native plant growth interferes with navigation, and other management options are ineffective at reducing this nuisance, herbicide treatment of navigation lanes may be considered. A broad spectrum herbicide or mixture of herbicides can be used to target all plant species in a treatment area. If individual species are targeted, a more specific herbicide may be applied in a manner that would target that particular species. Herbicide treatment of native plants may be a less desirable option when exotic species are a threat. Because the herbicides kill plants instead of merely cutting them, more opportunistic exotic plants may be better able to colonize the treated areas. With any herbicide treatment, the risk of dilution exists.

The method used for this type of treatment involves spraying herbicides to the surface of the water within the treatment area. Only those chemicals registered with the U.S. EPA and the Wisconsin Department of Agriculture, Trade, and Consumer Protection may be used. Herbicides registered for use in Wisconsin undergo a strict registration process. Before they are labeled for aquatic use, the data must demonstrate that they pose minimal risk to human health or the environment when used according to label requirements. Often a mixture of three chemicals (Cutrine®, Aquathol K®, and Reward®) is used to target all plants and algae. This approach should be used for early season applications on low-growing plants to minimize the amount of plant matter dying off at once. However, sometimes a later season follow-up treatment is needed to maintain open water. If this approach is used, it is likely that annual treatments would be needed to maintain effective control. Any treatment of this type would require a Chapter 107 permit. The need for navigation lanes on Chute Pond is very limited if not nonexistent.

**Herbicide treatment of shorelines**

As with manual removal, herbicide treatment of near-shore vegetation is an option with certain restraints. Individuals must obtain a Chapter 107 permit from the Wisconsin DNR to chemically treat aquatic plants in a 30-foot strip along their property extending out 150 feet if necessary. If native plant species are targeted, the same three chemicals used in treating navigation lanes would be used in this approach as well. Herbicides are able to provide control in shallow confined areas such as around docks. However, there is a negative public perception of chemicals. In addition, care must be taken to minimize the effect to non-target plant species. Water-use restrictions after application are often necessary.

**Aquatic plant harvesting**

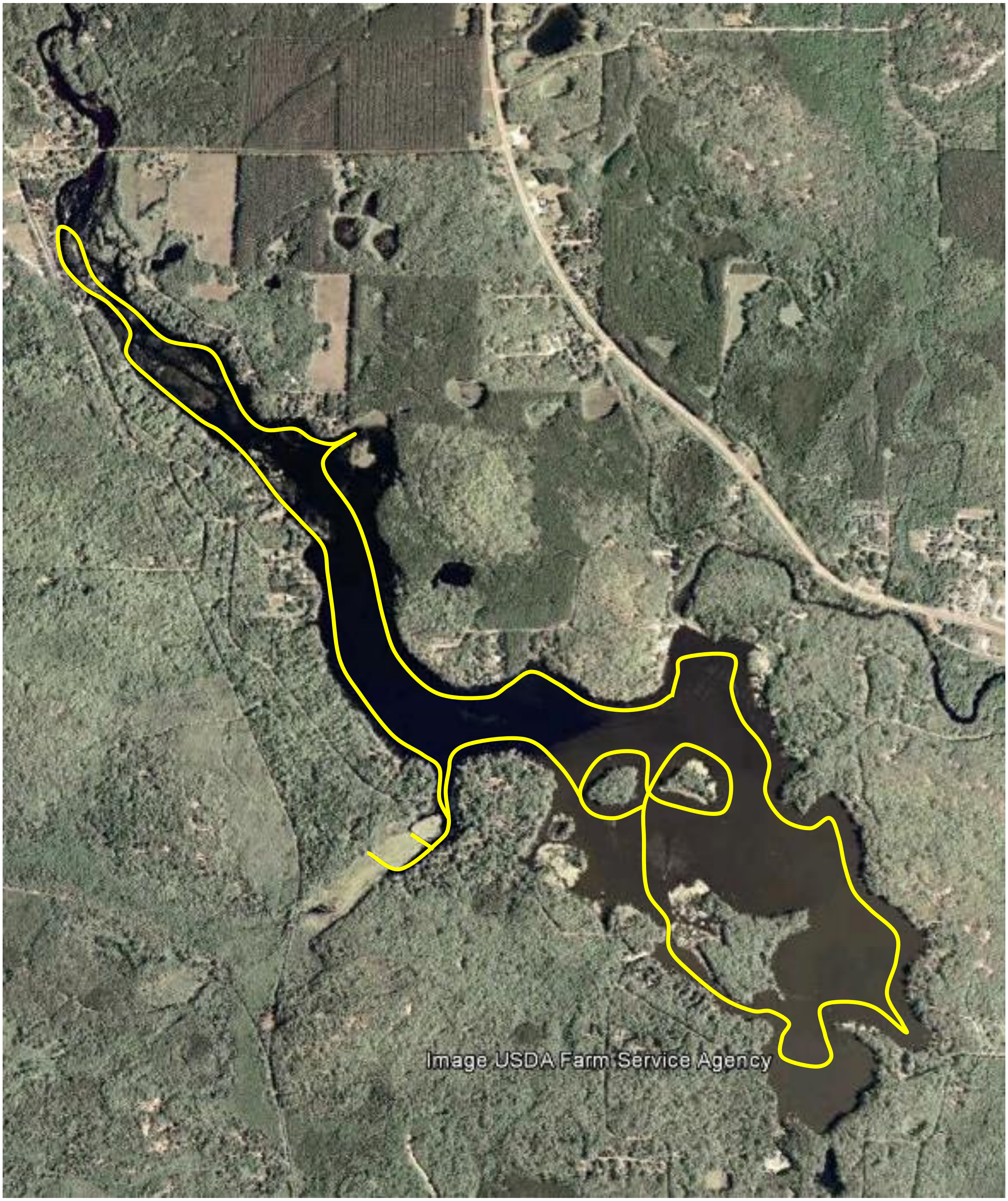
Mechanical harvesting involves the removal of aquatic plants from a lake using a machine that cuts and collects the plants for transport to an off-shore disposal site (Nichols, 1974). Mechanical harvesting has been used as an aquatic plant management tool on Chute Pond for many years. Generally, harvesting equipment can be adjusted to cut to a desired depth up to approximately five feet. Harvesting operations often include equipment, such as a barge, to transport plant materials from a harvester to the shore where a conveyor is used to transfer the materials to a waiting truck. Harvesting is often used for areas where dense, sometimes monotypic, aquatic plant growth significantly interferes with navigation. Harvesting produces fast results on a small scale, and the removal of plant biomass from a lake. In addition, the benefits of harvesting include nutrient removal, and few if any seasonal restrictions. However, this method is limited to water deep enough for navigation. In addition, harvesting is not generally used to restore aquatic plant communities. It is a maintenance approach used primarily for navigational issues. Harvesting can complicate the management of exotic species, particularly Eurasian watermilfoil. Because milfoil spreads efficiently through fragmentation, and harvesting results in a large number of fragments, the two are generally considered incompatible. Harvesting also comes with high initial equipment costs, as well as relatively high maintenance, labor, and insurance costs, disposal site requirements, and a need for trained staff.

A WDNR permit is required by NR 109 for aquatic plant harvesting. In the summer of 2012, the District's harvesting permit was renewed. The existing permit allows for cutting in the areas shown in **Figure 18** which total approximately 100 acres on Chute Pond. According to the permit conditions, the acreage includes the cutting of curly leaf pondweed and cutting a 25 foot wide navigation channel around the lake. It also includes picking up nuisance floating rafts of vegetation. The permit was issued for a 3 year term and will expire on December 31, 2014. Other permit conditions include:

1. The WDNR should be notified with any questions regarding the permit conditions and may schedule and conduct an onsite supervision of harvesting on occasion.

2. Mechanical harvesting will only be allowed in the areas specified in the permit and may be revised upon Department approval in the second year of the permit. A copy of the permit and maps shall be kept on the harvesters at all times harvesting operations are conducted.

**Figure 18. Permitted locations for mechanical harvesting of aquatic plants for Chute Pond, Oconto County, WI, as approved by the WDNR until December 31, 2014**.



3. Aquatic plants cut must be removed from the water. Care should be taken to remove curly leaf pondweed and Eurasian milfoil fragments which may be cut. Curly leaf pondweed should be harvested prior to July to remove the plant with the turions (reproductive structures) attached. Disposal of the harvested aquatic plants must be in the designated location and must be in accordance with any applicable state, county and local regulation.

4. Emergent and floating vegetation such as water lilies and wild rice should be avoided since it is unique habitat which is declining in area of growth in well developed lakes. There may be situations which could be approved to be harvested on an individual case basis if impinging upon navigation into a riparian owner dock.

5. All mechanical harvesting records must be maintained and made available to the WDNR upon request. Annual reports summarizing harvesting activities shall be sent to the WDNR by November 1 each year. The annual report shall include a map showing the areas harvested and the total acres harvested along with an estimate of harvester loads cut during the season.

6. The impending Aquatic Plant Management Plan should be used to update the harvesting strategy when the final plan is approved by the Department.

## Exotic Species Management

Because Eurasian watermilfoil and curly-leaf pondweed exist in Chute Pond and other exotic species exist in the State, control options for these species should be revisited. Exotic aquatic plant species have interfered with recreational activities including swimming, pleasure boating, hunting, and fishing in numerous lakes throughout Wisconsin. Communities of native aquatic plants, as well as fish and wildlife, have also suffered as a result of these aquatic invaders. In terms of exotic species, Eurasian watermilfoil is currently the most abundant, and poses the greatest threat to the District.

**Herbicide treatment of exotics**
Herbicides have been the most widely used and often most successful tools for controlling Eurasian watermilfoil and curly-leaf pondweed. The most commonly employed herbicide used to treat Eurasian watermilfoil in Wisconsin is 2,4-D (e.g. Navigate®, DMA4®, Sculpin®). Herbicides containing 2,4-D have been effective at managing Eurasian watermilfoil in hundreds of Wisconsin lakes. When applied at labeled rates, 2,4-D has been shown to be an effective tool at selectively controlling Eurasian watermilfoil. Based on published concentration, exposure time data (Green and Westerdahl 1990) a 2,4-D concentration of 2.0 mg/L is required for good control at an exposure time of 24 hours after treatment (HAT). In addition, 1.0 mg/L is required for good control at 48 HAT and 0.5 mg/L is required for 72 HAT. The reports in **Appendix B** show that in the upper portion of the lake, insufficient contact time has been reached due to dilution from the inflowing water.

The herbicide most often used to control curly-leaf pondweed is endothall (e.g. Aquathol®). While endothall herbicides are effective on a broad range of aquatic monocots, early season applications made at low rates are able to select for curly-leaf pondweed. Endothall herbicides effectively kill the parent plant, but the turions are resistant to herbicides, allowing curly-leaf pondweed to regenerate annually.

Studies conducted by the Army Corps of Engineers have found that conducting treatments of curly-leaf pondweed using Aquathol® when water temperatures are in the 50-60° F range will kill plants before turions (vegetative reproductive structures) form, thus providing long-term control.

Researchers found that conducting treatments over three or more consecutive seasons for established curly-leaf pondweed populations will target both the standing crop of the pondweed as well as the resulting regrowth from the turions (Skogerboe and Poovey, 2002).

Both endothall and 2,4-D are herbicides which break down microbially and do not persist in the environment. When applied at the labeled rates, herbicides are an effective management tool for control of many aquatic plant species. While no control method could be considered cheap, herbicide treatments are among the least costly of methods. This is in part due to the relatively low labor costs in comparison to measures such as hand-pulling, mechanical harvesting, etc. Perhaps the greatest consideration is that these herbicides often produce long-term control of exotics. The greatest disadvantage of herbicide treatments is that they rarely produce 100% control. In order to effectively manage an exotic species with herbicides, the chemical has to be present at a high enough concentration for a long enough period of time to cause plant mortality. A number of factors can influence this. All herbicides in an aquatic environment will become diluted by the surrounding water. This makes it particularly difficult to achieve success in smaller, spot treatments. Flowing systems have increased risk of lowered exposure time. Microbes break down the chemicals at varying rates. Certain plants are more resilient than others. Factors such as pH and plant maturity may also reduce treatment efficacy. Several follow-up treatments, whether in-season or in subsequent years, may be needed to reduce exotic species to target levels.

More recently, whole-lake treatments have gained more favor within the State. By targeting a whole-lake low-dose concentration of herbicide, the exposure time can be extended since dilution is generally mitigated. This is not the case in flowing systems, however. In addition, not only are the known locations of invasive species targeted with whole-lake treatments, the unknown locations are as well.

As with any herbicide treatment, collateral damage is always a concern. The desired result of herbicide treatment of exotic species is to effectively eliminate the target species while minimizing the impact to non-target species or water quality. This can be difficult in situations where native species sensitive to herbicide treatments are present or where large amounts of plant biomass may remain after treatment. To offset this risk, early-season treatments with selective herbicides and concentrations can target exotic species when the plants are small and cooler temperatures slow the microbial decomposition of herbicides.

**Biological control - milfoil weevils**

There has been considerable research on biological vectors, such as insects, and their ability to affect a decline in Eurasian watermilfoil populations. Of these, the milfoil weevil (*Euhrychiopsis lecontei*) has received the most attention. Native milfoil weevil populations have been associated with declines in Eurasian watermilfoil in natural lakes in Vermont (Creed and Sheldon, 1995), New York (Johnson et al., 2000) and Wisconsin (Lilie, 2000). While numerous lakes have attempted stocking milfoil weevils in hopes of controlling milfoil in a more natural manner, this method has not proven successful in Wisconsin. A twelve-lake study called "The Wisconsin Milfoil Weevil Project" (Jester et al. 1999) conducted by the University of Wisconsin, Stevens Point in conjunction with the Wisconsin DNR researched the efficacy of weevil stocking. This report concluded that milfoil weevil densities were not elevated, and that Eurasian watermilfoil was unaffected by weevil stocking in any of the study lakes. Recently, however, work carried out on a number of Portage County lakes has shown some promise at enhancing milfoil weevil populations. In order for weevils to be successful in reducing the extent of Eurasian watermilfoil, a number of environmental criteria are needed, including the availability of proper year-round habitat.

**Lake Drawdowns**

Lake drawdowns have been used as a means to manage both exotic and native aquatic plants in flowages and millponds. Drawdowns for control of exotic species have been more heavily promoted by the Wisconsin DNR in recent years. The benefits of an effective drawdown can include reductions in both exotic and native plant densities, increases in native plant diversity, and compaction and decomposition of organic sediments. If done properly, a drawdown can result in a number of positive changes to a lake.

The financial cost of conducting a drawdown is often minimal in a situation like Chute Pond since the dam can be adjusted to let water out of the lake at no cost. There would, however, be costs associated with the permitting process and likely outreach efforts. Other costs of a drawdown include short-term loss of recreational use, impacts to local economies and loss of wildlife including fish, mollusks and other invertebrates. According to the DNR, these impacts are minimal if drawdowns are executed correctly.

Drawdowns can be conducted over the growing season, over the winter, or both. Growing season drawdowns allow for a more prolonged period of time when the lake bed is exposed and desiccation and decomposition rates are highest. Growing season drawdowns can also stimulate emergent plan habitat in exposed areas. The effectiveness of a winter drawdown is a result of freezing conditions and is therefore dependent upon weather and snowfall amounts. These freezing conditions have been shown to be an effective tool for controlling Eurasian watermilfoil.

Before serious consideration, it should be determined whether or not the dam on Chute Pond can be opened sufficiently to allow the lake to drop to an effective level. A partial drawdown (up to five feet in depth) should have a significant impact to the plant community. The river channel and pools of water that remain during a drawdown can act as a refuge for fish and unfortunately for exotic species as well. The District should also be aware that the permitting process for a drawdown can be more substantial and time-consuming than other permit types. If a drawdown is chosen as a management tool it is also recommended the District involve the pertinent resource professionals throughout the process. This should result in the most effective drawdown possible.

Chute Pond is a high-use recreational lake. Many property owners and local businesses rely on Chute Pond for summer recreation and economic stability. Currently, there is little or no support from the District board and general membership for a drawdown on Chute Pond.

# Conclusions and Recommendations

Results of the property owner survey indicated that the aesthetics and recreational opportunities of Chute Pond are very important to residents and largely the reason for owning property on the lake. Results also indicate that "weed growth in the lake" is their highest ranking concern. Future management of aquatic plants in Chute Pond will continue to be a challenge. The District will have to contend with nuisance levels of exotic and native aquatic plant species.

## Eurasian Watermilfoil and Curly-leaf Pondweed

After the initial introductions, Eurasian watermilfoil and curly-leaf pondweed quickly colonized Chute Pond. In many ways the lake has ideal conditions for the growth and spread of aquatic plants including the exotic species which will continue to be a threat to the lake's ecosystem. The nature of Chute Pond will also continue to complicate control efforts which are more easily employed on other lakes. Chute Pond is a shallow, fertile waterbody which encourages both plant and algae growth. High recreational use and harvesting efforts can promote Eurasian watermilfoil growth which can spread quickly through fragmentation. Numerous non-navigable areas (shallow, rocky or stump-laden) provide refuge for milfoil growth away from the effects of treatments. In addition, as a flow-through system, chemicals applied during a treatment can be diluted by inflowing water. The full extent of dilution and its impact is difficult to determine.

Currently, Chute Pond has an above average diversity of submergent aquatic plants. It would appear chemical treatments are providing seasonal relief of Eurasian watermilfoil. Unfortunately, late-season regrowth has been observed for the past two years. A number of species potentially susceptible to herbicide treatments which target Eurasian watermilfoil, including northern watermilfoil, are present in Chute Pond.

Several options are available for managing Eurasian watermilfoil in lakes. However, with the current distribution of milfoil, few options are practical enough for this situation. Recent whole-lake treatments were effective at greatly reducing Eurasian watermilfoil in the lower sections of the lake. These treatments have also reduced the remaining milfoil to less than 70 acres. Although the desired results were not attained (greater efficacy), much of the flowage continues to have a low occurrence of Eurasian watermilfoil.

During recent communications with the Wisconsin DNR, it was decided the treatment in 2014 would utilize a faster-acting contact herbicide. Reward® (diquat) is a broad-spectrum herbicide that can effectively control aquatic plant growth with as little as six hours of contact time. To control submersed weeds, the Reward® product label lists application rates of 0.5-2.0 gallons per surface acre (per 4 foot water depth). For water depths of 2 feet or less including shorelines, the application rate should not exceed 1 gallon per surface acre. For best results, re-treatments can take place on 14-21 day intervals.

It is recommended this approach, or a similar approach be used to manage Eurasian watermilfoil in Chute Pond until the distribution of this species is reduced to less than 10% of the lake (approximately 43 acres). Admittedly, aquatic plant management in a high-flow situation is challenging. Neither current research nor experience on similar waterbodies has provided a management approach expected to effectively control aquatic invasive species and protect the native aquatic plant communities in a flowage of this type. The District should understand that management of Chute Pond will need to be adaptive. If the currently proposed approach is unable to provide continued progress in the coming years, a modified treatment approach or other non-chemical management approach should be considered.

Herbicide management of curly-leaf pondweed should continue to be put on hold until sufficient progress is gained in Eurasian watermilfoil management and resources become available to focus on curly-leaf pondweed.

Due to the limited herbicide contact time that occurs in much of Chute Pond, periodic drawdowns and mechanical harvesting may be effective long term alternatives for aquatic plant management in much of the waterbody. The District should continue selective weed-cutting activities in the lake while Eurasian watermilfoil management is ongoing. Postponing cutting entirely does not address the nuisance growth of native plants. Returning to the level of cutting performed prior to the infestation of Eurasian watermilfoil may worsen the problem and accelerate the spread of milfoil. As a compromise, the District should annually postpone cutting until four weeks after treatment. This will allow the treatments to take full effect. At that time, cutting for nuisance relief could take place. Operators should be made aware of the locations treated, how to properly identify Eurasian watermilfoil, and to avoid cutting in areas of active Eurasian watermilfoil growth. Cutting areas of curly-leaf pondweed in the spring and early summer is recommended. This should reduce the number of turions (vegetative reproductive structures) produced. By mid-summer, curly-leaf pondweed will begin to die-back. At that point, cutting to manage this species will be unnecessary.

Because of the ability of Eurasian watermilfoil and curly-leaf pondweed to spread within this water body, it is recommended that annual surveys be performed to find any new locations of these species before they reach nuisance levels. With the wide-spread distribution of milfoil in the lake, it is recommended that lake-wide monitoring utilizing current DNR protocols be employed to accurately locate and map aquatic invasive species in Chute Pond.

It is also recommended that annual winter stakeholder meetings take place to assess the results of the previous year's AIS management activities. Attendees should include representatives from the WDNR, Army Corps of Engineers, District Board, Cason & Associates and the Oconto County AIS specialist. These meetings should provide consensus on annual invasive species management activities.

**Aquatic Invasive Species grant**

The Aquatic Invasive Species – Established Population grant awarded to the District by the WDNR in 2011 will be used toward lake management expenses through 2013. It is recommended the District reapply for a follow-up grant for activities starting in 2014. Two grant cycles will take place before the beginning of the 2014 treatment season. The upcoming deadlines are August 1, 2013 and February 1, 2014. It is recommended the District apply for this grant to continue with the progress made and knowledge gained over the past two to three years.

**Clean Boats, Clean Waters**

The Chute Lake P & R District has a Clean Boats, Clean Water (CBCW) program that has been in place since 2009. However, very few volunteers have stepped forward to take part in this program. Chute Pond has a high-recreational use. The WDNR in cooperation with the UW-Extension Lakes Program has developed this volunteer watercraft inspection program designed to educate motivated lake organizations in preventing the spread of exotic plant and animal species among Wisconsin lakes. This program is particularly useful to Chute Pond since Eurasian watermilfoil and curly-leaf pondweed are both present. Through the Clean Boats, Clean Waters program, volunteers are trained to organize and conduct a program to monitor and stop the spread of exotic plants and animals both into and out of Chute Pond. As part of the 2011 Aquatic Invasive Species grant, the District agreed to contribute 200 volunteer hours annually to this project.

For more information, contact:
Erin McFarlane
Aquatic Invasive Species Volunteer Coordinator
Phone: 715-346-4978
E-mail: erin.henegar@uwsp.edu

A printable brochure regarding the Clean Boats, Clean Waters program can be downloaded at www.pacbsa.org/document/clean-boats-clean-water-brochure/120687

Education plays a big part in the Clean Boats, Clean Waters program. All individuals willing to participate should be taught to identify exotic species. The District should make it a priority to include such measures during all normally scheduled meetings whenever possible. In addition, special meetings should be sponsored to train volunteers for this program. Other training sessions are expected to be held in the County by Amanda Strick, the Oconto County Aquatic Invasive species Coordinator. Ms. Strick can be reached at 920-834-7155.

The native plant, northern watermilfoil, grows in Chute Pond. Because it superficially looks much like Eurasian watermilfoil, care should be taken to specifically learn to differentiate between the two species. In addition to Eurasian watermilfoil and curly-leaf pondweed, it would behoove members of the District to become familiar with the identification of other exotic species that pose a threat to Wisconsin lakes (see **Appendix G**). Additional information and education materials are available through the Wisconsin DNR and the local UW-Extension office. **Appendix G** also contains information regarding management options for the exotic species previously mentioned. As always, education should be a key component of any exotic species management effort.

The DNR has recently simplified the grant application for Clean Boats Clean Waters candidates through the *Lean 6 Sigma* Program. This program allows for easier grant awards, data collection, and financial reporting requirements for sponsors simply wishing to implement CBCW projects. More information about this program can be found at: dnr.wi.gov/Aid/documents/AIS/CBCW_Fact_Sheet.pdf.

## Water Quality Management

Water quality data for Chute Pond suggest during the warmest time of the year, Chute Pond can experience moderate to poor water quality. However, improved conditions are seen in the spring and fall. Very little historic data exist to determine if trends exist.

**Nutrient management options**
Elevated nutrient inputs from human activities around a lake can adversely affect both water clarity and water quality. A number of practices can be carried out to improve water quality. Significant contributions of nutrients to the lake can come from direct runoff from areas closest to the lake. The following are options for water quality enhancement which both the District, as a whole, and individual lakefront property owners can undertake in an effort to maintain water quality.

The first step in managing nutrients in a lake is to control external sources of nutrients. These can include: encouraging proper lawn care, restoring vegetation buffers around waterways, encouraging beneficial agricultural practices, and reducing run-off.

**Lawn care practices**
Individuals can play a large part in reducing sedimentation from local sources. Mowed grass up to the water's edge is a poor choice for the well-being of a lake. Studies show that a mowed lawn can cause seven times the amount of phosphorus and 18 times the amount of sediment to enter a waterbody (Korth and Dudiak, 2003). Lawn grasses also tend to have shallow root systems that cannot protect the shoreline as well as deeper-rooted native vegetation (Henderson et al., 1998). Property owners within the District should take care to keep leaves and grass clippings out of the lake whenever possible, as they contain nitrogen and phosphorus. The best disposal for organic matter, like leaves and grass clippings, is to compost them.

Fertilizers that enter the lake will encourage an increase in plant and algae biomass. Fertilizers contain nutrients that can wash directly into the lake. While elevated levels of phosphorus can cause unsightly algae blooms, nitrogen inputs have been shown to increase weed growth. Increases in plant biomass will lead to further sedimentation and navigational issues. Landowners are encouraged to perform a soil test before fertilizing. A soil test will help determine if a yard needs to be fertilized. For assistance in having soil tested, contact the local county UW-Extension office. Since April 1, 2010, fertilizers containing phosphorus cannot be applied to lawns or turf in Wisconsin. This change in the State's statutes is intended to provide protection to Wisconsin's lakes, rivers, streams and other water resources from phosphorus run-off. The fact is most lawns in Wisconsin don't need additional phosphorus. The numbers on a bag of fertilizer are the percentages of available nitrogen, phosphorus and potassium found in the bag. Phosphorus free fertilizers will have a 0 for the middle number (e.g. 10-0-3).

**Vegetative buffer zones**

There are beneficial alternatives to the traditional mowed lawn. It is best to leave the natural shoreline undisturbed. If clearing is necessary to access and view the lake, consider very selective removal of vegetation.

If the natural shoreline has been disturbed or removed it would be ideal to restore it. Restoring a vegetative buffer zone is an important alternative. Ideally, a buffer zone consists of native vegetation that may extend from 25 – 100 feet or more from the water's edge onto land, and 25 – 50 feet into the water. Often a buffer to this extent is not feasible, either physically or economically. In these cases, a smaller or narrower buffer can still provide the same benefits of a more extensive buffer, just on a smaller scale. A buffer should cover between 50% and 75% of the shoreline frontage (Henderson et al., 1998). In most cases this still allows plenty of room for a dock, swimming area, and lawn. Buffer zones are made up of a mixture of native trees, shrubs, and other upland and aquatic plants. Studies have also shown that providing complex habitats through shoreline features, such as plants and erosion control devices, can result in significant increases in fish diversity and numbers (Jennings et al., 1999).

Shoreline vegetation serves as an important filter against nutrient loading and traps loose sediment. A buffer provides excellent fish and wildlife habitat, including nesting sites for birds, and spawning habitat for fish. Properly vegetated shorelines also play a key role in bank stabilization. A number of resources are available to assist property owners in creating beneficial buffer zones. These include the Wisconsin DNR, local UW-Extension office, and the County Land and Water Conservation Department. These organizations can provide descriptions of beneficial native plant species and listings of aquatic nurseries in the State.

**Erosion control**

Erosion is a natural process, but it's for the benefit of the landowner and health of the lake that erosion control practices be carried out to slow the process as much as possible. Sedimentation into the lake causes nutrient pollution, turbid water conditions, eliminates fish spawning habitat, and increases eutrophication. Shoreline owners are encouraged to leave existing vegetation undisturbed, as it is a great shore stabilizer. The placement of logs, brush mats, and rock riprap are also options against erosion. When riprap is used it is recommended that desirable shrubs and aquatic plants be planted within the riprap. The plantings serve as nutrient filters and habitat. Before any shoreline stabilization project is initiated, it is advised that property owners contact the local Wisconsin DNR office for project approval and to obtain any necessary permits.

**Reduced impacts from boating**

Boat traffic can cause an increase in suspended solids, especially in shallow areas of lakes (Hill, 2004). Studies have shown that maximum increases in turbidity occur between two and 24 hours following boating activities. The full effects of heavy boating depend upon a number of factors including propeller size, boat speed, draft, and sediment characteristics (Asplund, 1996). Silty sediments tend to have the highest susceptibility to resuspension and the highest potential for the reintroduction of nutrients into the water column. Studies have also focused on algae (chlorophyll a) concentrations but found no significant changes following boating activity. This is due primarily to an indeterminate time lag which occurs between the release of nutrients and the subsequent increase in algal growth. It has also been suggested that disturbances to the native plant communities due to watercraft use can accelerate the spread of opportunistic exotic plant species such as Eurasian watermilfoil and curly leaf pondweed (Asplund and Cook, 1997).

Wisconsin statutes require boaters to maintain no-wake speeds within 100 feet of shorelines, other boats, or fixed structures, including boat docks and swimming platforms. However, it is difficult to enforce such regulations, and even slow boat traffic can have a negative impact on sediments and plant communities in shallow areas. This not only has a negative impact to the lake but shallow conditions can also damage boat propellers and motors. It is recommended that the District take the opportunity to educate members and lake users alike of the impacts boating can have on a lake.

**Septic system maintenance**

Septic systems are known to contribute nutrients to a lake. It is the responsibility of lakeshore property owners to ensure that septic systems are properly functioning. A failing septic system can contaminate both surface and ground water. Many Counties in Wisconsin are currently taking inventory of septic systems and enrolling them in a three-year maintenance program. Property owners should avoid flushing toxic chemicals into septic systems. This can harm important bacteria that live in the tank and naturally break down wastes. Owners should also avoid planting trees, compacting soil, or directing additional surface runoff on top of the drain field.

**Wisconsin Citizen Lake Monitoring Network**

Very limited historic water quality data exists for Chute Pond. District volunteers should consider participating in the Wisconsin Citizen Lake Monitoring Network. This program provides an opportunity for volunteers from lake organizations to assist in state-wide water quality monitoring. Volunteers on Chute Pond could start by collecting water clarity data and water samples for analysis of phosphorus and chlorophyll. Through a database managed by the

DNR, information gathered can be shared by volunteers and archived. The types of data collected depend on what concerns and interests exist for a particular lake, as well as the amount of time available for monitoring. It is highly recommended that the District participate in this program. The importance of long-term data is crucial in assessing changes to the lake environment. In addition, participating in projects of this type can help the District secure additional grant money from the WDNR. Funds are awarded to organizations that demonstrate a commitment to the health and wellbeing of their lakes.

# Implementation Plan

## Management Goal 1: Reduce exotic aquatic plant growth within Chute Pond.

**Management Action**: Annual monitoring and chemical treatment(s).
**Timeframe**: Annual surveys in spring and fall. Spring treatments to control Eurasian watermilfoil and/or curly-leaf pondweed.
**Facilitators**: District Board, Cason & Associates, LLC

**Description**: Surveys for exotic species, namely Eurasian watermilfoil and curly-leaf pondweed will be conducted in the spring and fall, respectively. These surveys will be conducted by Cason & Associates staff and will follow current DNR protocols.

Spring surveys will be used to monitor the distribution of curly-leaf pondweed in Chute Pond. The District plans to use the information obtained to prioritize spring harvesting locations for curly-leaf pondweed. This cutting will abide by the conditions in the existing harvesting permit. If survey results show a significant expansion in the distribution of curly-leaf pondweed, management efforts will be discussed. Additional chemical treatments for curly-leaf pondweed may take place within the timeframe of this management plan if needed.

Fall surveys will be used to monitor the distribution of Eurasian watermilfoil in Chute Pond. These surveys will assess the efficacy of previous herbicide treatments and determine the need for additional treatments. Annual spring treatments are anticipated to further reduce the distribution of Eurasian watermilfoil. Whole-lake liquid 2,4-D treatments has been the most recent and successful approach used on Chute Pond. Prior to the use of liquid 2,4-D, the large-scale use of Navigate® (granular 2,4-D) was employed with less success. Currently, a majority of the lake, particularly the highest used recreational areas are free of nuisance Eurasian milfoil growth. It is anticipated that multiple treatment approaches may be employed over the next five years. Changes may be made to the herbicide type or formulation, the application rates or methodology, and/or combinations of herbicides.

As treatments take place, hand-pulling will be encouraged by the District. As small scattered locations of invasive species are identified, the District will solicit volunteers to hand-pull these plants. In addition, property owners will be encouraged to hand-pull exotic species around their docks and shorelines.

If treatments cease to provide further reductions in Eurasian watermilfoil, the District will more seriously consider other management options such as drawdowns and harvesting.

The District plans to include funding for surveys and treatments in the annual budget. This should include approximately $1,500 for each survey. Treatment costs will vary depending upon treatment needs. The District plans to apply for further funding through the Wisconsin DNR's Aquatic Invasive Species grant program to offset treatment and monitoring costs.

## Management Goal 2: Manage the health of the native plant community within Chute Pond.

**Management Action:** Selective harvesting of native plants within Chute Pond according to DNR permit conditions.
**Timeframe:** Annual summer harvesting.
**Facilitator:** District Board
**Description:** In order to manage nuisance levels of native aquatic plants, the District plans to continue the annual harvesting program established on Chute Pond. Harvesting for native aquatic plants is expected to be delayed annually until at least four weeks following herbicide treatment of Eurasian watermilfoil. Once this period has passed, operators will be instructed to cut in areas specifically allowed through the permit. They will be made aware of all permit conditions. They will also be educated on the difference between Eurasian watermilfoil and curly-leaf pondweed and aware (via onboard maps) of the current distribution of the species in the lake. For the time being, they will be instructed to avoid cutting in areas of Eurasian watermilfoil growth. It is anticipated the harvesting permit will be renewed as a multi-year permit starting in 2015.

## Management Goal 3: Encourage shoreline improvements on an individual riparian owner basis.

**Management Action**: Restore or improve near-shore plant community to improve water quality and fish and wildlife habitat. Educate District members regarding the reduction of nutrients and sediments from immediate watershed.
**Timeframe**: Ongoing
**Facilitator**: District Board
The District board plans to provide information to its membership regarding shoreline improvement options and other actions the District as a whole and individuals can take. Particular attention will be paid to the use of vegetative buffer strips and tree falls as a means to improve fish habitat in the lake. Resources included in this plan as well as those available from the Wisconsin DNR, Oconto County and UW-Extension will be utilized. The District will also solicit appropriate speakers to address these issues at membership meetings. Shoreline improvement demonstrations may be planned at the District's discretion.

## Management Goal 4: Continued participation in the Clean Boats, Clean Waters Citizen Lake Monitoring Network programs.

**Management Action:** Expand on Clean Boats, Clean Waters and Citizen Lake Monitoring Network programs on Chute Pond.
**Timeframe**: Annual, continuous
**Facilitator**: District Board

District volunteers are currently trained and participate in the monitoring of boat landings through the Clean Boats, Clean Waters program. In the past, it has been challenging for the District Board to recruit volunteers for this program. Members of the Board are dedicated to this program and will continue to encourage lake residents to become trained and volunteer through this program. The District will work with the Wisconsin DNR and the County Aquatic Invasive Species Coordinator to expand this program and increase the number of volunteers and hours. Annually, over 200 hours of volunteer time are anticipated for this program.

In the past, the District has participated in the Wisconsin DNR's Citizen Lake Monitoring Network program. However, currently volunteers do not collect water quality data. The District Board has acknowledged the benefit of participating in this program. Starting in 2014, the District will solicit volunteers from its membership to take part in this program. District members are expected to participate in a training session. The level of involvement and the number of trained individuals will depend upon volunteer availability and interest. Volunteers will also be encouraged to take part in the training to identify additional invasive species.

# References

Asplund, T. R., and C. M. Cook. 1997 Effects of motor boats on submerged aquatic macrophytes. Lake and Reservoir Management,. 13(1):1-12.

Asplund, T. R. 1996. Impacts of motorized watercraft on water quality in Wisconsin Lakes. Wis. Dept. Nat. Res. Bur. Research, Madison, WI. PUBL-RS-920-96. 46 pp.

Baumann, T., M. Bratager, W. Crowell, S. Enger, M. Johanson, G. Montz, N. Hansel-Welch, W.J. Rendall, L. Skinner, and D. Wright. 2000. Harmful exotic species of aquatic plants and wild animals in Minnesota: annual report 1999. Minnesota Department of Natural Resources, St. Paul, Minnesota, USA.

Borman, Susan, Robert Korth, and Jo Temte. 1997. Through the Looking Glass – A Field Guide to Aquatic Plants. Wisconsin Lakes Partnership, University of Wisconsin, Stevens Point.

Brakken, J., 2000. *What are the odds of invasion?* Wisconsin Association of Lakes.

Carlson Robert E. 1977. *A trophic state index for lakes*. Limnology and Oceanography. 22(2):361-369.

Creed, R.P. Jr., and S.P. Sheldon. 1995. *Weevils and Watermilfoil: Did a North American herbivore cause the decline of an exotic weed?* Ecological Applications. 5(4): 1113-1121.

Eggers, Steve, and Donald Reed. 1997. *Wetland Plants and Plant Communities of Minnesota and Wisconsin.* U.S. Army Corps of Engineers, St. Paul District.

Eiswerth, M.E., S.G. Donaldson and W.S. Johnson, 2003. *Potential environmental impacts and economic damages of Eurasian watermilfoil (Myriophyllum spicatum) in Western Nevada and Northeastern California.* Weed Technology: Vol. 14, No.3.

Engel, Sandy. 1985. *Aquatic community interactions of submerged macrophytes*. Technical Bulletin No. 156. Department of Natural Resources. Madison, Wisconsin.

Fasset, Norman C. 1940. *A Manual of Aquatic Plants.* University of Wisconsin Press, Madison.

Fink, D.F. 1994. *A Guide to Aquatic Plants - Identification and Management.* Ecological Services Section, Minnesota Department of Natural Resources, St. Paul. 52 pp.

Green, W.R. and H.E. Westerdahl. 1990. Response of Eurasian Watermilfoil to 2,4-D Concentration and Exposure Times. J. Aquat. Plant Manage. 28: 27-32.

Henderson, C.L., C.J. Dindorf, and F. J. Rozumalski. 1998. *Lakescaping for Wildlife and Water Quality.* State of Minnesota, Department of Natural Resources.

Hill, David F. 2004. Physical impacts of boating on lakes. Lakeline. Fall 2004. pp. 15-18.

Jennings, M., M.A. Bozek, G. Hatzenbeler, E. Emmons, and M. Staggs. 1999. Cumulative effects of incremental shoreline habitat. North American Journal of Fisheries Management. 19(1): 18-27.

Jester, Laura L., Daniel R. Helsel and Michael A. Bozek. 1999. *Wisconsin Milfoil Weevil Project – Gilbert Lake Final Report.* University of Wisconsin – Stevens Point.

Johnson, R.L., P.J. Van Dusen, J.A. Tonerand, N.G. Hairston. 2000. *Eurasian watermilfoil biomass associated with insect herbivores in New York.* Cornell University.

Korth, Robert and Tamara Dudiak. 2003. *The Shoreland Stewardship Series #1.* University of Wisconsin-Extension, Wisconsin Department of Natural Resources, The Wisconsin Lakes Partnership, Wisconsin Association of Lakes, River Alliance of Wisconsin.

Lilie, R.A. 2000. *Temporal and spatial changes in milfoil distribution and biomass associated with weevils in Fish Lake, WI*. Wisconsin Department of Natural Resources.

Madsen, John. 2001. *Symposium: The potential to use fluridone to selectively control Eurasian watermilfoil in Minnesota.* University of Minnesota. St. Paul.

Newroth, P. R. 1985. *A review of Eurasian watermilfoil impacts and management in British Columbia. In: Proc. First Int. Symp. on watermilfoil (Myriophyllum spicatum) and related Haloragaceae species*. Aquatic Plant Management Society, Inc. pp. 139-153.

Nichols, Stanley A. 1999. *Floristic quality assessment of Wisconsin lake plant communities with example applications.* Journal of Lake and Reservoir Management. 15(2):133-141.

Nichols, Stanley A. 1974. *Mechanical and habitat manipulation for aquatic plant management.* Technical Bulletin No. 77. Department of Natural Resources. Madison, Wisconsin.

Nichols, Stanley A., and James G. Vennie. 1991. *Attributes of Wisconsin Lake Plants.* Wisconsin Geological and Natural History Survey.

Omernik, J.M. and A.L. Gallant. 1988. Ecoregions of the Upper Midwest States. EPA/600/3-88/037. U.S. EPA, Environmental Research Laboratory, Corvallis, OR. 56p.

Pullman, Douglas G. 1993. *The Management of Eurasian Watermilfoil in Michigan.* The Midwest Aquatic Plant Management Society. Vol. 2, Ver. 1.0.

Shaw, Bryon, Christine Mechenich, and Lowell Klessig. 2004. *Understanding lake data.* University of Wisconsin – Extension. RP-03. 20 pp.

Skogerboe, J. and A. Poovey. 2002. *Long-term control of curly-leaf pondweed on Minnesota lakes using Aquathol-K: Return of the natives.* Midwest Aquatic Plant Management Society annual conference. Brookfield, Wisconsin.

Smith, C.S., and M.S. Adams, 1986. *Phosphorus transfer from sediments by Myriophyllum spicatum.* Limnology and Oceanography. Vol. 31, no. 6.

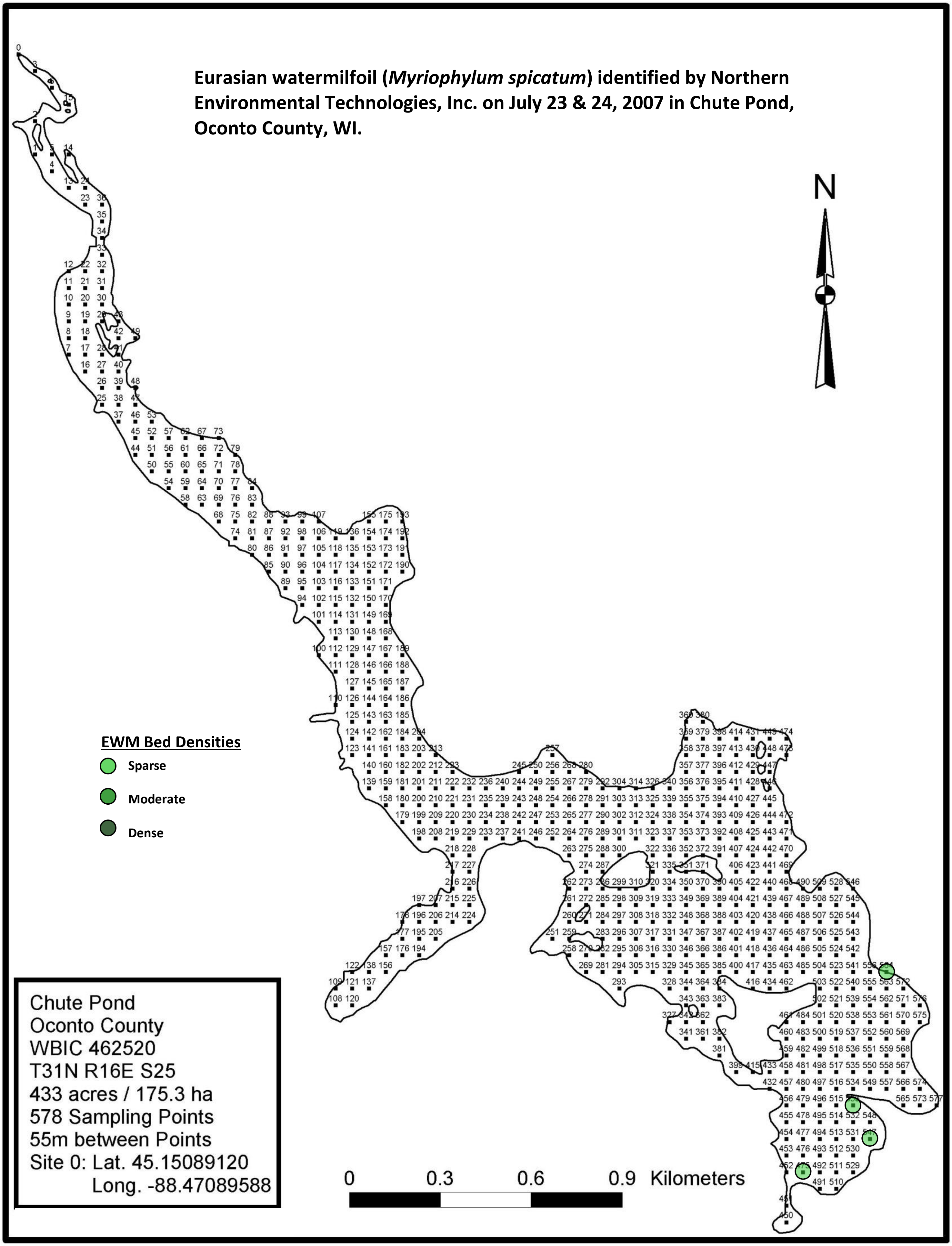
Smith, Gordon E., 1971. *Resume of studies and control of Eurasian watermilfoil (Myriophyllum spicatum) in the Tennessee Valley from 1960 through 1969.* Hyacinth Control Journal, vol. 9, no. 1.

Unmuth, J.M.L., R.A. Lilie, D.S. Dreikosen, and D.W. Marshall, 2000. *Influence of dense growths of Eurasian watermilfoil on lake water temperature and dissolved oxygen.* Journal of Freshwater Ecology. Vol. 15, no. 4.

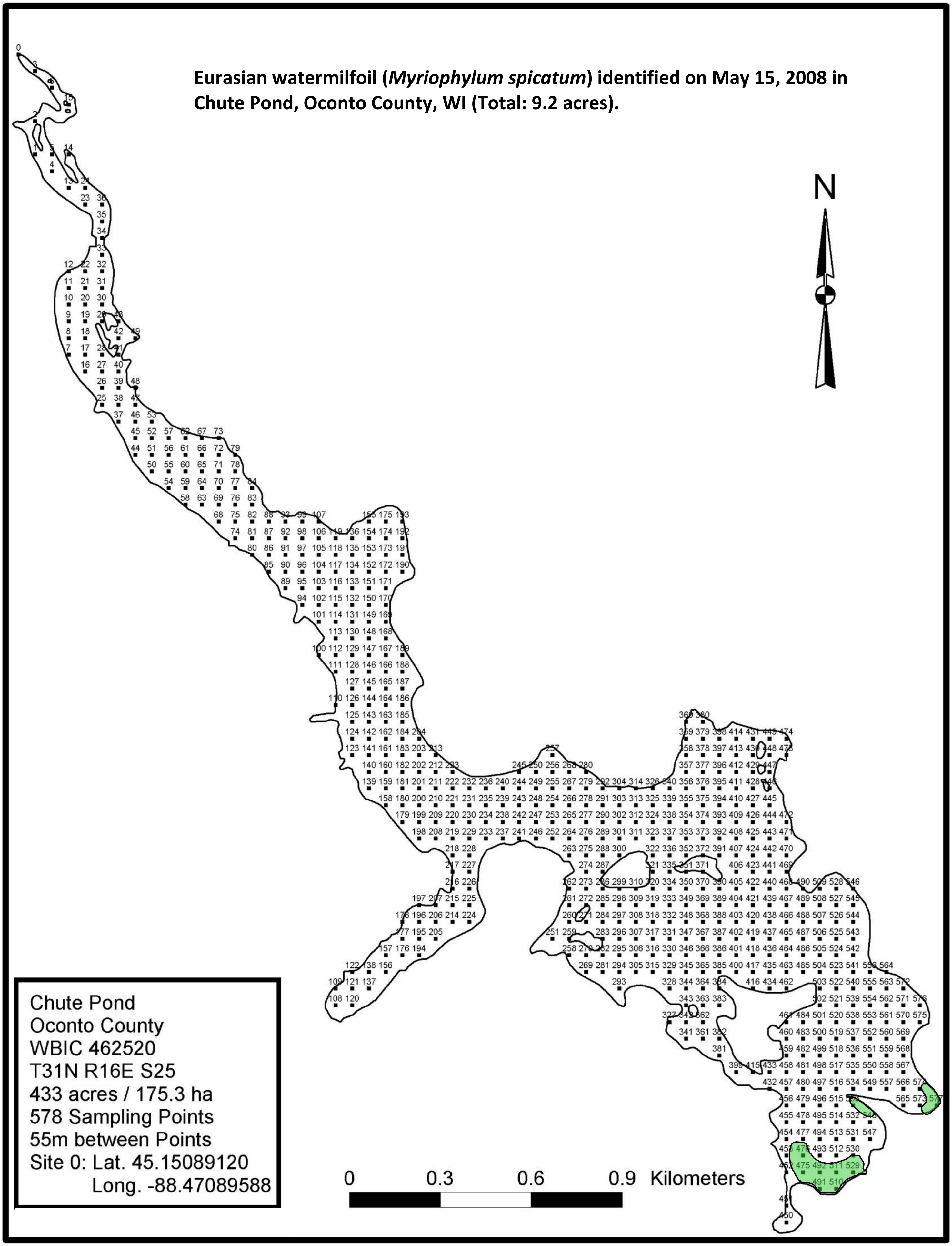
Whitley, J. R., Barbara Bassett, J. G. Dillard, and R. A. Haefner. 1999. *Water Plants for Missouri Ponds.* Conservation Commission of the State of Missouri.

# Appendix A

- **Aquatic invasive species survey maps from 2007 to 2013 for Chute Pond, Oconto County, Wisconsin.**

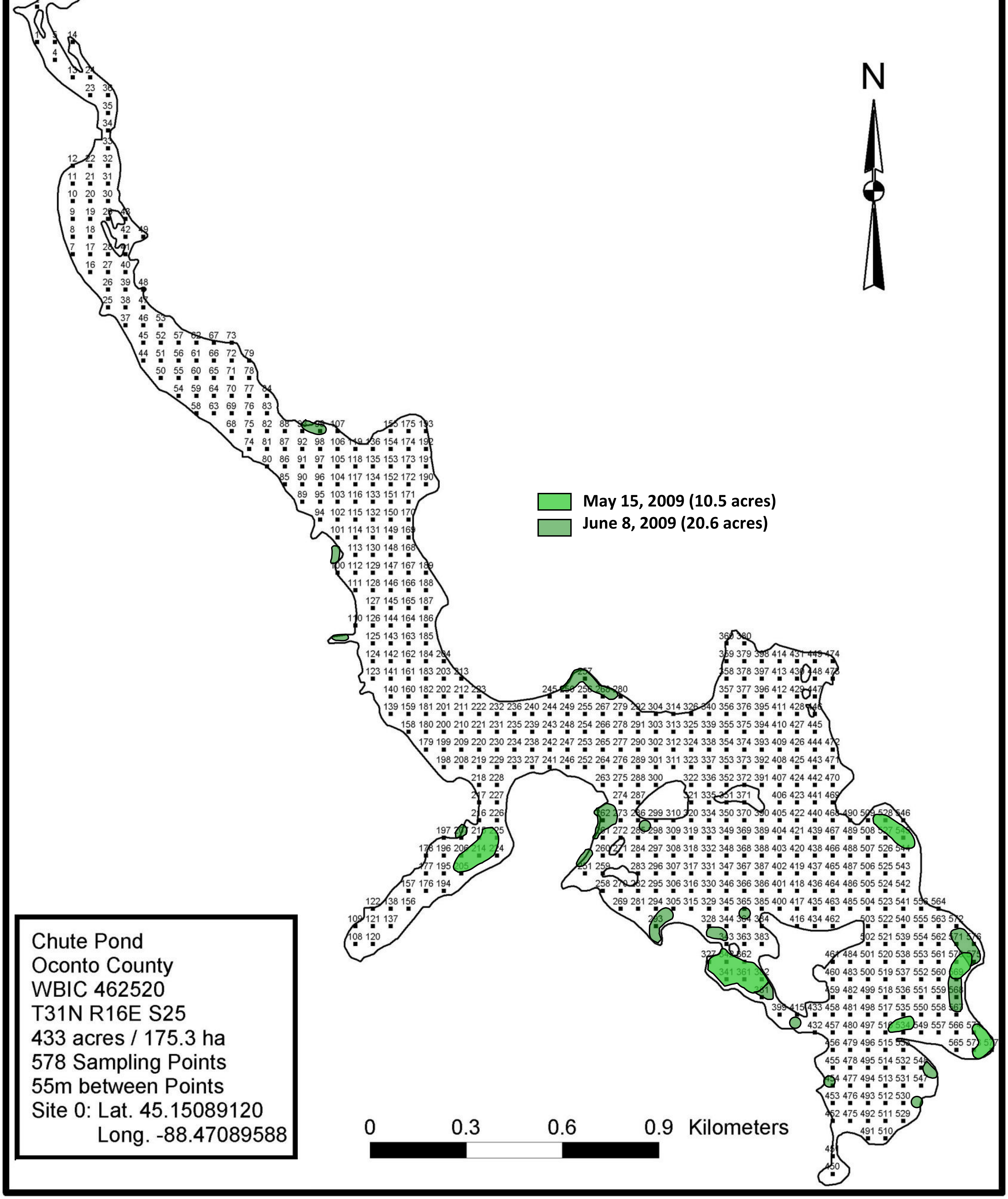


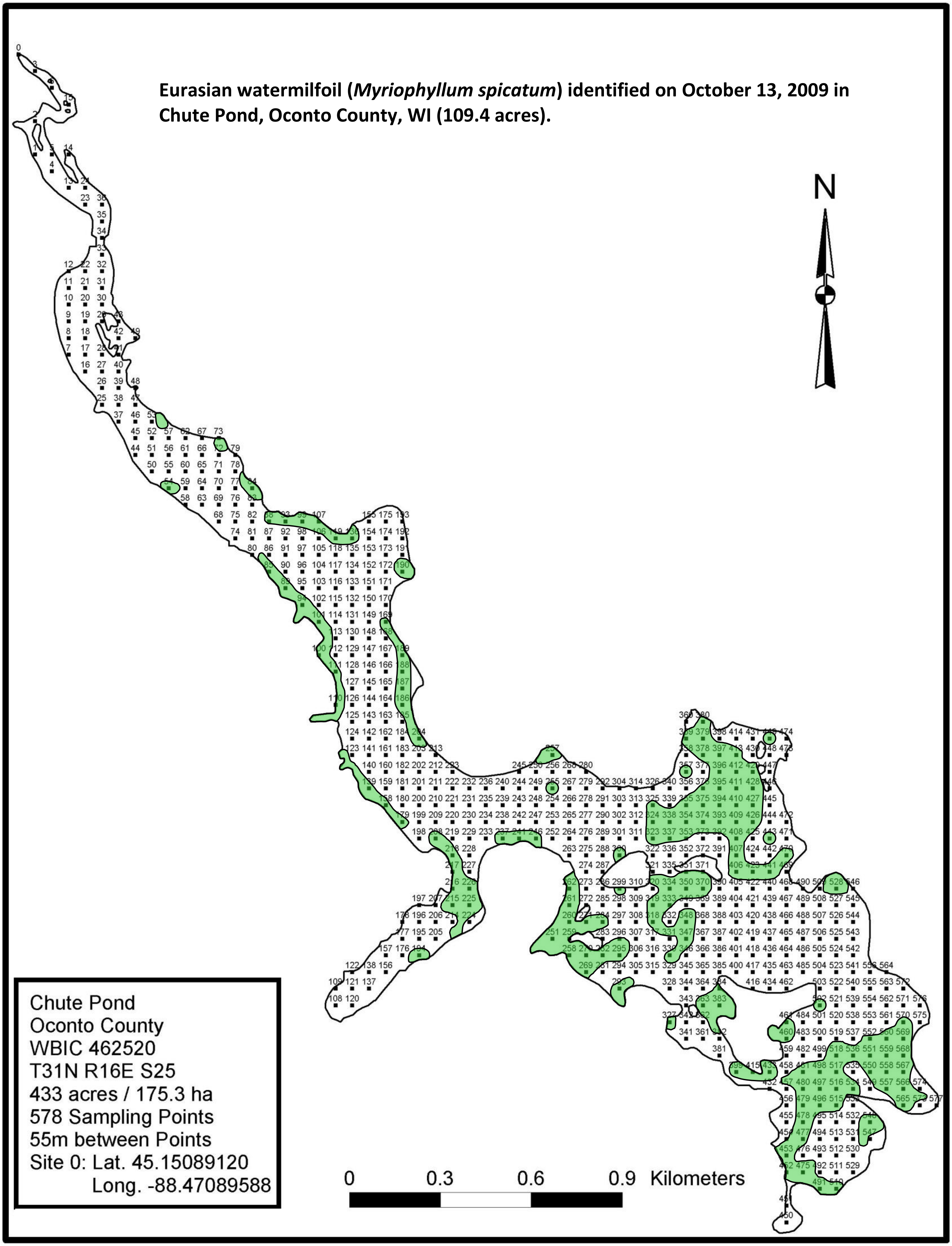

**Eurasian watermilfoil (*Myriophylum spicatum*) identified by Northern Environmental Technologies, Inc. on July 23 & 24, 2007 in Chute Pond, Oconto County, WI.**



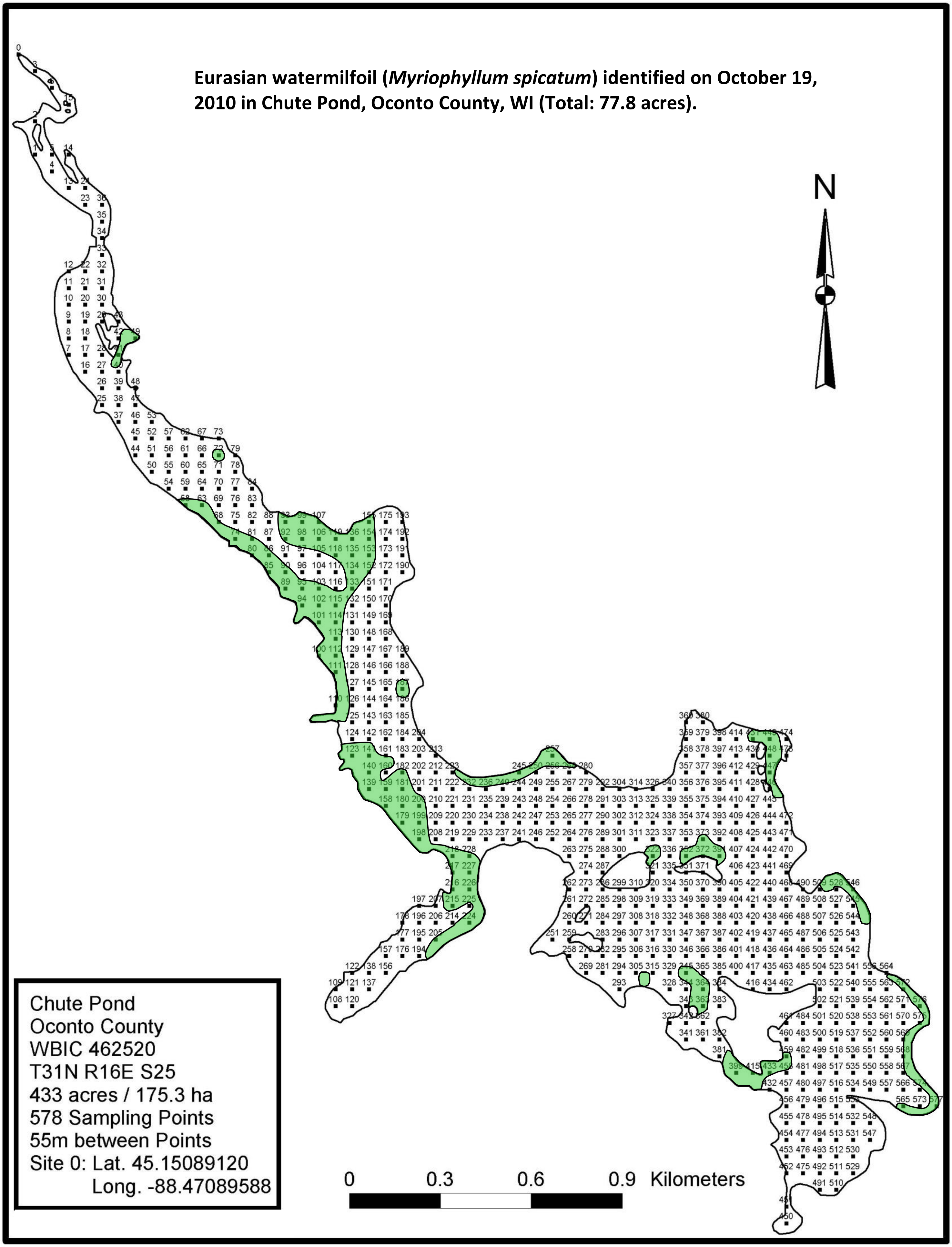

**Eurasian watermilfoil (*Myriophylum spicatum*) identified on May 15, 2008 in Chute Pond, Oconto County, WI (Total: 9.2 acres).**

**Eurasian watermilfoil (*Myriophylum spicatum*) identified on May 15 and June 8, 2009 in Chute Pond, Oconto County, WI (Total: 31.1 acres).**

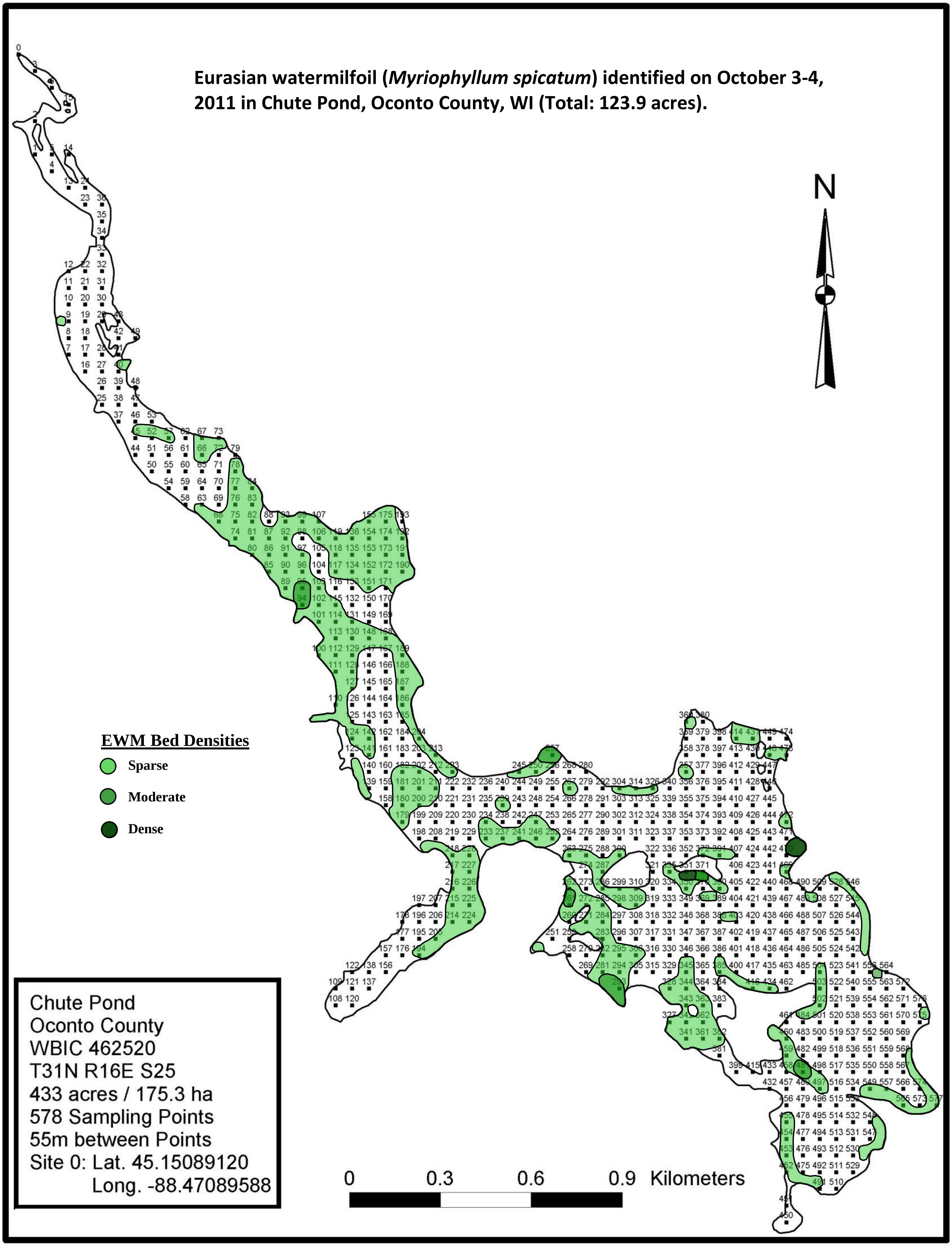




Eurasian watermilfoil (*Myriophyllum spicatum*) identified on October 13, 2009 in Chute Pond, Oconto County, WI (109.4 acres).
N
0 0.3 0.6 0.9 Kilometers
Chute Pond
Oconto County
WBIC 462520
T31N R16E S25
433 acres / 175.3 ha
578 Sampling Points
55m between Points
Site 0: Lat. 45.15089120
Long. -88.47089588

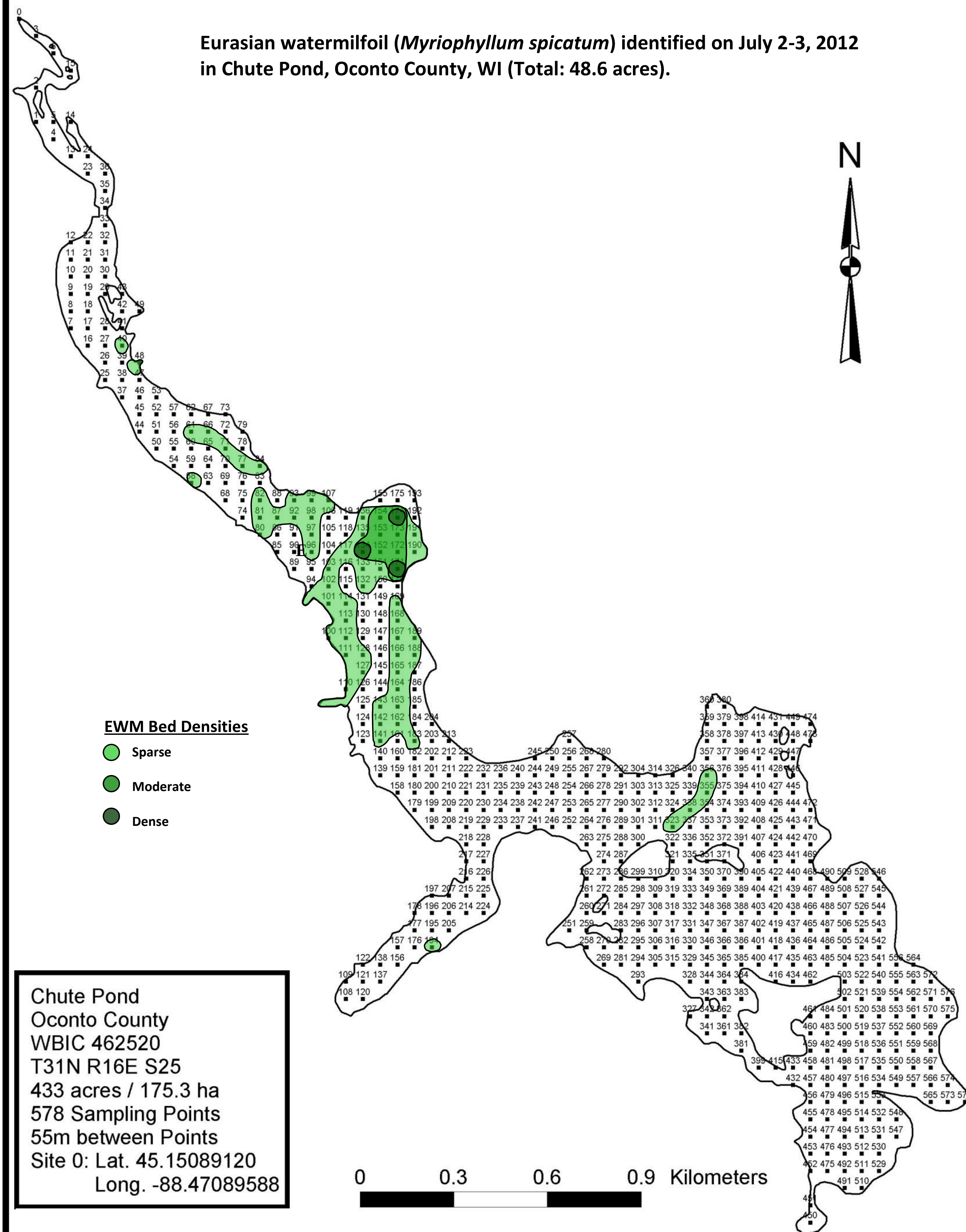


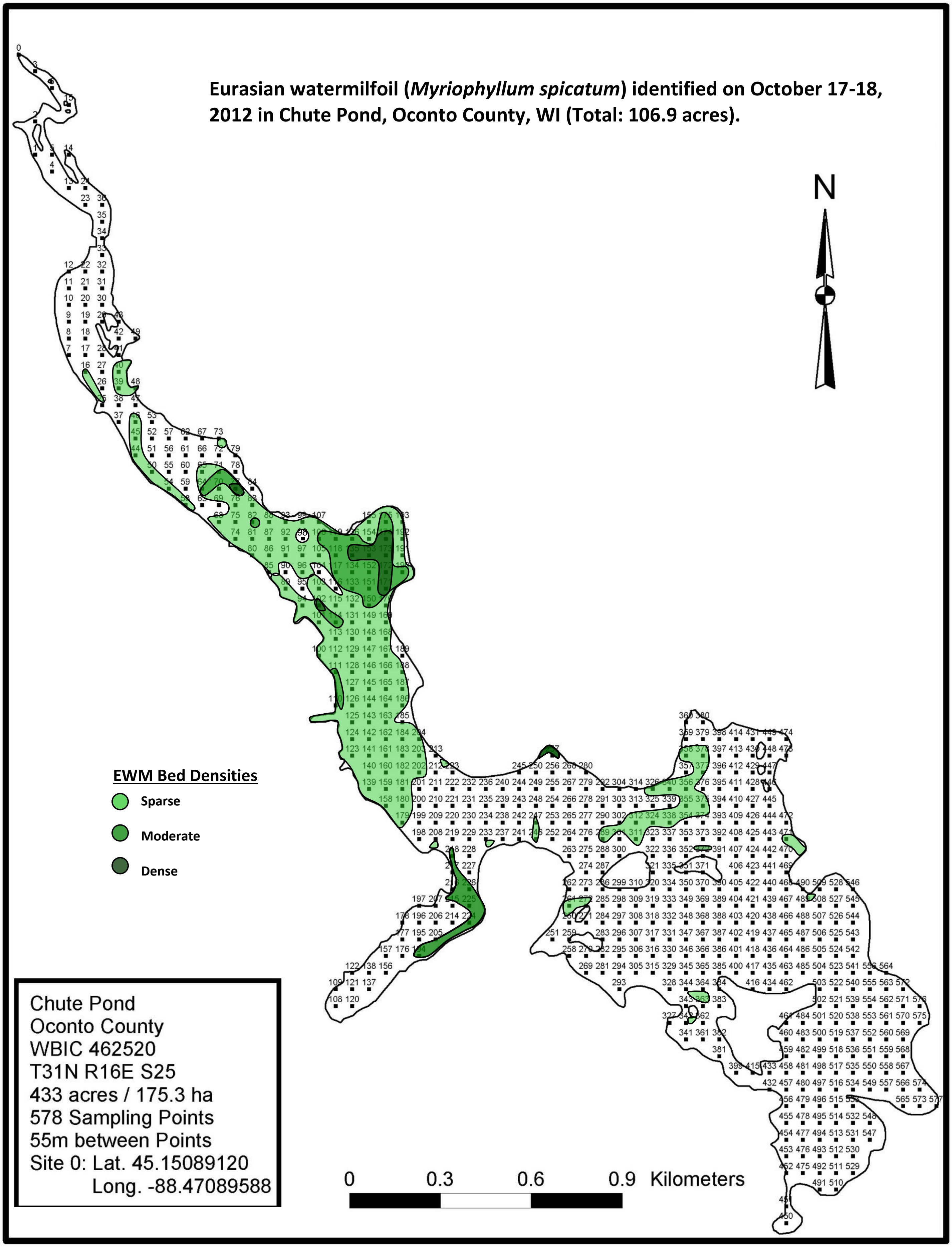
Eurasian watermilfoil (*Myriophyllum spicatum*) identified on October 19, 2010 in Chute Pond, Oconto County, WI (Total: 77.8 acres).
N
Chute Pond
Oconto County
WBIC 462520
T31N R16E S25
433 acres / 175.3 ha
578 Sampling Points
55m between Points
Site 0: Lat. 45.15089120
Long. -88.47089588
0 0.3 0.6 0.9 Kilometers



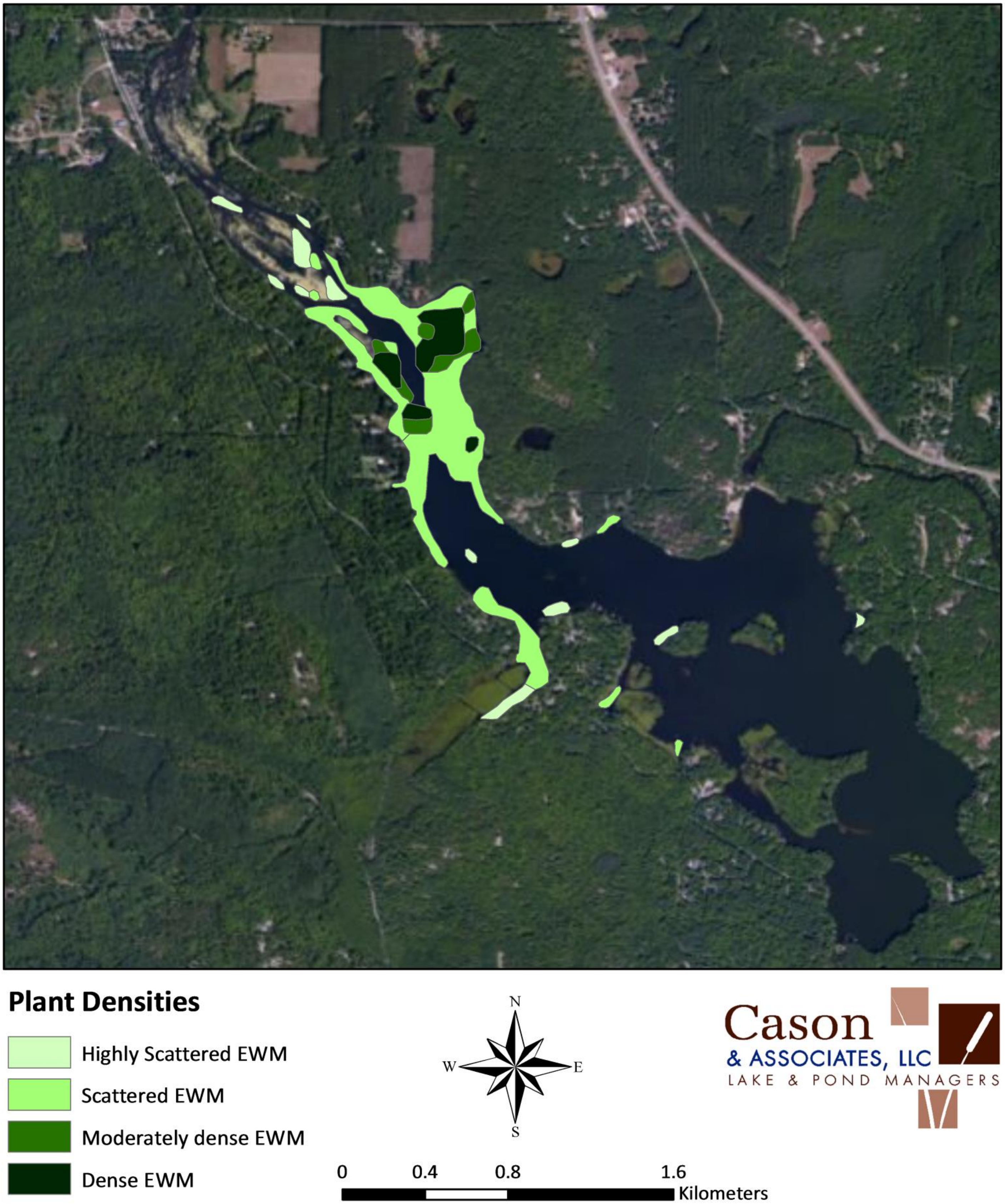

**Eurasian watermilfoil (*Myriophyllum spicatum*) identified on October 3-4, 2011 in Chute Pond, Oconto County, WI (Total: 123.9 acres).**

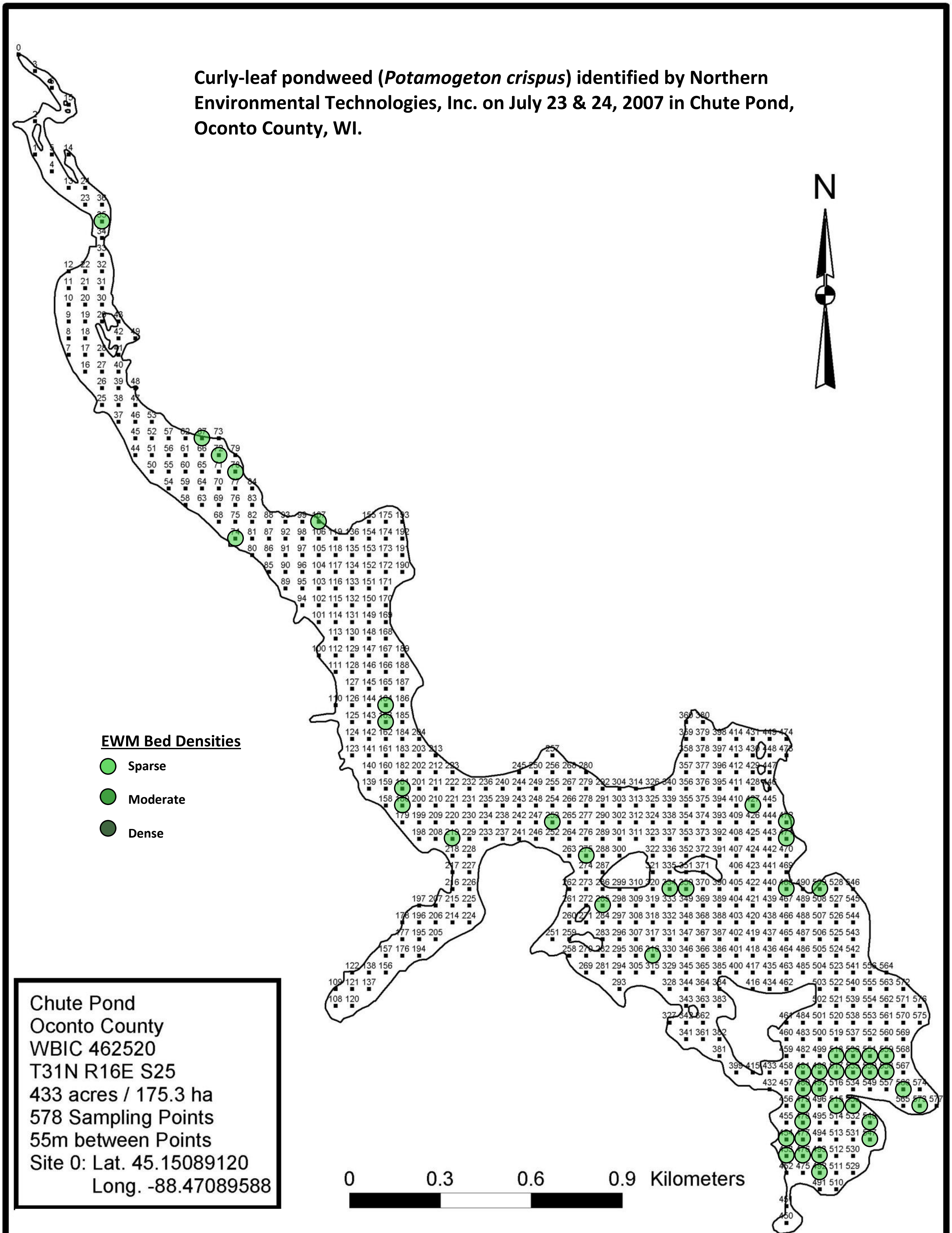
**Eurasian watermilfoil (*Myriophyllum spicatum*) identified on July 2-3, 2012 in Chute Pond, Oconto County, WI (Total: 48.6 acres).**



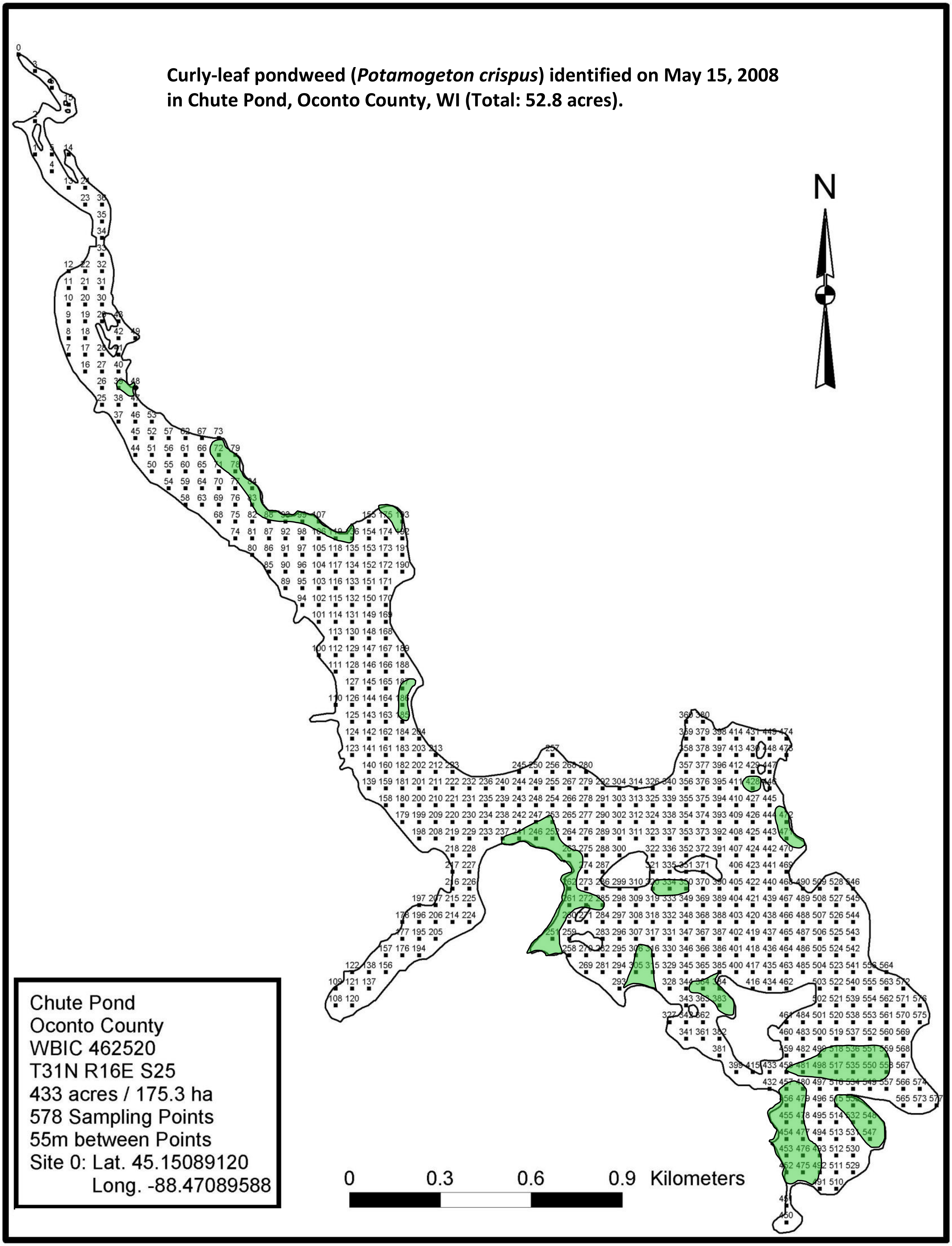

Eurasian watermilfoil (*Myriophyllum spicatum*) identified on October 17-18, 2012 in Chute Pond, Oconto County, WI (Total: 106.9 acres).
N
EWM Bed Densities
Sparse
Moderate
Dense
Chute Pond
Oconto County
WBIC 462520
T31N R16E S25
433 acres / 175.3 ha
578 Sampling Points
55m between Points
Site 0: Lat. 45.15089120
Long. -88.47089588
0 0.3 0.6 0.9 Kilometers

**Eurasian watermilfoil (*Myriophyllum spicatum*) identified on October 13-14, 2013 in Chute Pond, Oconto County, WI (Total: 67.8 acres).**

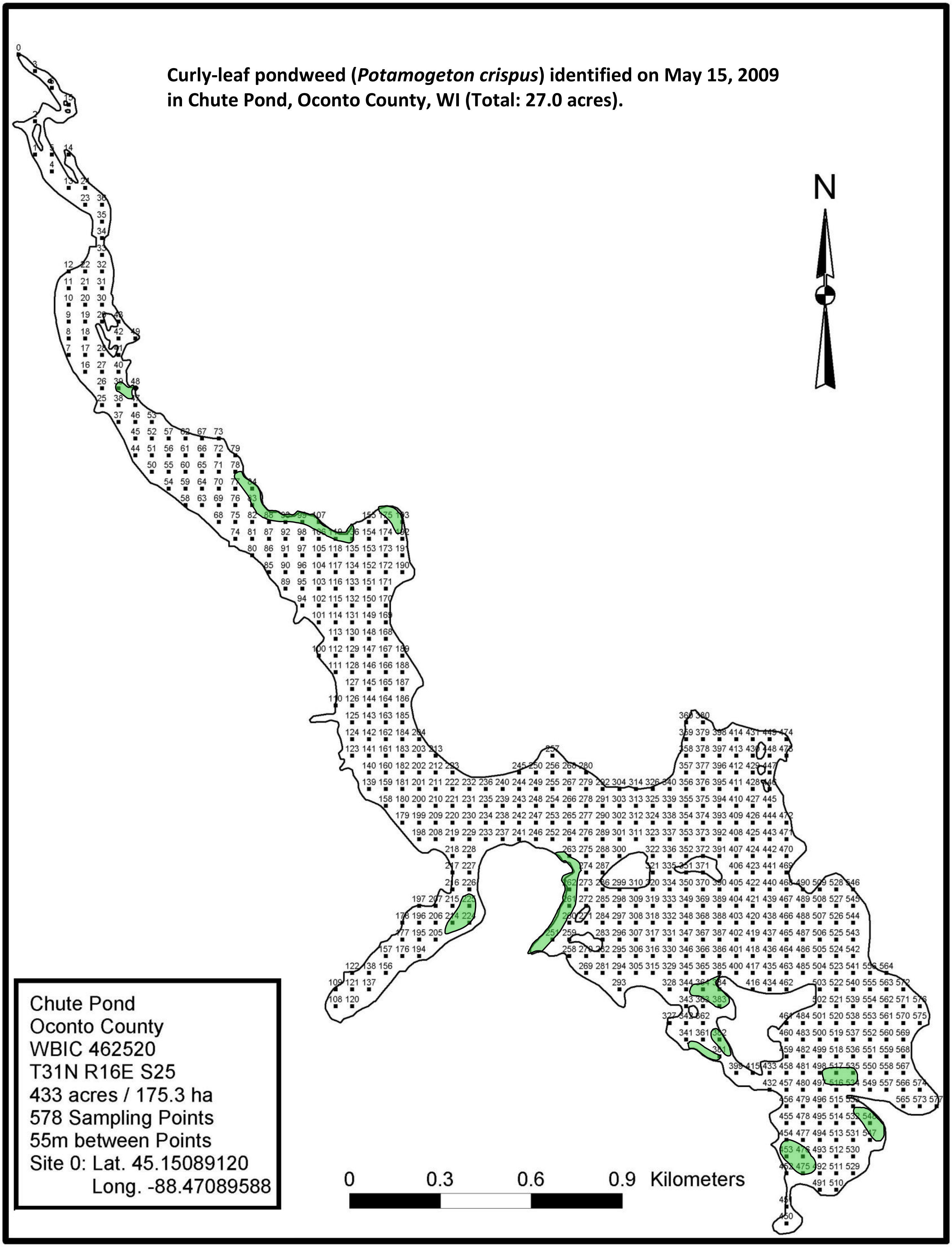




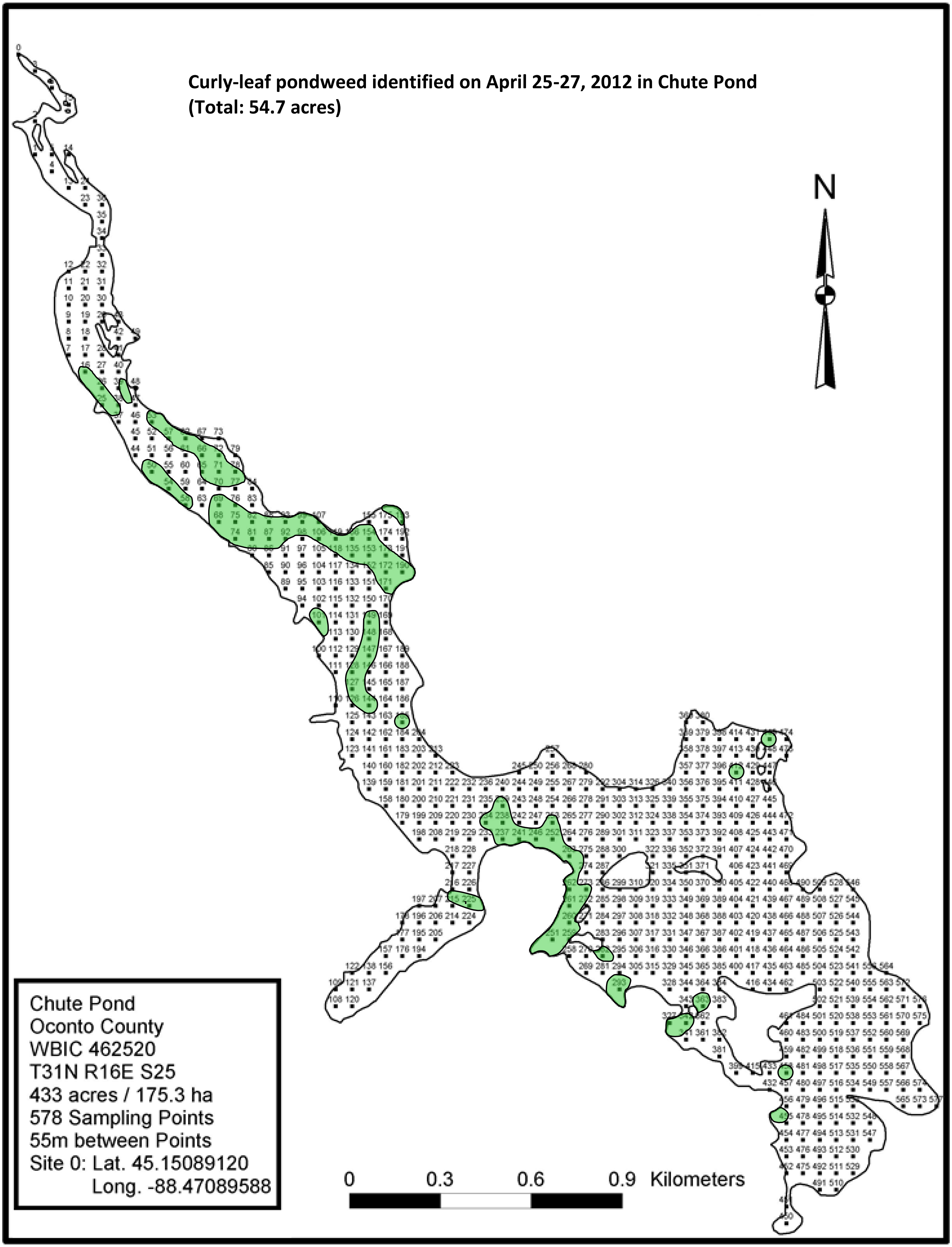
Curly-leaf pondweed (Potamogeton crispus) identified by Northern Environmental Technologies, Inc. on July 23 & 24, 2007 in Chute Pond, Oconto County, WI.
N
EWM Bed Densities
Sparse
Moderate
Dense
Chute Pond
Oconto County
WBIC 462520
T31N R16E S25
433 acres / 175.3 ha
578 Sampling Points
55m between Points
Site 0: Lat. 45.15089120
Long. -88.47089588
0 0.3 0.6 0.9 Kilometers



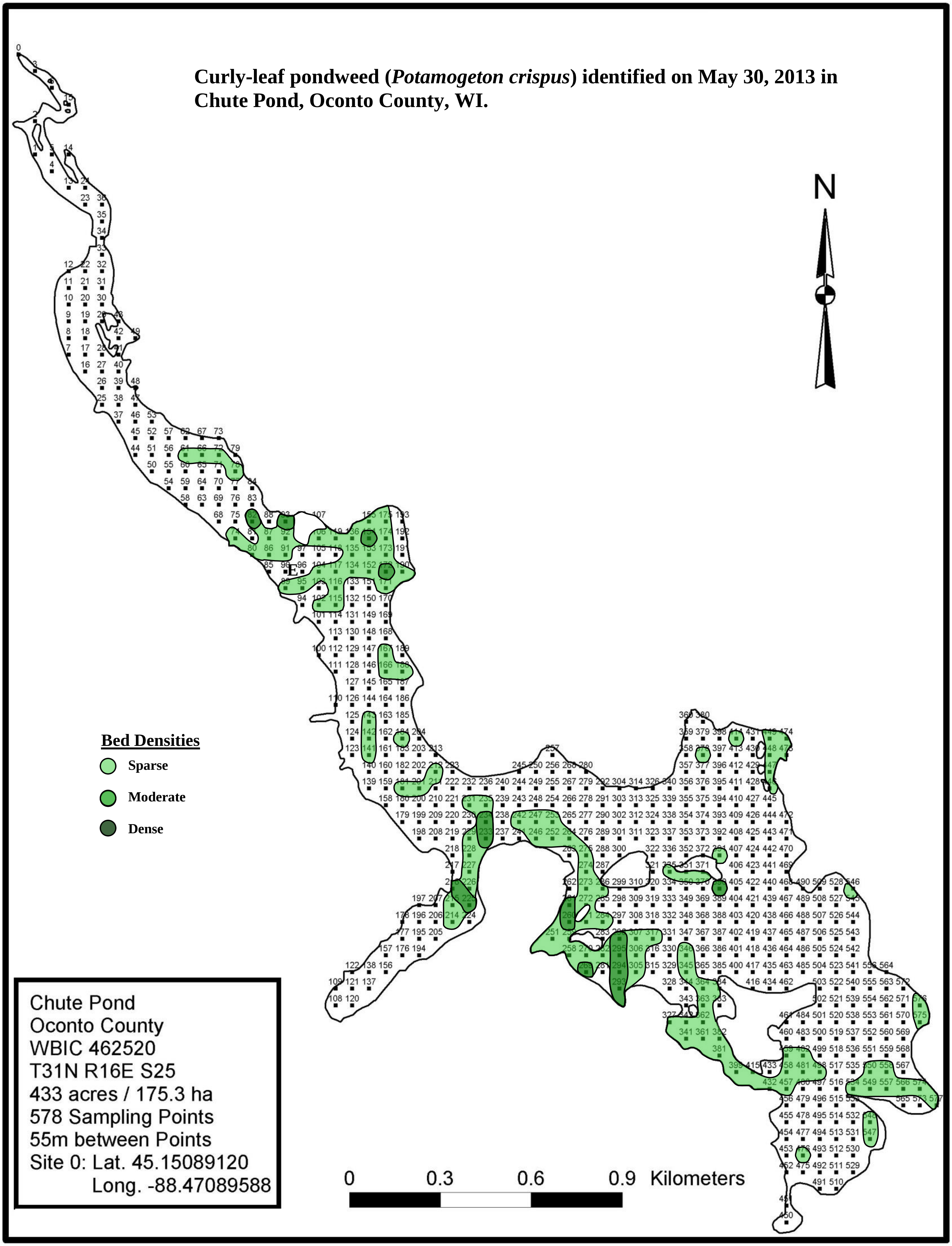

**Curly-leaf pondweed (*Potamogeton crispus*) identified on May 15, 2008 in Chute Pond, Oconto County, WI (Total: 52.8 acres).**


Curly-leaf pondweed (*Potamogeton crispus*) identified on May 15, 2009
in Chute Pond, Oconto County, WI (Total: 27.0 acres).
N
0
0.3
0.6
0.9
Kilometers
Chute Pond
Oconto County
WBIC 462520
T31N R16E S25
433 acres / 175.3 ha
578 Sampling Points
55m between Points
Site 0: Lat. 45.15089120
Long. -88.47089588

**Curly-leaf pondweed identified on April 25-27, 2012 in Chute Pond**
**(Total: 54.7 acres)**



**Curly-leaf pondweed (*Potamogeton crispus*) identified on May 30, 2013 in Chute Pond, Oconto County, WI.**



# Appendix B

- **Chute Pond, Oconto County, Herbicide Monitoring Summaries, 2012 and 2013**

**Draft: Chute Pond, Oconto County,**
**Herbicide Monitoring Summary, 2012**

**11 December 2012**

**John Skogerboe**
**US Army Engineer Research and Development Center (ERDC)**

On 4 May 2012 Chute Pond was treated with a liquid formulation of 2,4-D at a lake wide target application rate of 300 ug/L ae (3 mg/L ae) to control Eurasian milfoil. Water sample sites were established at 10 sites to monitor herbicide concentration and exposure times.

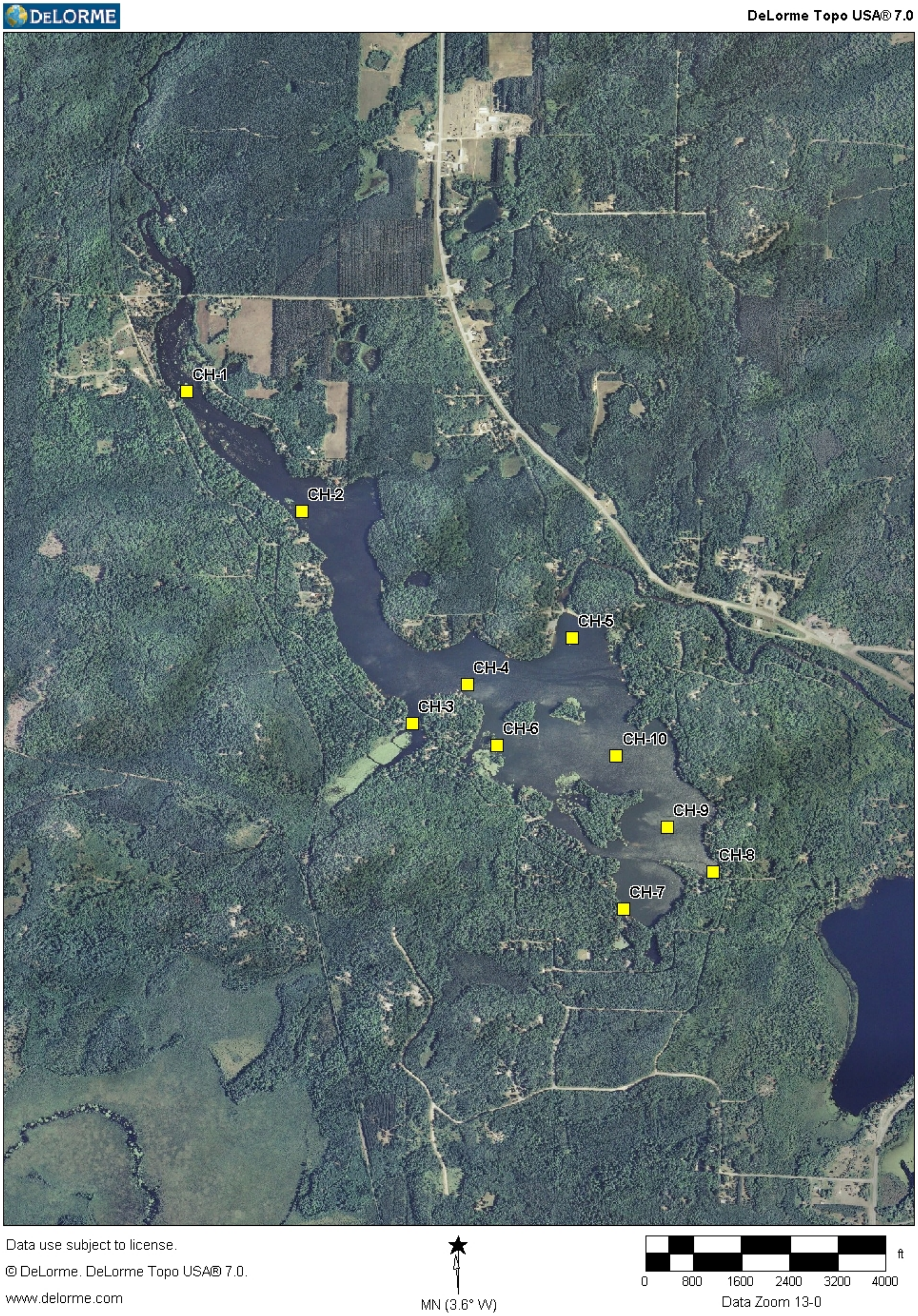
Water samples were collected using an integrated water sampler which collects a water sample from the entire water column. Water samples were collected at intervals of approximately 0.25, 3, 4, 7, 10, 14, 21, and 28 days after 2,4-D treatment (DAT). Samples were taken to shore after completion of each sample interval, and 3 drops of muriatic acid were added to each sample bottle to fix the herbicide and prevent degradation. Samples were then stored in a refrigerator, until shipped to the ERDC laboratory in Gainesville, FL for analysis of 2,4-D.

Herbicide concentrations in water samples from the northern bay were all less than 10 ug/L ae (Figure 2). This is however the inflow point to the lake.

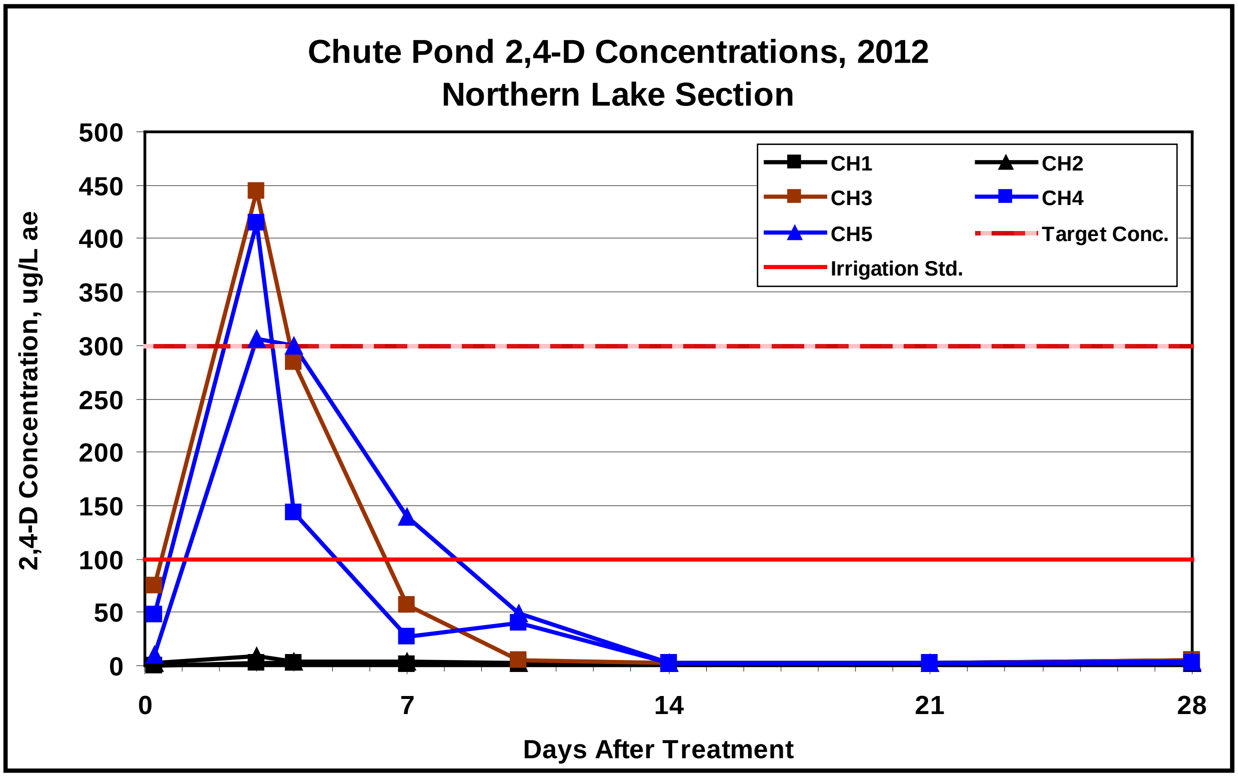
The peak herbicide concentrations in the middle section of the lake(CH3, CH4, and CH5) ranged from 306 to 445 ug/L ae compared to the lake wide target concentration of 300 ug/L ae. The mean concentration from 0 to 7 DAT in this section was 187 ug/L ae. Herbicide concentrations at sites CH3 and CH4 were less than the irrigation standard of 100 ug/L ae by 7 DAT. Herbicide concentrations at site CH5 was less than the irrigation standard by 10 DAT. Site CH5 was the site nearest to the DAM.

The peak herbicide concentrations in the southern section of the lake (CH6, CH7, CH8, CH9 and CH10) ranged from 282 to 387 ug/L ae compared to the lake wide target concentration of 300 ug/L ae (Figure 3). The mean concentration from 0 to 7 DAT in this section was 211 ug/L ae. Herbicide concentrations at all sites were less than the irrigation standard of 100 ug/L ae by 14 DAT.

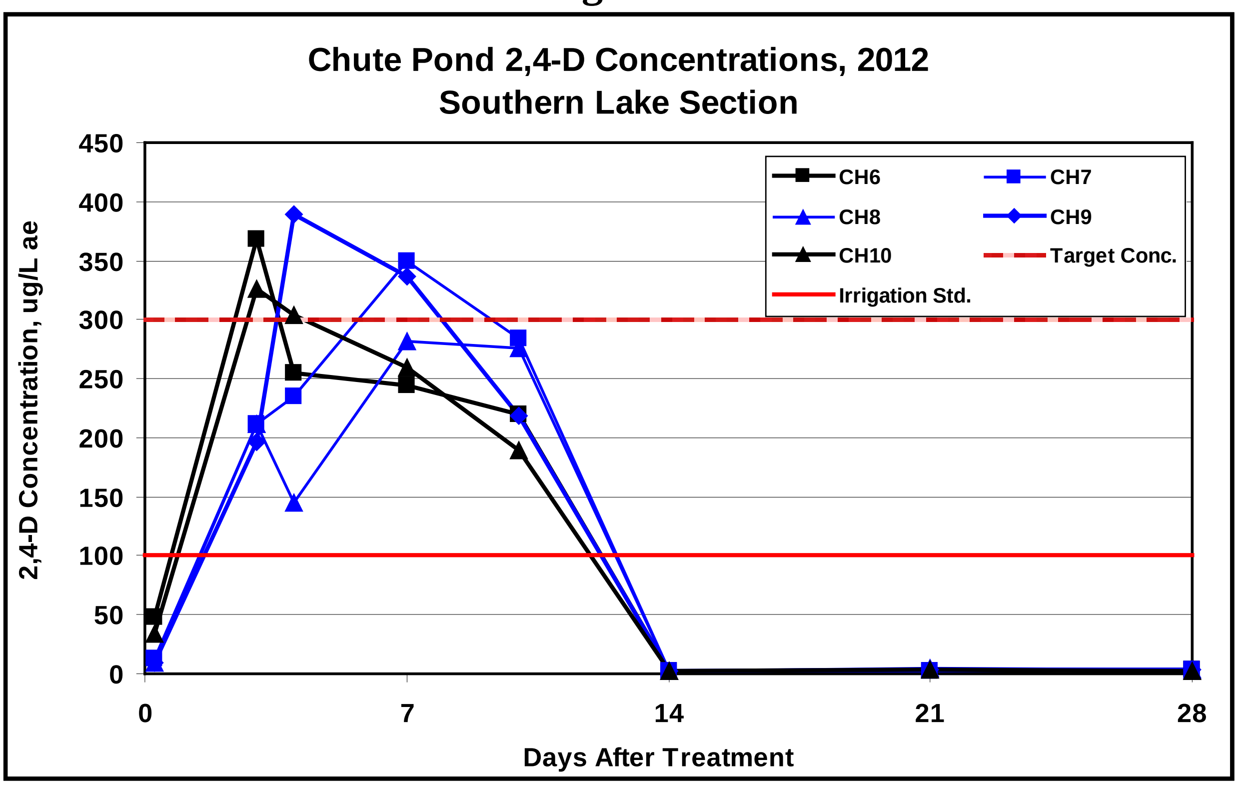
# Figure 1. Chute Pond 2,4-D Sample Locations, 2012



# Figure 2




# Figure 3



# Draft: Chute Pond, Oconto County, Herbicide Concentration Monitoring Summary, 2013

**3 March 2013**

**John Skogerboe**

Chute Pond has an area of 433 acres, a maximum depth of 19 ft, and a mean depth of 7 ft. The lake is listed as a eutrophic, flowage on the WI DNR Lake Finder website.

On 29 May 2013 the northern arm of the lake was treated with a liquid formulation of 2,4-D (Figure 1) to control Eurasian watermilfoil (*Myriophyllum spicatum*). Exact locations of the herbicide applications are not currently available. According to the WI Dept. of Natural Resources (DNR) Aquatic Plant Management Herbicide Treatment Record (APMHTR), the 2,4-D was applied to infested areas at a target concentration of 2.0 mg/L (2000 ug/L) acid equivalent (ae). On 5 June, 2013 the northern arm of the lake was again treated with a liquid formulation of endothall presumably to control Eurasian watermilfoil (*Myriophyllum spicatum*). The endothall was applied to infested areas at a target concentration of 1.5 mg/L (1500 ug/L) active ingredient (ai). Endothall application rates are specified as active ingredient (ai) in the product label, while endothall chemical analysis is specified as acid equivalent (ae). A concentration of 1500 ug/L ai is equal to 1065 ug/L ae. The water temperatures was reported in the APMHTR to be 60$^{o}$F (15.6$^{o}$C) and the wind was 0-5 mph from the west at the time of the 2,4-D treatment. The average wind speed in Antigo, WI was reported by www.wunderground.com to be 8 mph from different directions. The wind speed seemed to be highly variable with max winds of 25 mph and gusts to 54 mph. The water temperatures was reported in the APMHTR to be 61$^{o}$F (16.1$^{o}$C) and the wind was 5 to 10 mph from the west at the time of the endothall treatment. The average wind speed in Antigo, WI was reported by www.wunderground.com to be 6 mph from variable directions. The wind speed seemed to be highly variable with max winds of 37 mph and gusts to 43 mph.

Water sample sites were established at 3 locations (Ch1, Ch2, and Ch3) in the northern arm to monitor 2,4-D dissipation and degradation (Figure 2). Water samples were established at 4 locations (Ch4, Ch5, Ch6, and Ch7) in the middles section of the lake to monitor dissipation into untreated portions of the lake. An additional 3 water sample locations (Ch8, Ch9, and Ch10) were located along the northern border of the south basin. Water samples were collected using an integrated water sampler which collects a water samples from the entire water column. Water samples were collected at intervals of approximately 1, 2, 5, 7, 10, 13, and 21 days after treatment (DAT). Samples were taken to shore after completion of each sample interval, and 3 drops of muriatic acid were added to each sample bottle to fix the herbicide and prevent degradation. Samples were then stored in a refrigerator, until shipped to the US Army Engineer Research and Development Center (ERDC) laboratory in Gainesville, FL for analysis of 2,4-D. Endothall was not included in the original treatment protocol when the water sample plan was developed. A water sample protocol therefore was not developed specifically for the endothall treatment, however endothall analysis was requested for the water samples that were collected.

## 2,4-D Results

Concentrations of 2,4-D in samples collected from the northern arm, 0 to 7 DAT, ranged from 6 to 115 ug/L ae compared to the target concentration of 2000 ug/L ae (Figure 3). All concentrations of 2,4-D were less than the irrigation standard (100 ug/L ae) by 5 DAT.

Concentrations of 2,4-D in samples collected from the central basin, 0 to 7 DAT, ranged from 26 to 948 ug/L ae (Figure 4). The mean basin wide concentration from 0 to 7 DAT was 324 ug/L ae. All concentrations of 2,4-D were less than the irrigation standard (100 ug/L ae) by 5 DAT.

Concentrations of 2,4-D in samples collected from the southern basin, 0 to 7 DAT, ranged from 6 to 200 ug/L ae (Figure 5). The mean basin wide concentration from 0 to 7 DAT was 94 ug/L ae. All concentrations of 2,4-D were less than the irrigation standard (100 ug/L ae) by 10 DAT.

**Endothall Results**

Endothall concentration data has to date not been received from the analytical laboratory. Based on previous data collected on numerous WI lakes, endothall dissipation and degradation rates are similar to 2,4-D. Endothall concentrations in Chute Pond would be expected to be similar to 2,4-D concentrations, with a 7 day lag time.

**Discussion and Conclusions**

Based on 2,4-D concentration data collected in 2013, dissipation from the northern arm of the lake is rapid (Figure 6). Based on published concentration, exposure time data (Green and Westerdahl 1990) a 2,4-D concentration of 2000 ug/L ae is required for good control at an exposure time of 24 hours after treatment (HAT). The max mean concentration in the northern arm was 52 ug/L ae. Concentrations of 2,4-D in samples collected from the central basin indicated that 2,4-D was rapidly dissipated into the basin and exposure times were greater than 48 HAT. Based on the published concentration, exposure time data, 1000 ug/L ae is required for good control at 48 HAT and 500 ug/L ae is required for 72 HAT. Concentrations in the central basin were greater than 500 ug/L ae through 48 HAT, however the 72 HAT sample interval specified in the Chute Pond Herbicide Sample Plan was apparently not collected. Some dissipation of 2,4-D into the southern basin occurred but the concentrations in samples collected there low.

Exposure time requirements for 2,4-D, endothall, and triclopyr to control Eurasian watermilfoil are similar (Green and Westerdahl 1990, Netherland et al 1991, Netherland and Getsinger 1992). The herbicide fluridone requires weeks to months for Eurasian watermilfoil control (Netherland et al 1993), and diquat requires less than 6 hrs (Skogerboe et al 2006). Based on herbicide concentration monitoring data collected (by the US Army Engineer Research and Development Center and the WI DNR) on 59 different WI lakes since 2008 for a total of 119 years of monitored treatments, granular herbicide formulations do not measurably affect exposure times.

**References**

Green, W.R. and H.E. Westerdahl. 1990. Response of Eurasian Watermilfoil to 2,4-D Concentration and Exposure Times. J. Aquat. Plant Manage. 28: 27-32

Netherland, M.D., W.R. Green, and K.D. Getsinger. 1991. Endothall Concentration and Exposure Time Relationships for the Control of Eurasian Watermilfoil and Hydrilla. J. Aquat. Plant Manage. 29: 61-67

Netherland, M.D., and K.D. Getsinger. 1992. Efficacy of Triclopyr on Eurasian Watermilfoil: Concentration and Exposure Time Effects. J. Aquat. Plant Manage. 30: 1-5

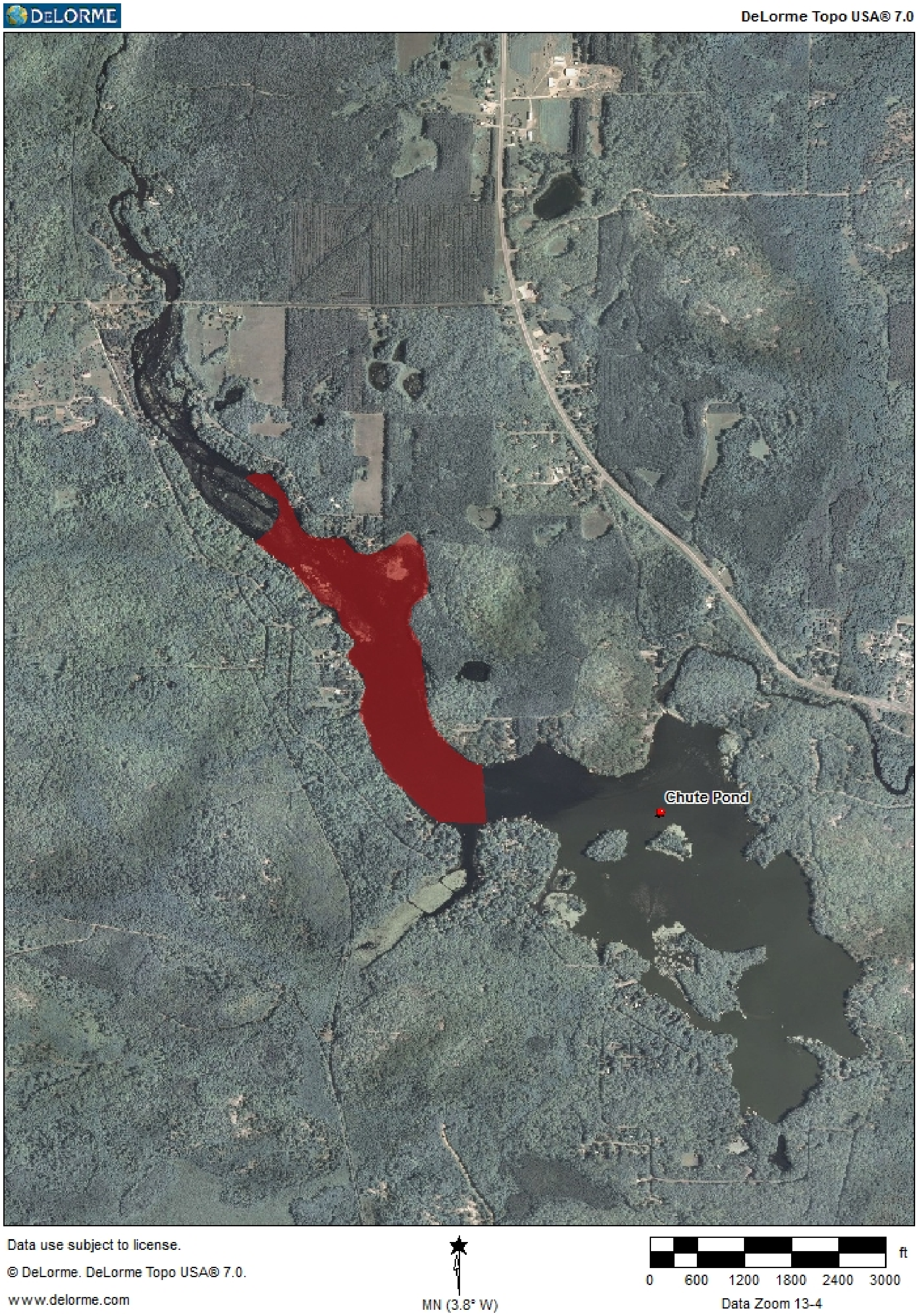
Netherland, M.D., K.D. Getsinger, and E.G. Turner. 1993. Fluridone Concentration and Exposure Time Requirements for Control of Eurasian Watermilfoil and Hydrilla. J. Aquat. Plant Manage. 31: 189-194

Skogerboe, J.G., K.D. Getsinger, and LA.M. Glomski. 2006. Efficacy of Diquat on Submersed Plants Treated Under Simulated Flowing Water Conditions. J. Aquat. Plant Manage. 44: 122-125

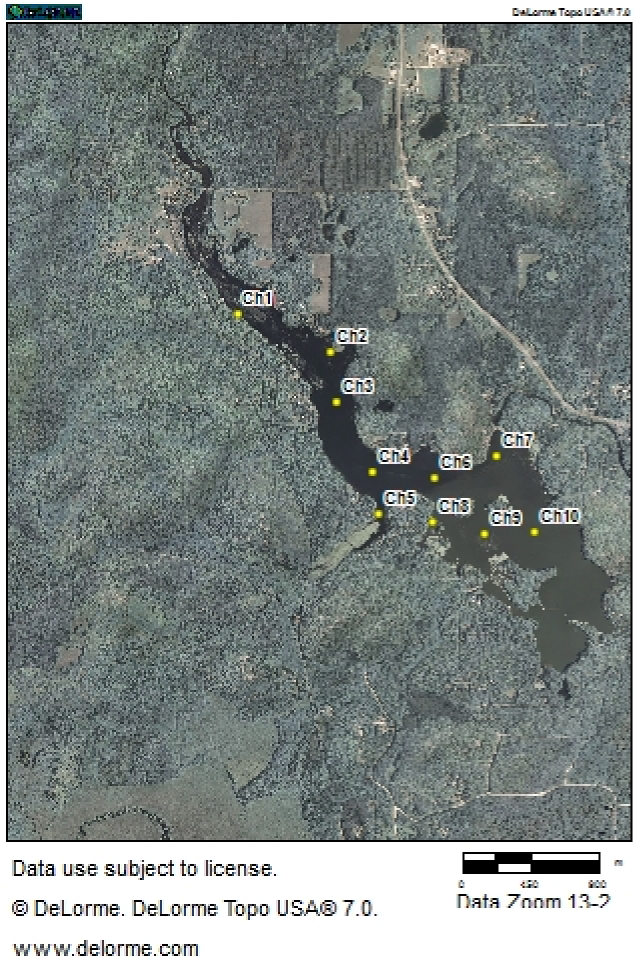
WI Department of Natural Resources. Aquatic Plant Management Treatment Record, Form 3200-111. Chute Pond. 29 May 2013.

WI Department of Natural Resources. Aquatic Plant Management Treatment Record, Form 3200-111. Chute Pond. 5 June 2013.

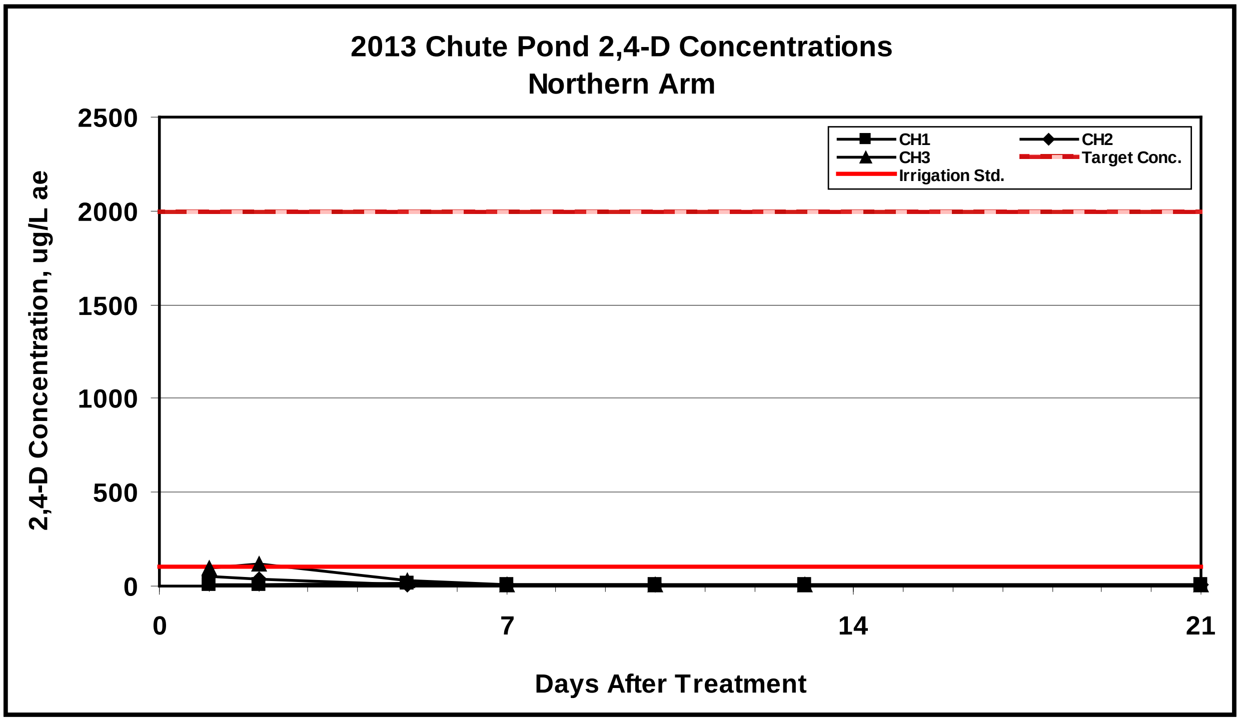
**Figure 1. 2013 Chute Pond Approximate Herbicide Treatment Area**



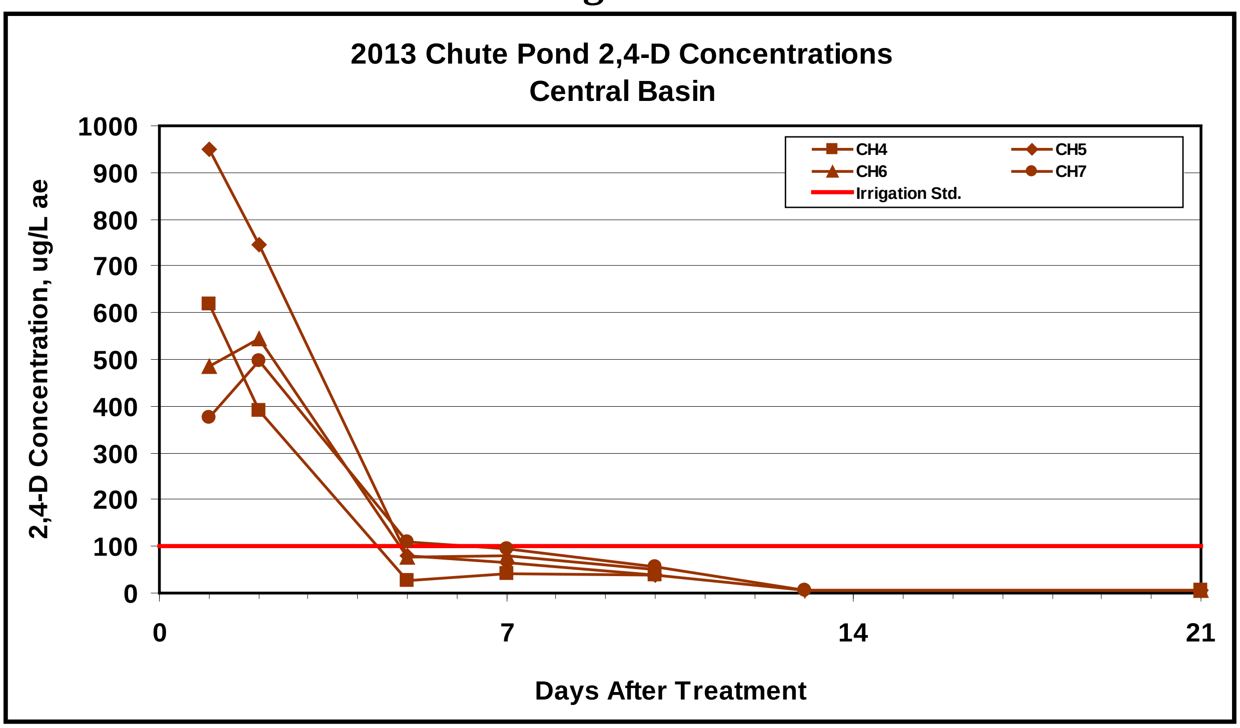
# Figure 2.  2013 Chute Pond Herbicide Sample Site Locations



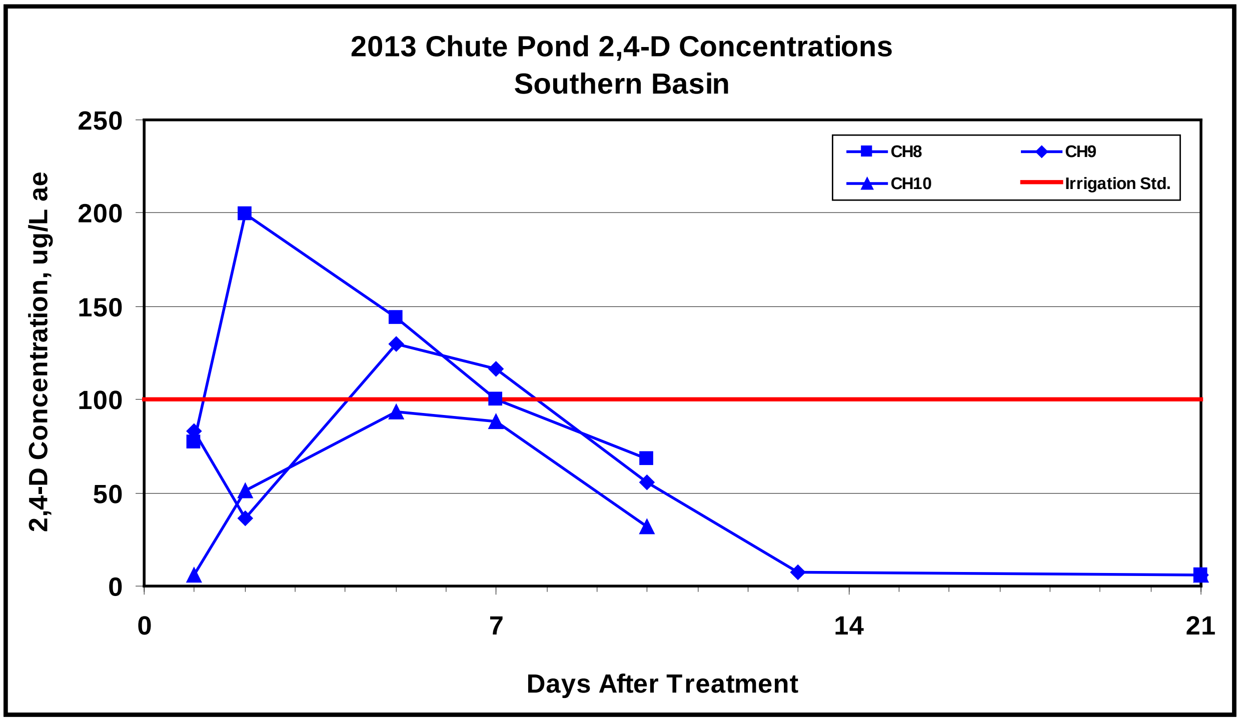
# Figure 3



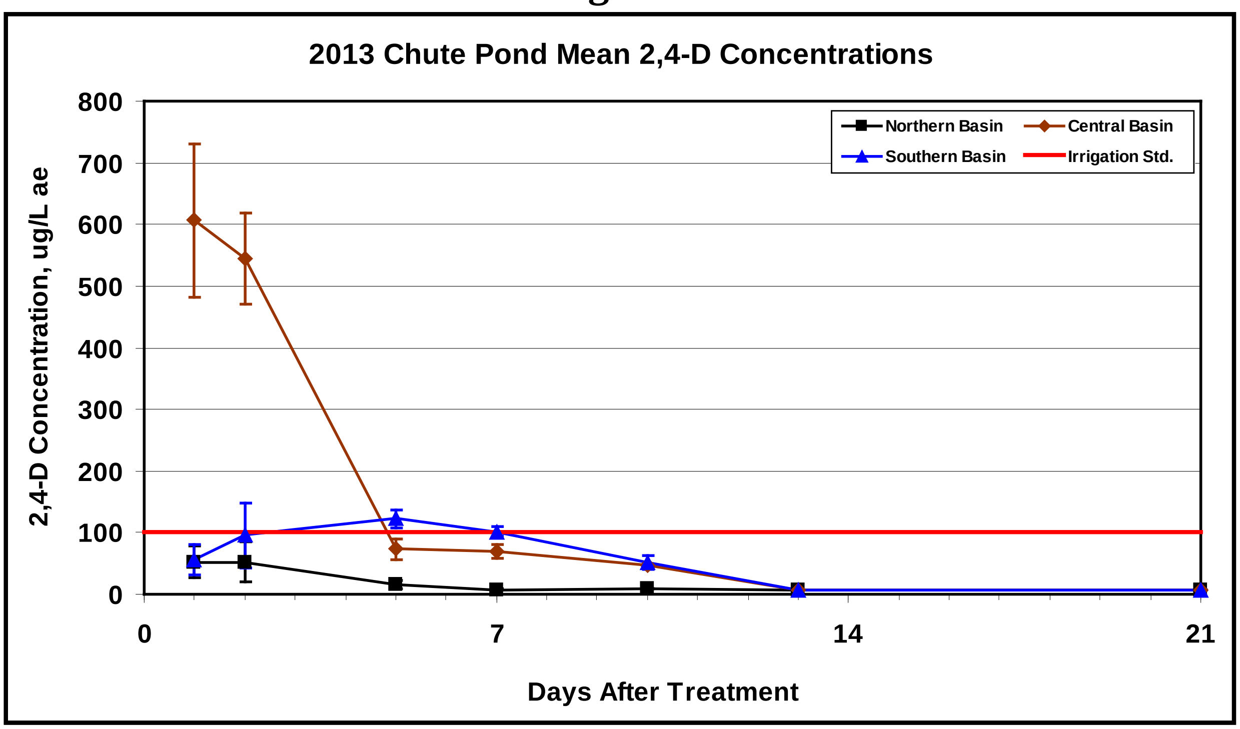

# Figure 4



# Figure 5




# Figure6



# Appendix C

- **Results of the property owners survey conducted by the Chute Lake P & R District in 2012 (responses in red).**

***1. Which of the following best describes your residency status?***

Summer 41    Year-round/permanent 14    Year-round/Occasional 51

**If Not Permanent:** Approximately how many days per year are you at the property?

| | | | | | |
|---|---|---|---|---|---|
| 10 | 30 (5) | 60 (6) | 90 (3) | 120 (5) | 190 |
| 14 | 35 | 62 | 100 (12) | 140 (2) | 200 (4) |
| 20 (2) | 40 (7) | 75 | 110 | 150 (7) | 250 |
| 21 | 45 (2) | 80 (2) | 114 | 164 | |
| 25 (5) | 50 (6) | 84 | 115 | 180 (2) | |

Depends, 15-30, 50+, 80+, 80-100, 90-120
Almost every weekend and sometime during the week when we take vacation
**Average: 87 days**

**Which of the following best describes the location of yo**ur primary residence?

Other Wisconsin City 81    Outside Wisconsin 11

***2. How long have you owned the property?***

| | | | | | | |
|---|---|---|---|---|---|---|
| ½ | 10 (7) | 20 (6) | 30 | 40 (4) | 50 | 60 |
| 1 (3) | 12 (2) | 21 (2) | 31 | 41 | 52 | 62 |
| 2 (6) | 13 (2) | 22 (2) | 32 (2) | 42 | 53 | 65 |
| 4 | 15 (2) | 23 | 35 | 44 (2) | 55 | 70 |
| 6 (4) | 16 | 25 (4) | 37 | 45 | | 72 |
| 7 (6) | 17 (2) | 26 (3) | 38 | 48 | | 73 |
| 8 (3) | 18 | 27 (2) | 39 | 49 (2) | | |
| 9 (5) | 19 (2) | 28 (2) | | | | |

**Average: 23.2 years**

***3. The following is a list of factors that may have been important to you in selecting your property on Chute Pond.***

| | *Not at all important* 1 | 2 | 3 | *Very Important* 4 | 5 | 6 | Average |
|---|---|---|---|---|---|---|---|
| Quality of property itself | 0 | 2 | 5 | 22 | 30 | 46 | 5.1 |
| Real estate investment | 12 | 10 | 13 | 28 | 23 | 20 | 3.9 |
| Recreational opportunities | 0 | 2 | 7 | 18 | 38 | 43 | 5.0 |
| Purchase price of property | 8 | 5 | 11 | 22 | 27 | 31 | 4.4 |
| Proximity to primary residence | 12 | 7 | 15 | 14 | 29 | 27 | 4.2 |
| Area amenities | 4 | 8 | 27 | 28 | 25 | 15 | 4.0 |
| Peace/tranquility of area | 0 | 2 | 3 | 16 | 36 | 49 | 5.2 |
| Entertainment of friends and family | 1 | 8 | 11 | 24 | 33 | 29 | 4.6 |
| Family inheritance/tradition | 28 | 11 | 11 | 13 | 10 | 32 | 3.6 |
| Know others in the area | 17 | 13 | 17 | 24 | 25 | 12 | 3.6 |
| Water Quality | 0 | 1 | 9 | 20 | 25 | 52 | 5.1 |

Other: Wildlife, taxes too high, water quality, water patrol, weeds, lake, woods, trails, fish, weed control

***4. Which of the following describes your lake frontage within 25 feet of the water's edge?*** (Check all that apply to your frontage)

| | | | |
|---|---|---|---|
| Sand beach 24 | Retaining wall 16 | Pier/dock 90 | Boat hoist 18 |
| Sparse vegetation 37 | Stabilizing rocks 66 | Thick vegetation 39 | Unaltered/undeveloped 21 |

Other: no frontage, stumps, lawn, boat landing, trees, jet ski lift, lake weeds and muck, grass, old boat house, medium vegetation

***5. What do you think is the best feature of Chute Pond?***

- The rock formations & beauty surrounding the lake
- Location & people
- It's close to home
- The lake itself, sandbar, fishing
- Shape of the lake with the bays & islands and that we are able to ski until 6 (10-6)
- Size, fish
- Its locality and diversification of use
- A great place to relax, enjoy the outdoors & wildlife
- Sandbar
- Full use lake in the area
- That it's not just a round lake, there's islands and curvy shorelines creating lots of beauty-and things like slippery rock and the sandbar
- Sandbar
- Beautiful location, great fishing, boating, skiing, and slow pontoon rides, swimming
- Dam, sandbar
- Fishing is good
- Wildlife, National Forest-not all cottages
- Not too far from home, nice swimming for kids
- Fishing
- Sandbar
- Right now nothing-the weed situation is ruining the use of the lake
- Quiet during the week
- All around recreation
- Most people or owners care about the lake
- Good balance of recreation, fishing-can kayak, canoe, boat, fish all on the same lake
- Sandbar
- The nature and beauty
- Serenity!
- Size and shape-fishing is very good
- Our grandparents built over 60 yrs ago. It used to be serene. Can't say that's true anymore.
- Wonderful scenery, looks like shoreline of Canada, slippery rock, peace and quiet during the week and from Sept to May
- Bars on the lake and the entertainment…such as winter drag races
- Fishing and pontoon boating
- Fishing

***5. What do you think is the best feature of Chute Pond? (cont.)***

- Has many different options
- The water, rocks, trees, and overall view
- The beautiful lake with all the trees and rocks (jumping rock)
- Fishing, peace, and quiet
- Beauty
- Size and shape
- Consistent water levels
- Most cottages have over 100 ft of frontage…fewer cottages on lake
- People are friendly
- The location and beautiful forest that surrounds it…all that it has to offer residents and visitors
- Scenic beauty and wildlife
- Irregular shape
- Location
- Close to home
- Love the peacefulness of Chute
- Water and natural sites to visit
- Its diversity. 1) Lots of shoreline and islands means your view changes as you travel the lake, you don't see the whole lake from where you are. 2) The lake offers so much recreation, restaurants, skiing/tubing, fishing, boating, sand bar, etc.
- Variety of landscape and properties-National Forest, Islands, Sand Bar, Eagles, Loons, Fishing, Everbreeze.
- Full Rec lake, although, what are those large masses of dirt, twigs, etc that randomly float to the surface of the lake, one by the sandbar and another between islands. If someone hit them as they are rising how dangerous is this What are they? Why do they float up at all?
- Shoreline beauty, Size
- Scenic look, pretty
- Close to home
- Constant water level
- Close to primary home
- Its many bays and versatility
- Four large bays for boating and fishing
- (WAS) it used to be the peace and quiet, but now there's Everbreeze with live bands in the afternoons and Skinny Dave's at night until all hours of the morning.
- The beauty and peacefulness of the area
- Fishing
- The beauty of the lake and islands. The privacy afforded by living on an island.
- Can do multiple things at the same time
- Water clarity when the weeds are not being cut!
- Fish-no wake after 6 pm
- Diverse-fishing, recreation, hunting
- The flow of water from the river and the islands
- Wonderful location, its size, the county park, things to do on the lake
- It is a beautiful lake with loons, islands, etc.

***5. What do you think is the best feature of Chute Pond? (continued)***

- The variety of activities that you can do there
- Weed removal, not overly busy lake, active Lake Association (Thank you)
- Peace and quiet
- The beauty
- Recreational opportunities
- Wildlife, fishing
- Not over-built, still a "natural" feeling
- The dam
- Diversity-entertainment opportunities-friendly people-fishing-wildlife
- I think the untamed, natural look of Chute Pond is its best feature.
- Several bars and restaurants in close proximity
- Unlimited activities
- The diversity of the lake and shoreline
- Location, natural features
- Size and irregular shape/shoreline-up north feel
- Fishing, hiking
- Wildlife only-swimming, boating, and other water related activities have been so negatively impacted by weed types-not just the invasive species
- The beauty of the different bays, channels, and islands
- Clean water, good fishing, birds and animals, quietness
- Varied recreation, close to the Fox Valley
- Location – I would say it's a beautiful lake but this year was a weed bed.
- The wildlife, view, scenery
- Size

***6. If you were in charge of the lake and could change one thing what would it be?***

- Limit size and horsepower (boats that are larger are turning up more weeds than others-had floating weeds 50 ft out all summer)
- Free boat launch for all lake front owners
- Educate and enforce boaters getting too close to the shoreline when pulling tubers, skiers, etc.
- Do a better job in controlling the weeds, clean the bottom, such as scraping the muck out
- Weed control-more of it
- Happy the way everything is right now
- Work harder in keeping all areas of the lake more navigable by boat
- Enforce the water skiing and jet skis laws better
- Control weed population
- Better weed control
- Go back to the way harvesters could go closer to shore, so they can pick up more weeds

***6. If you were in charge of the lake and could change one thing what would it be? (continued)***

- Eliminate weed problem-unable to fish now from pier as I have always done for the last 40 years
- Cutting of weeds should be done equally among property owners, not just a select few
- Build a winged weed catcher on weed cutters to pick up all those floaters-the prime of the year is almost useless in the center area near Everbreeze
- Less weeds near dock
- More consistant water level and weed pickup
- Quality of fishing
- Eliminate more weeds
- No public access-major cause of invasive weeds
- Not allow jet skis
- Weeds
- Remove weeds
- Drain the lake, kill the weeds & restock fish
- Get rid of the jet skis
- Raise water level
- Weed clean up & weed cutting-too many weeds floating down the river and into the lake
- Remove the sandbar
- Having a sandy beach on our lake frontage
- Sandbar needs management. A lot of drunk people staying late into evening. Time limit/hrs?
- I've seen the lake all my life with my grandparents, then parents. I've seen it clear, then very, very weedy, and with harvestors. I'd harvest weeds more aggressively and enforce the no wake.
- Harvest weeds!
- I really like it like it is
- Get large speed boats off the lake
- No jet skis and limit boats to no more than 100 HP
- Plant fish, provide free access to lake for property owners in the Rehab zone but not on Chute Pond.
- We need more or better control of the lake level
- Weeds
- Lower the taxes
- Weeds
- Weeds down
- Deeper in a few areas-channel
- No duck and goose hunting near cottages
- Reduce skiing hours for more quiet time. Lake is way too busy and noisy during the day.
- Dredge shallow areas to make it deeper, remove stumps
- Weed growth in the lake
- Better weed control
- Size of motors allowed
- I can't get in a boat to fish anymore. So I have to fish off shore, the last 2-3 years I caught more weeds than fish.
- I would get the weeds down.

***6. If you were in charge of the lake and could change one thing what would it be? (continued)***

- Lower the water level of lake and control the muskrat population.
- Reduce weeds
- Expand or add swimming beaches
- Better weed cutting/weed control
- Weed control/water quality
- Get rid of weeds and muck esp. Eurasin Milfoil and Curly Leaf Pond weeds
- Time buoys marking rocks are put in and taken out
- Get rid of the weeds.
- Dredge the area south of bridge to “Snag Bay”
- Clean up the weeds
- Weed control
- Eliminate/manage weeds
- Invasive species irradication
- I would limit number of boats to be launched on a daily basis. For a small pond we have 4 (maybe 5) boat launches.
- 1 launch, filled parking area, less non land owner boats on lake.
- Maintain quality of lake
- Better control of lake weeds
- More accountability of lake board and employees
- Exempt property owners from boat launch fees, being as they already pay property taxes
- Less weeds
- Have the harvester cut the weeds deeper
- Keep the weeds down
- No snowmobiles
- Get rid of weeds and snails
- Contain the number of boats that are allowed to launch at the public launches
- I would clean up the weeds!! I would have the channels patrolled and fine people leaving a wake. A few fines given would take care of this!!
- Improve lake quality
- Boat speeding or skiing, etc 11:00 am to 4:30 pm like some of the lakes north of Chute Pond
- Weed maintenance
- Regularly harvest weeds with a bigger crew and some type of schedule that is followed so all areas are tended to regularly.
- Not to poison weeds-try and find a better way
- Weeds and floater problem, not sure anything else can be done
- Less weeds
- Don’t have the winter frolic on the lake
- No jet skis-too dangerous
- Get rid of weed cutters
- I would like to see it made better for fishing. It seems to have lost its quality of being a good fishing lake.
- Weed control
- Wouldn’t change a thing
- Limit the number of jet skis on the lake

***6. If you were in charge of the lake and could change one thing what would it be? (continued)***

- Clear weeds
- Reduce the amount of floating weeds and educate people that weeds that move are to be taken out of the lake by them.
- The weed problem
- Get rid of the weeds
- More weed pick up close to dock. More "No Wake" education and signs
- Better control of weeds
- The weed problem
- The buildup of sludge/muck in the center of the waterway in the northern river portion of the lake. Weed problem too
- Get rid of the weeds-dredge the channel
- Investigate dredging
- Weed problem
- Stop cutting the weeds! Cutting spreads the seeds from the weed cutting machines!!
- Reduce weeds/algae
- Eliminate jet skis and boats with motors >50 hp

7. ***The following is a list of activities that you or members of your household may participate in on Chute Pond. For each item please indicate whether you have done that in the past year. If you have participated in an activity please rate the overall importance of that item to you and your family from 1 to 6, with 1 being Not at All Important, to 6 being Very Important to you or family members:***

| | *Not at All Important* | | | | *Very Important* | | |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | Average |
| *Swimming* | 5 | 3 | 10 | 21 | 20 | 45 | 4.8 |
| *Fishing* | 1 | 1 | 11 | 13 | 31 | 50 | 5.1 |
| *Observing Wildlife* | 0 | 1 | 7 | 20 | 34 | 48 | 5.1 |
| *Enjoying the View/Scenery* | 0 | 2 | 1 | 13 | 27 | 67 | 5.4 |
| *Water Skiing/Tubing* | 28 | 13 | 11 | 11 | 16 | 20 | 3.3 |
| *Canoe/Kayak/Paddle boating* | 5 | 6 | 14 | 21 | 27 | 29 | 4.4 |
| *Motor Boating/Cruising* | 2 | 6 | 3 | 17 | 31 | 47 | 5.0 |
| *Entertaining* | 4 | 5 | 12 | 28 | 32 | 26 | 4.5 |
| *Sailing/Wind Surfing* | 61 | 9 | 3 | 3 | 4 | 4 | 1.7 |
| *Relaxing Dockside or on Beach* | 1 | 3 | 5 | 17 | 30 | 50 | 5.1 |
| *Jet Skiing* | 58 | 2 | 1 | 4 | 12 | 10 | 2.3 |
| *Winter Sports* | 19 | 8 | 9 | 22 | 22 | 23 | 3.9 |

- There needs to be a special limit on jet skiing – some are involved in racing. Witnessed two trying to run over a loon and her baby - a deliberate act.

***8. What types of watercraft do you use on Chute Pond?*** (check all that apply)

| | | |
|---|---|---|
| Rowboat/paddleboat 61 | Pontoon 73 | Runabout inboard 8 |
| Runabout outboard under 25 hp 25 | Sailboat 6 | Personal watercraft/ |
| Runabout outboard 25 hp or more 41 | Canoe/kayak 61 | jet ski 20 |

***9. Do you feel that there is adequate law enforcement on Chute Pond?***

| Yes 50 | No 37 | Don't Know 21 |
| --- | --- | --- |
| Gotten better | None at all | 1st year – have never seen one |
| | Absolutely no! | |

***10. What is your opinion regarding lake use regulations on Chute Pond in general?***

| Sufficiently regulated 59 | Under-regulated 43 | Over-regulated 4 |
| --- | --- | --- |
| No enforcement | | |

***If Under or Over: What would you like to see changed?***

- Better patrol-mainly weekends
- Would like to see more enforcement
- More safety when jet skis are out-no respect for the small boats
- It looks like people self-regulate and obey the rule-sometimes someone is in a hurry but it's not abused
- Maybe better/clearer signs at each landing
- Better enforcement of rules
- More "slow" signs
- More patrolling
- Fishing boats exempt
- No wake start at 7pm (11am-7pm)
- Regular enforcement so word spreads
- Enforce it. Under regulated is understated… not a night goes by without boats going well beyond no wake
- Boats do not abide by the rules. They go way too fast before and after the no wake…especially the jet skis.
- The people living or staying on the lake are the worst violators
- I think the no wake should go away
- Early morning for fishing (over regulated)
- Making the ordinance enforceable
- Reduce ski hours to 11-3, more quiet time
- A regulator
- Limit vessel weights to minimize shore erosion
- More patrol, ability to ticket & enforce
- I am in favor of the no wake rule and wish that people would adhere to it
- Making people follow ordinance…The times are fine if followed
- More law enforcement weekends and holidays
- More "No Wake" signs or better placement of signage
- Maybe change times so people follow the rules
- We need a township officer for the no wake
- New signs! And common sense and common courtesy by everyone, including long-term residents who think they can do whatever they want
- Periodic checking on weekends other than holidays

*10. What is your opinion regarding lake use regulations on Chute Pond in general?*
*If Under or Over: What would you like to see changed? (continued)*

- I can understand between island, but I do not understand why other two areas have no wake
- Like to see smaller motors and no wake areas and times enforced
- Was severely violated in 2012
- No wake ordinance-remove-not needed
- No one monitors the north end of the lake, river portion
- More policing and changed to 5:00
- Enforcement and education of what defines "no wake"
- Regulation! Even the "old folks" and their pontoon boats go way too fast=Big ake=shore erosion
- Ordinance enforcement
- Signage and fines imposed
- There is too many boats not giving sufficient distance to shore and other boats
- More county or DNR presence
- Tickets written
- No wake before 11:00 or after 4:30 with some enforcement there of
- Post regulations well, educate at boat landings, enforcement

***11. The following is a list of issues that could have future impact on Chute Pond. Please rate the potential impact of each issue on the lake from 1 to 6, with 1 being No Impact, to 6 being a Very Strong Impact for each issue:***

| | *No Impact* | | *Neutral* | | | *Very Strong impact* | |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | Average |
| Motor boat/jet ski traffic | 3 | 1 | 14 | 18 | 27 | 43 | 4.8 |
| Drinking, driving | | | | | | | |
| Shoreline erosion | 5 | 8 | 19 | 20 | 22 | 33 | 4.4 |
| Lake level fluctuation | 6 | 4 | 25 | 18 | 25 | 27 | 4.3 |
| Inadequate law enforcement | 6 | 8 | 25 | 31 | 17 | 19 | 4.0 |
| Failing septic systems | 3 | 6 | 13 | 17 | 29 | 38 | 4.7 |
| Are they checked? | | | | | | | |
| Shoreline development | 5 | 6 | 18 | 29 | 26 | 22 | 4.3 |
| Did not think this was legal per DNR | | | | | | | |
| Construction site issues | 7 | 11 | 26 | 32 | 14 | 14 | 3.7 |
| Weed growth in lake | 0 | 2 | 0 | 4 | 16 | 86 | 5.7 |
| Most critical issue | | | | | | | |

12. ***Do you feel that you can offer input into matters regarding the management of Chute Pond?***

Yes 67 No 36 not sure, undecided

***If No: Please explain why you feel that way?***

- Not there too much
- Just don't have the time to get involved
- Do not have information to make a good answer
- Nobody listens. I know it's hard-you get so many opinions and concerns
- CLA is dead
- There are things that can't be changed-i.e. weeds, public access
- Too costly to dredge portions of the lake
- Too old
- I do not think one person like myself would make a difference
- The number of boats needs to be limited on weekends & holidays. Not admit as many a possible so as to make as much money as possible. Sandbar needs managing. Island owners are fed up. In Waukesha Co. when boat launch parking lots are full, no one else is allowed on the lake until someone leaves.
- I don't have a lot of time
- I'm not well informed. I know I should take more interest!
- We do not live on Chute Pond but below dam on Oconto River
- They don't listen anyway
- No one listens
- We are happy and don't have any issues right now
- Unqualified
- We are only summer visitors for a month
- I'm not that informed on all the matters
- We are on the Oconto River, below where the Waupee comes in. No one on the lake really cares what we think. We're confused as to why we are taxed as part of the Association. There are no benefits, not even a landing fee break.
- Not able to be up there often enough
- Offer yes something done questionable
- Hands are tied with current regulations
- As an older resident there is not much I can do, but hope the future of Chute Pond remains strong.
- I'm not there enough
- No wake means No Wake-Like no fishing license means no fishing. DNR doesn't listen. Same old crap every year. Give out a couple "no wake" warnings or fines and the problem will be over. But that won't happen. No one listens!
- Have in past, nothing happens. Other lakes in northern WI have individual fishing and skiing restrictions, but I and others on these and other issues are always stopped in our tracks per DNR. Why? Why do other lakes have different restrictions?
- At this time not able to make meets that will change in the future
- Not listened to
- Annual meeting agenda set including budget predetermined
- I have no background or experience in management
- We're only there a short time each year

***13. On a scale from 1 to 6, with 1 being Not at All Satisfied, to 6 being Very Satisfied, how satisfied are you with the overall management of Chute Pond?***

| Not at All Satisfied | | Neutral | | Very Satisfied | |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |
| 4 | 22 | 12 | 35 | 26 | 4 |

***14. Have you attended an Annual Meeting of the Chute Pond Protection and Rehabilitation District in the past 3 years?***

Yes 58 No 49

- Too frustrating
- Nothing is really accomplished
- Same complaints every year-not worth going to
- We live full time in Chicago
- Same old crap
- Due to illness
- Just purchased in Aug

**15. Please check the age(s) of the primary owners of the property on Chute Pond?**

18 to 34 1 35 to 54 38 55+ 70

***16. Which of the following best describes how often you have children on your property?***

Always 10 Often 41 Seldom 39 Rarely 13 Never 1

***17. How many bedrooms does your Chute Pond home have?***

One 7 Two 54 Three 38 Four or more 5

***18. Do you rent your Chute Pond property?***

Never 101 Sometimes 5 Often 0

***19. How is your Chute Pond property owned?***

| Individually | Jointly | Trust | Family LLC | Other | Living estate |
|---|---|---|---|---|---|
| 57 | 24 | 9 | 4 | 1 | 1 |

***20. If you have any additional comments you would like to pass along please do so below:***

- All lake front owners should have free boat launch.
- Law enforcement is adequate (keeping cost down otherwise if law enforce has to write citations to pay its own salary-that's ridiculous).
- The weed problem is terrible, especially on the East Shore Dr shoreline.
- Nice safe community, very friendly.
- We have so many weeds in front of our shoreline, it is impossible to rake them all out. We could spend all weekend every weekend & still not be done. And once we get them raked out…then what do we do with them? It would be nice if there was someplace to put them.

***20. If you have any additional comments you would like to pass along please do so below (continued):***

- Since 1959 it was heaven to come up and the last 5 yrs were hell. Unable to fish in all the places we always did. My concern is will the weed condition ever improve. Almost impossible at times to get the pontoon away from shore and down to the lake.
- More info in general on fishing/stocking.
- Spend $ to control weeds-once the lake gets a bad reputation of weedy lake…it will drop property value.
- The lake needs a better managed stocking program for musky, northern, & panfish. The Chute seems to be heavily fished.
- Allow permits for dredging the areas containing heavy muck/weeds
- I have been hearing rumors that the lake might be drained. I hope this will not have to be done, but if this is what it takes to solve the problem…I'll support it.
- Several of the above questions don't seem to be necessary?
- Sand bar users often come up on the island to urinate and defecate. They come up on the property as if it's an extension of the sand bar. Our neighbors had to remove their dock and place thorny bushes to keep people away. It's getting old-we no longer have peace and quiet.
- Taxes too high
- I have hunted, fished, camped, and owned property in the area for over 60 years. Things have changed but I still love the area!
- I would like them to stop lowering the lake in the fall. We need water flow year round. Lowering the lake is filling it up with silt. Maintain a higher water level to reduce the growth of weeds in the summer.
- Keep up the good work!
- With the narrow passageways, rafts in the water, rocks, and all the boat traffic…the lake is too small for jet skis. Chute pond just makes the 400 acres requirement to have jet ski.
- Weed harvesters go to certain areas of the lake to gather weeds, but not others where they have become abundant.
- Campground, trailer park, Y camp all use lake with boats but home owners are paying for the invasive species weed control. Several Public boat landings. What is their contribution to the weed control?
- Not having the luxury of enough free time to participate in and attend lake management meetings and work details, I cannot be very critical on the services being provided. I would very much enjoy becoming involved and possibly helping to achieve a common goal as future time will allow.
- Weed control very important! Where can we take the weeds we remove?
- Our main concern would be the weed management. Many weekends in late summer were spent pulling out weeds that floated onto our shore. Another concern is the geese and their poop. Not sure what can be done about that though. Thanks for asking our opinion.
- DNR and Lake District need to allow choppers, as the Native Species are getting out of control, on the north shoreline near cottages.
- Heard we have issues with weed cutters? We need to make sure weeds do not impede us in keeping Chute as a nice place to come to. The area close to bridge on the north side seems to get shallower every year.

***20. If you have any additional comments you would like to pass along please do so below (continued):***

- Thanks to all the people who go to great lengths to manage the lake.
- I know this isn't regarding the lake itself-but the road to get back here (S Shore Drive) is in terrible condition in parts.
- I love my little heaven on earth here at Chute Pond, but it is disheartening when friends or family come up to take the rowboat or canoe to go fishing and there are too many weeds in the lake to ever fish from the dock! Since I am on a limited income it doesn't seem fair that I pay the same amount of taxes as the people with the big motorboats and jet skis!!
- Buoys marking no wake areas and rocks should stay in place until mid-October-now removed in mid-September but still boat traffic thru mid-October.
- The park and park campground are most likely important to Oconto County, as such they should see that we have more enforcement than lakes the county does not have such strong interest in.
- Every annual meeting we spend an hour discussing who did not get their weeds cut or did not cut often enough. I don't think you can do more than you are doing. Weeds have always been there and you are controlling them.
- Don't like loud bar music across lake.
- Looking forward to seeing results of this survey. Nice job!
- Arrived in spring the lake was very beautiful-after the cutting started it was the same cesspool as usual and we all know the cutters are spreading the seed over the years-please save ourselves thousands of dollars on repairs and labor. DO cut the cutters which are most likely outdated-sell for the metal content, We suggest raising the water level as high as possible-some plants will not survive under water. Invasive species still can be sprayed! Fish, etc. will benefit from the plants and be more prolific, which is needed. Do consider this option. Get the lake looking beautiful again. Let Mother Nature take its course!
- Charge more for the boat launch access to limit outsiders. Cut weeds near properties. Inspect septics more often.
- The environmental issues of the lake are a big frustration. Either the committee seems to move so slowly, which is typical of groups or the DNR won't allow the lake district to do anything. The DNR is very counterproductive.
- Introduce walleye. We own the NE point on the large island-many boats violate the distance from shore law, erosion is a problem.
- What do questions 15-20 have to do with management of the lake? The county park/boat landings and Y camp have a much larger impact on the lake.
- Keep up the good work.
- Thank you for your efforts to improve Chute Pond.
- Keep up the good work!
- Tax assessments of off lake properties totally unfair.
- There should be limits to number of people using the park and non-owner boats on the lake.
- This survey does not get at the heart of issues by the generalized questions. I understand that the DNR has a lot of control but I also tired of excuses for things we do not have control over. Ex: Will the harvester needs repair-at the beginning of cutting season? Why wasn't it put away for winter ready to start next spring?

***20. If you have any additional comments you would like to pass along please do so below (continued):***

- When it is windy on Chute Pond there is few fair places to fish in fall, now we have to worry about duck hunters along the shore of the middle island in the lake with their shotguns? Things change over the years, not always for the best. When I was young your dad took my dad and I on the lake for a boat ride, those were great years of fishing and Chute Pond in general.
- When the weed cutters are out on the lake, myself and neighbors rarely see them on our part of the lake. I hear comments from my neighbors "It's who you know that gets the work done."
- Thank you for asking for input.
- Chute Lake is a recreational lake. Not a weed bed the DNR is making it to be. I did not have a weed problem when we bought the place. Could not take jet ski out this summer because of weeds. Embarrassed to have company come out.
- Property owners need it clarified that they do not own the water in front of their property. With extreme boat traffic on holidays we had company and anchored off shore of the island. While enjoying swimming a couple came to their shore and yelled at us for swimming in front of their property.

# Appendix D

- **Aquatic plant survey data collected on July 2 - 3, 2012 on Chute Pond, Oconto County, WI.**

| | |
|---|---|
| ASIN | *Asclepius incarnata*, Marsh milkweed |
| CEDE | *Ceratophyllum demersum*,Coontail |
| CHAR | *Chara* ,Muskgrasses |
| ELAC | *Eleocharis acicularis*,needle spikerush |
| ELCA | *Elodea canadensis*,Common waterweed |
| FIAL | filamentous algae |
| HEDU | *Heteranthera dubia*,Water star-grass |
| LETR | *Lemna trisulca*,Forked/star duckweed |
| MEBE | *Megalodonta beckii*,Water marigold |
| MOSS | moss |
| MYSI | *Myriophyllum sibiricum*,Northern water milfoil |
| MYSP | *Myriophyllum spicatum*,Eurasian water-milfoil |
| NAFL | *Najas flexilis*,Bushy pondweed |
| NITE | *Nitella* sp.,Nitella |
| NUVA | *Nuphar variegata*,Spatterdock |
| NYOD | *Nymphaea odorata*,White water lily |
| POAM | *Potamogeton amplifolius*,Large-leaf pondweed |
| POCR | *Potamogeton crispus*,Curly-leaf pondweed |
| POEP | *Potamogeton epihydrus*,Ribbon-leaf pondweed |
| POFR | *Potamogeton friesii*,Frie's pondweed |
| PONA | *Potamogeton natans*,Floating-leaf pondweed |
| POPU | *Potamogeton pusillus*,Small pondweed |
| PORI | *Potamogeton richardsonii*,Clasping-leaf pondweed |
| POZO | *Potamogeton zosteriformis*,Flat-stem pondweed |
| RAAQ | *Ranunculus aquatilis*,Stiff water crowfoot |
| SAGI | *Sagittaria* sp. (arrowhead) |
| SPPO | *Spirodela polyrhiza*,Large Duckweed |
| STPE | *Stuckenia pectinata*,Sago pondweed |
| TYLA | *Typha latifolia*,Broad-leaved cattail |
| UTMI | *Utricularia minor*,Small bladderwort |
| UTVU | *Utricularia vulgaris*,Common bladderwort |
| VAAM | *Vallisneria americana*,Wild celery |
| WOCO | *Wolffia columbiana,Common watermeal* |

| sampling point | Depth (ft) | comments | ASIN | CEDE | CHAR | ELAC | ELCA | HEDU | LETR | MEBE | MOSS | MYSI | MYSP | NAFL | NITE | NUVA | NYOD | POAM | POCR | POEP | POFR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 1 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 2 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 3 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 4 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 5 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 6 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 7 | 3.9 | | | | | | | | | | | | | | | | | | | | |
| 8 | 0.4 | | | | | | | | | | | | | | | 2 | | | | | |
| 9 | 1.5 | | | | | | | | | | | | | | | | | | 1 | | |
| 10 | 0.5 | | | | 1 | | | | | | | | | | | | v | | | | |
| 11 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 12 | 2.5 | | | | | | | | | | | | | | | | | | | | |
| 13 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 14 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 15 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 16 | 1 | | | | | | | | | | | | | | | | 1 | | | | |
| 17 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 18 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 19 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 20 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 21 | 1.5 | | | | | | | | | | | | | | | | | | v | | |
| 22 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 23 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 24 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 25 | 2.5 | | | v | | | | | | | | v | | | | | | | | | |
| 26 | 1 | | | v | | | | | 1 | | | v | | | | | | | | | |
| 27 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 28 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 29 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 30 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 31 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 32 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 33 | 3 | | | 1 | 1 | | | 1 | 1 | | | | | | | | | | | | |
| 34 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 35 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 36 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 37 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 38 | 2.5 | | | 1 | | | | | | | | | | | | | | | v | | 1 |
| 39 | 3 | | | | | | | | 1 | | | | | 1 | | | | | | | |
| 40 | 2.5 | | | 1 | | | | | 1 | | | | v | | 1 | | | v | | | |
| 41 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 42 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 43 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 44 | 3 | | | | | | | | 1 | | | 1 | | | | | | | | | |
| 45 | 2 | | | 1 | | | 1 | | | | | 1 | | | | | | | | | |

| sampling point | Depth (ft) | comments | PONA | POPU | PORI | POZO | RAAQ | SAGI | SPPO | STPE | TYLA | UTMI | UTVU | VAAM | WOCO | FIAL | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 1 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 2 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 3 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 4 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 5 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 6 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 7 | 3.9 | | | | | | | | | | | | | 1 | | | | | | | |
| 8 | 0.4 | | | 1 | | | | | 1 | | | | | | | | | | | | |
| 9 | 1.5 | | | 1 | | 1 | | | | | | | | 1 | | | | | | | |
| 10 | 0.5 | | | 2 | | | | | 1 | | | | | | | 2 | | | | | |
| 11 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 12 | 2.5 | | | | | 1 | | | | | | | | | | | | | | | |
| 13 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 14 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 15 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 16 | 1 | | | 1 | | 1 | | | | | | | | | | | | | | | |
| 17 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 18 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 19 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 20 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 21 | 1.5 | | | | | 1 | | | | | | | | | | | | | | | |
| 22 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 23 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 24 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 25 | 2.5 | | | | | 1 | | | | | | | | | | | | | | | |
| 26 | 1 | | | 3 | | | | | 1 | | | | | | | | | | | | |
| 27 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 28 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 29 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 30 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 31 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 32 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 33 | 3 | | | | | | | | | | | | | | | | | | | | |
| 34 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 35 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 36 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 37 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 38 | 2.5 | | | | | | | | | | | | | | | | | | | | |
| 39 | 3 | | | 1 | | 1 | | | | | | | | | | | | | | | |
| 40 | 2.5 | | | | | | | | v | | | | | | | | | | | | |
| 41 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 42 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 43 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 44 | 3 | | | | | | | | | | | | | | | | | | | | |
| 45 | 2 | | | | | 1 | | | 1 | | | | | | | 1 | | | | | |

| sampling point | Depth (ft) | comments | ASIN | CEDE | CHAR | ELAC | ELCA | HEDU | LETR | MEBE | MOSS | MYSI | MYSP | NAFL | NITE | NUVA | NYOD | POAM | POCR | POEP | POFR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 46 | 3.1 | | | 1 | | | 1 | | | | | 1 | | | | | | v | | | |
| 47 | 4 | | | 1 | | | 1 | | 1 | | | 1 | | | | | | | | | |
| 48 | 1 | | | 1 | | | 1 | | 3 | | | | v | | | | v | | | | |
| 49 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 50 | 2 | | | 1 | | | | | | | | | | | | | | | | v | |
| 51 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 52 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 53 | 2.6 | | | 1 | | | 1 | | 1 | | | 1 | | | | | | | | | |
| 54 | 1.5 | | | | | | 1 | | 1 | | | | | | | | | | | | |
| 55 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 56 | 2 | | | 1 | | | 1 | 1 | 1 | | | 1 | | | | | | | | | 2 |
| 57 | 2 | | | 1 | | | | | 1 | | | 1 | | | | | | | | | |
| 58 | 1 | | | 1 | | | 1 | | 2 | | | 1 | 1 | | | | | | | | |
| 59 | 2 | | | | | | 1 | | 1 | | | | | | | | | | | | |
| 60 | 2 | | | | 1 | | | | 1 | | | | | | | | 1 | | | | |
| 61 | 2 | | | | | | | | 1 | | | | 1 | | | | | | | | |
| 62 | 3 | | | 1 | | | | | | | | | | | | | | | | | |
| 63 | 3.2 | | | 1 | | | | | 1 | | | | | | | | v | 2 | 1 | | |
| 64 | 2 | | | | | | | | 1 | | | 1 | | | | | v | | | | |
| 65 | 2.5 | | | 1 | | | 1 | | 1 | | | | | | | | | | | | |
| 66 | 2.5 | | | | | | | | 1 | | | | 1 | | | | | | | | |
| 67 | 4 | | | | | | 1 | | 1 | | | 1 | | | | | | | | | |
| 68 | 4.5 | | | 1 | | | | | 1 | | | | | | | | | | | | |
| 69 | 3 | | | 1 | | | 1 | | 1 | | | | | | | | | | | | |
| 70 | 3 | | | | | | 1 | | 2 | | | | | | | | | | | | |
| 71 | 2.5 | | | | | | | | 1 | | | | v | | | | v | | | | |
| 72 | 4 | | | 1 | | | | | 1 | | | | | | | | | | | | |
| 73 | 5 | | | | | | | | 1 | | | | | | | | | | | | |
| 74 | 2.4 | | | | | | 2 | | 1 | | | | | | | | v | 1 | | | |
| 75 | 3 | | | 1 | | | 1 | | 1 | | | | | | | | | | | | |
| 76 | 3.2 | | | | | | 1 | | 1 | | | 1 | | | | | | | | | |
| 77 | 2.5 | | | | | | | | 1 | | | 1 | 1 | | | | | | 1 | | |
| 78 | 4 | | | 1 | | | 1 | | 1 | | | | | | | | | | | | |
| 79 | 7.4 | | | 1 | | | 1 | | 1 | | | | | | | | | | | | |
| 80 | 1.5 | | | 1 | | | | | 2 | | | | 1 | | | | 1 | | | | |
| 81 | 1.5 | | | 1 | | | 3 | | | | | | v | | | | | v | | | |
| 82 | 2 | | | 1 | | | 1 | | 1 | | | | v | | | | | v | | | |
| 83 | 2.5 | | | 1 | | | 1 | | | | | | | 1 | | | | | | | |
| 84 | 3 | | | 1 | | | 2 | | 1 | | | 1 | v | | | | | | v | 1 | |
| 85 | 1.5 | | | 1 | | | 1 | | 2 | | | | | | | | 1 | | | | |
| 86 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 87 | 3 | | | | | | 3 | | 1 | | | | v | | | | | v | | | |
| 88 | 3 | | | | | | | | v | | | | | | | | | | | 1 | |
| 89 | 2 | | | | | | 1 | | 1 | | | | | | | | | | | | |
| 90 | 2 | | | | | | | | 2 | | | | | | | v | | | | | |
| 91 | | Not navigable | | | | | | | | | | | | | | | | | | | |

| sampling point | Depth (ft) | comments | PONA | POPU | PORI | POZO | RAAQ | SAGI | SPPO | STPE | TYLA | UTMI | UTVU | VAAM | WOCO | FIAL | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 46 | 3.1 | | | | | 3 | | | 1 | | | | | | | | | | | | |
| 47 | 4 | | | | | 1 | | | | | | | | 1 | | | | | | | |
| 48 | 1 | | | | | | | | 1 | | | | | | | 1 | | | | | |
| 49 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 50 | 2 | | | | | 1 | | | | | | | | 2 | | | | | | | |
| 51 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 52 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 53 | 2.6 | | | | | 1 | | | | | | | | | | | | | | | |
| 54 | 1.5 | | | 1 | | | | | | | | | | 2 | | | | | | | |
| 55 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 56 | 2 | | | | | 2 | | | | | | | | | | | | | | | |
| 57 | 2 | | | | | 1 | | | | | | | | | | | | | | | |
| 58 | 1 | | | | | 1 | 1 | | 1 | | | | | | | | | | | | |
| 59 | 2 | | | 1 | | | 1 | | | | | | | | | | | | | | |
| 60 | 2 | | | | 2 | | 1 | | 1 | | | | | | | | | | | | |
| 61 | 2 | | | 1 | | | 1 | | | 1 | | | | | | 1 | | | | | |
| 62 | 3 | | | | | | | | | | | | | | | | | | | | |
| 63 | 3.2 | | | | | | | | | | | | | | | | | | | | |
| 64 | 2 | | | | | 1 | 3 | | | 1 | | | | | | | | | | | |
| 65 | 2.5 | | | | | 1 | 1 | | | | | | | | | | | | | | |
| 66 | 2.5 | | | | | | | | | | | | | | | | | | | | |
| 67 | 4 | | | | | 2 | | | 1 | | | | | 1 | | | | | | | |
| 68 | 4.5 | | | | | 1 | | | | | | | | | | 1 | | | | | |
| 69 | 3 | | | | | | | | | | | | | 1 | | | | | | | |
| 70 | 3 | | | | | | 1 | | | 2 | | | | 1 | | | | | | | |
| 71 | 2.5 | | | | | 1 | | | | | | | | | | | | | | | |
| 72 | 4 | | | | | | | | | | | | | | | | | | | | |
| 73 | 5 | | | | | 1 | | | 1 | | | | | 1 | | | | | | | |
| 74 | 2.4 | | | | | | | | | | | | | | | | | | | | |
| 75 | 3 | | | | | | 1 | | | | | | | | | | | | | | |
| 76 | 3.2 | | | 1 | | | | | | | | | | | | | | | | | |
| 77 | 2.5 | | | | | 1 | | | | | | | | | | | | | | | |
| 78 | 4 | | | | | | | | | | | | | 1 | | | | | | | |
| 79 | 7.4 | | | | | | | | | | | | | 1 | | | | | | | |
| 80 | 1.5 | | | | | | 1 | | | | | | | 1 | | 1 | | | | | |
| 81 | 1.5 | | | | | | | | | | | | | | | 1 | | | | | |
| 82 | 2 | | | | | | | | | | | | | | | 1 | | | | | |
| 83 | 2.5 | | | | 1 | | | | | | | | | 1 | | | | | | | |
| 84 | 3 | | | | | | 1 | | | | | | | | | | | | | | |
| 85 | 1.5 | | | | | | | | | | | | | | | 1 | | | | | |
| 86 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 87 | 3 | | | | | | | | | | | | | | | | | | | | |
| 88 | 3 | | | | | | | | | | | | | v | | | | | | | |
| 89 | 2 | | | | | | | | | | | | | | | | | | | | |
| 90 | 2 | | | | | | | | | 1 | | | | | | | | | | | |
| 91 | | Not navigable | | | | | | | | | | | | | | | | | | | |

| sampling point | Depth (ft) | comments | ASIN | CEDE | CHAR | ELAC | ELCA | HEDU | LETR | MEBE | MOSS | MYSI | MYSP | NAFL | NITE | NUVA | NYOD | POAM | POCR | POEP | POFR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 92 | 2.5 | | | 1 | | | | | | | | | v | | | | | | | | |
| 93 | 3 | | | 1 | | | 2 | | 3 | | | | v | | | | | | | | |
| 94 | 4.1 | | | 1 | | | 2 | | 1 | | | | 1 | | | | | | | | |
| 95 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 96 | 4.8 | | | 1 | | | 1 | | 1 | | | v | v | | | | | v | | | |
| 97 | 3.5 | | | | | | 1 | | 3 | | | | v | | | | | 1 | | | |
| 98 | 4 | | | | | | 1 | | 1 | | | | v | | | | | | | 1 | |
| 99 | 3 | | | 1 | | | 2 | | 1 | | | | v | | | | | | | | |
| 100 | 2.5 | | | 1 | | | 1 | | 1 | | | 1 | v | 1 | | | 1 | | | | |
| 101 | 3 | | | 1 | | | 1 | | | | | | v | | | | | | | 1 | |
| 102 | 3.5 | | | 1 | | | 1 | | 1 | | | | 1 | 1 | | | | | | | |
| 103 | 3.5 | | | 1 | | | | | 1 | | | | 2 | | | | | | | | |
| 104 | 3.5 | | | | | | 1 | | 1 | | | | | | | | | | | | |
| 105 | 4 | | | | | | 1 | | 1 | | | | | | | | | | | | |
| 106 | 3.8 | | | | | | 2 | | | | | | | 1 | | 1 | | | | | |
| 107 | 3 | | | 1 | | | 2 | | 2 | | | | 1 | 1 | | | | | 1 | | |
| 108 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 109 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 110 | 3 | | | 1 | | | 1 | | 1 | | | | 1 | 1 | | | | | | | |
| 111 | 6.2 | | | 1 | | | 1 | | 1 | | | | 1 | | | | | | | | |
| 112 | 5.8 | | | 1 | | | 1 | | | | | | v | 1 | | | | | | | |
| 113 | 5.3 | | | 1 | | | 1 | | 1 | | | | 1 | 1 | | | | | | v | |
| 114 | 5.6 | | | 1 | | | | | 1 | | | | 1 | | | | | | | | |
| 115 | 6 | | | | | | 1 | | 1 | | | | | | | | | | | | |
| 116 | 6.2 | | | 1 | | | | | 1 | | | | | | | | | | | | |
| 117 | 4.1 | | | 1 | | | 1 | | 2 | | | | 1 | | | | | | | | |
| 118 | 3.8 | | | v | | | 3 | | 1 | | | | | | | | | | 1 | | |
| 119 | 3.5 | | | 1 | | | 1 | | 1 | | | | | 1 | | | | | 1 | | |
| 120 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 121 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 122 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 123 | 6.7 | | | 1 | | | | | 1 | | | | | 1 | | | | | | | |
| 124 | 6.9 | | | 1 | | | 1 | 1 | 1 | | | | | | | | | | | | |
| 125 | 6.6 | | | 1 | | | 1 | | | | | | | | | | | | | | |
| 126 | 6.5 | | | 1 | | | 1 | | 1 | | | | | 1 | | | | v | | | |
| 127 | 6.5 | | | 1 | | | 1 | | 1 | | | | | | | | | | | | |
| 128 | 6 | | | | | | 1 | | 1 | | | | 1 | | | | | | | | |
| 129 | 5.3 | | | | | | 1 | | 1 | | | | | | | | | 1 | | | |
| 130 | 4.5 | | | 1 | | | | | 1 | | | | | | | | | | | | |
| 131 | 4.3 | | | v | | | | | 1 | | | | | | | | | | | | |
| 132 | 4.7 | | | 1 | | | 1 | | | | | | 1 | | | | | v | | | |
| 133 | 5 | | | 1 | | | 1 | | 1 | | | | 1 | | | | | v | | | |
| 134 | 4.5 | | | 1 | | | 1 | | 3 | | | | 2 | | | | | 1 | | | |
| 135 | 4.8 | | | 1 | | | 1 | | 1 | | | | 1 | | | | | 1 | | | |
| 136 | 4 | | | 1 | | | 1 | | 1 | | | 1 | 1 | 1 | | | | 1 | | | |
| 137 | | Not navigable | | | | | | | | | | | | | | | | | | | |

| sampling point | Depth (ft) | comments | PONA | POPU | PORI | POZO | RAAQ | SAGI | SPPO | STPE | TYLA | UTMI | UTVU | VAAM | WOCO | FIAL | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 92 | 2.5 | | | | | | | | | | | | | 1 | | | | | | | |
| 93 | 3 | | | | | | | | | | | | | | | | | | | | |
| 94 | 4.1 | | | | | | | | | | | | | 1 | | | | | | | |
| 95 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 96 | 4.8 | | | | | | | | | | | | | 1 | | | | | | | |
| 97 | 3.5 | | | | | | | | | | | | | | | | | | | | |
| 98 | 4 | | | | | | 1 | v | | | | | | | | 1 | | | | | |
| 99 | 3 | | | | | | | | | | | | | | | v | | | | | |
| 100 | 2.5 | | | | | | | | | | | | | 1 | | | | | | | |
| 101 | 3 | | | | | | | | | | | | | | | | | | | | |
| 102 | 3.5 | | | | | | | | | | | | | | | | | | | | |
| 103 | 3.5 | | | | | | | | | | | | | 2 | | | | | | | |
| 104 | 3.5 | | | | | | | | | | | | | | | | | | | | |
| 105 | 4 | | | | | | | | | | | | | | | 1 | | | | | |
| 106 | 3.8 | | | | | | | | | | | | | | | 1 | | | | | |
| 107 | 3 | | | | | | 1 | | 1 | | | | | | | | | | | | |
| 108 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 109 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 110 | 3 | | | 1 | 1 | 1 | | | | | | | | 1 | | | | | | | |
| 111 | 6.2 | | | | | 3 | | | | | | | | | | | | | | | |
| 112 | 5.8 | | | | | 1 | | | | | | | | | | | | | | | |
| 113 | 5.3 | | | | | 1 | | | | | | | | 2 | | | | | | | |
| 114 | 5.6 | | | | | | | | | | | | | 2 | | | | | | | |
| 115 | 6 | | | | | | | | | | | | | | | | | | | | |
| 116 | 6.2 | | | | | | | | | | | | | | | | | | | | |
| 117 | 4.1 | | | | | | | | | | | | | | | | | | | | |
| 118 | 3.8 | | | | | | | | | | | | | | | 1 | | | | | |
| 119 | 3.5 | | | | | | | | | | | | | | | 1 | | | | | |
| 120 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 121 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 122 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 123 | 6.7 | | | | | | | | | | | | | | | | | | | | |
| 124 | 6.9 | | | 1 | | | | | | | | | | | | | | | | | |
| 125 | 6.6 | | | | v | | | | | | | | | | | | | | | | |
| 126 | 6.5 | | | | | | | | | | | | | 1 | | | | | | | |
| 127 | 6.5 | | | | | 1 | | | | | | | | | | | | | | | |
| 128 | 6 | | | | | 1 | | | | | | | | | | | | | | | |
| 129 | 5.3 | | | | | | | | | | | | | 2 | | | | | | | |
| 130 | 4.5 | | | | | | | | | | | | | | | | | | | | |
| 131 | 4.3 | | | | | | | | | | | | | 1 | | | | | | | |
| 132 | 4.7 | | | | | | | | | | | | | | | | | | | | |
| 133 | 5 | | | | | | | | | | | | | | | | | | | | |
| 134 | 4.5 | | | | | 1 | 1 | | | 1 | | | | 3 | | | | | | | |
| 135 | 4.8 | | | | | | | | | | | | | | | | | | | | |
| 136 | 4 | | | | | 1 | v | | | | | | | | | | | | | | |
| 137 | | Not navigable | | | | | | | | | | | | | | | | | | | |

| sampling point | Depth (ft) | comments | ASIN | CEDE | CHAR | ELAC | ELCA | HEDU | LETR | MEBE | MOSS | MYSI | MYSP | NAFL | NITE | NUVA | NYOD | POAM | POCR | POEP | POFR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 138 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 139 | 5.9 | | | 1 | | | 1 | | | | | v | | | | | | | | | |
| 140 | 7.9 | | | 3 | | | | | | | | | | | | | | | | | |
| 141 | 7.4 | | | 3 | | | 1 | | 1 | | | | 1 | | | | | | | | |
| 142 | 6.8 | | | 1 | | | 1 | | | | | | 1 | | | | | 1 | | | |
| 143 | 6.5 | | | 3 | | | 1 | | | | | 1 | 1 | 2 | | | | | | | |
| 144 | 6.6 | | | 2 | | | | | 2 | | | | | 1 | | | | | | | |
| 145 | 5.5 | | | 1 | | | 1 | | 3 | | | | | 1 | | | | | | | |
| 146 | 5.7 | | | 1 | | | 1 | | 1 | | | | | 1 | | | | | | | |
| 147 | 4.7 | | | | | | | | | | | | | | | | | | | | |
| 148 | 4.6 | | | | | | 1 | | 1 | | | | | | | | | v | | | |
| 149 | 4.4 | | | 1 | | | 2 | | | | | | | | | | | | | | |
| 150 | 5 | | | | | | 1 | | 1 | | | | | | | | | | | | |
| 151 | 4.6 | | | | | | 1 | | | | | | | | | | | | | | |
| 152 | 5.2 | | | 1 | | | 1 | | | | | | v | | | | | | v | | |
| 153 | 4.5 | | | 1 | | | 1 | | 1 | | | | 2 | 1 | | | | | | | |
| 154 | 4 | | | 1 | | | 1 | | 1 | | | | 2 | 1 | | | | v | | | |
| 155 | 4 | | | 1 | | | 1 | | 1 | | | | | 1 | | | | | | | |
| 156 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 157 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 158 | 6.3 | | | | | | 1 | | 2 | | | v | | 1 | | | | | v | | |
| 159 | 7.7 | | | 2 | | | 1 | | 1 | | | 1 | | 1 | | | | | | | |
| 160 | 7.9 | | | 3 | | | | | 1 | | | | | 1 | | | | | | | |
| 161 | 6.8 | | | 1 | | | 1 | | | | | | | 2 | | | | | | | |
| 162 | 6.6 | | | 1 | | | 1 | | 1 | | | | 1 | 2 | | | | | | | |
| 163 | 7.1 | | | | | | 1 | | | | | | 1 | | | | | | 1 | | |
| 164 | 6.8 | | | | | | 1 | | 1 | | | | 2 | | | | | | | | |
| 165 | 6.4 | | | | | | | | 2 | | | | 1 | | | | | | | | |
| 166 | 5.2 | | | | | | | | 1 | | | 1 | 1 | | | | | | | | |
| 167 | 5.3 | | | | | | | | 2 | | | | 1 | | | | | | | | |
| 168 | 6.6 | | | 1 | | | 1 | | 1 | | | | 1 | 3 | | | | | | | |
| 169 | 6.1 | | | 1 | | | 1 | | | | | | 1 | 1 | | | | | | | |
| 170 | 6.2 | | | 1 | | | 1 | | 1 | | | | | | | | | | | | |
| 171 | 6.9 | | | 1 | | | | | | | | | 1 | | | | | | | | |
| 172 | 7 | | | 1 | | | 2 | | 1 | | | | 3 | 1 | | | | | | | |
| 173 | 7 | | | 1 | | | | | 1 | | | | 2 | | | | | | v | | |
| 174 | 7 | | | v | | | | | 1 | | | | 3 | | | | | | v | | |
| 175 | 7 | | | 3 | | | 1 | | | | | | | 1 | | | | | v | | |
| 176 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 177 | 2 | | | | 1 | 1 | 1 | 1 | | | 1 | | | | | | | | | | |
| 178 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 179 | 5.1 | | | | | | 1 | | | | | 1 | | | | | | | | | |
| 180 | 7.7 | | | 1 | | | | | | | | | | 1 | | | | | | | |
| 181 | 6.3 | | | 1 | | | | | 1 | | | | | 1 | | | | | | | |
| 182 | 7.4 | | | 1 | | | 1 | | 1 | | | | | 2 | | | | | | | |
| 183 | 6.8 | | | | | | 1 | | 1 | | | 1 | 1 | | | | | | | | |

| sampling point | Depth (ft) | comments | PONA | POPU | PORI | POZO | RAAQ | SAGI | SPPO | STPE | TYLA | UTMI | UTVU | VAAM | WOCO | FIAL | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 138 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 139 | 5.9 | | | | 1 | | | | | | | | | 1 | | 1 | | | | | |
| 140 | 7.9 | | | | | v | | | | | | | | | | | | | | | |
| 141 | 7.4 | | | | | 1 | | | | | | | | | | | | | | | |
| 142 | 6.8 | | | | | | | | | | | | | | | | | | | | |
| 143 | 6.5 | | | | | | | | | | | | | | | | | | | | |
| 144 | 6.6 | | | | | 1 | | | | | | | | 1 | | | | | | | |
| 145 | 5.5 | | | | | | | | | | | | | 1 | | | | | | | |
| 146 | 5.7 | | | | | | | | | | | | | | | 1 | | | | | |
| 147 | 4.7 | | | | | v | | | | | | | | | | | | | | | |
| 148 | 4.6 | | | | | | | | | | | | | | | | | | | | |
| 149 | 4.4 | | | | | 1 | | | | | | | | | | | | | | | |
| 150 | 5 | | | | | | | | | | | | | | | | | | | | |
| 151 | 4.6 | | | | | | | | | | | | | | | | | | | | |
| 152 | 5.2 | | | | | 1 | | | | | | | | | | | | | | | |
| 153 | 4.5 | | | | | | | | 1 | | | | | 1 | | 3 | | | | | |
| 154 | 4 | | | | | 1 | | | | | | | | | | | | | | | |
| 155 | 4 | | | 1 | | 1 | | | | | | | | | | | | | | | |
| 156 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 157 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 158 | 6.3 | | | | | v | | | | | | | | | | | | | | | |
| 159 | 7.7 | | | | | | | | | | | | | | | | | | | | |
| 160 | 7.9 | | | 1 | | | | | | | | | | | | | | | | | |
| 161 | 6.8 | | | | | | | | | | | | | | | | | | | | |
| 162 | 6.6 | | | | | | | | | | | | | 1 | | | | | | | |
| 163 | 7.1 | | | | | | | | | | | | | 3 | | | | | | | |
| 164 | 6.8 | | | | | | | | | | | | | 1 | | | | | | | |
| 165 | 6.4 | | | | | | | | | | | | | | | 1 | | | | | |
| 166 | 5.2 | | | | | | | | | | | | | | | 1 | | | | | |
| 167 | 5.3 | | | 1 | | | | | | | | | | 3 | | | | | | | |
| 168 | 6.6 | | | | | | | | | | | | | 2 | | | | | | | |
| 169 | 6.1 | | | | | 1 | | | | | | | | 2 | | | | | | | |
| 170 | 6.2 | | | | | | | | | | | | | | | | | | | | |
| 171 | 6.9 | | | | | v | | | | | | | | 1 | | v | | | | | |
| 172 | 7 | | | | | | | | | | | | | | | 2 | | | | | |
| 173 | 7 | | | | | | | | | v | | | | | | 2 | | | | | |
| 174 | 7 | | | | | | | | | | | | | | | 2 | | | | | |
| 175 | 7 | | | | | v | v | | | | | | | | | 2 | | | | | |
| 176 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 177 | 2 | | 1 | | | 1 | | | v | | | | | | | | | | | | |
| 178 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 179 | 5.1 | | | | | 1 | | | | | | | | 1 | | | | | | | |
| 180 | 7.7 | | | 1 | | | | | | | | | | | | | | | | | |
| 181 | 6.3 | | | | | 1 | | | | | | | | 1 | | | | | | | |
| 182 | 7.4 | | | | | | | | | | | | | | | | | | | | |
| 183 | 6.8 | | | | | | | | | | | | | | | | | | | | |

| sampling point | Depth (ft) | comments | ASIN | CEDE | CHAR | ELAC | ELCA | HEDU | LETR | MEBE | MOSS | MYSI | MYSP | NAFL | NITE | NUVA | NYOD | POAM | POCR | POEP | POFR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 184 | 7 | | | 1 | | | 1 | | 1 | | | | | | | | | | | | |
| 185 | 6.1 | | | 1 | | | | | 1 | | | | | | | | | | | | |
| 186 | 4.2 | | | v | | | 1 | | 1 | | | | | | | | | | | | |
| 187 | 3.1 | | | | | | 1 | | 1 | | | 1 | | | | | | | | | |
| 188 | 6.8 | | | 2 | | | | | 1 | | | | 1 | | | | | | | | |
| 189 | 6.4 | | | | | | 1 | | | | | | 1 | | | | | | | | |
| 190 | 5.7 | | | 3 | | | | | | | | | v | | | | | | 1 | | |
| 191 | 5.6 | | | 3 | | | 1 | | 1 | | | | | | | | | | | | |
| 192 | 5.6 | | | 2 | | | 1 | | 1 | | | | | | | | | | | | |
| 193 | 5.5 | | | 3 | | | | | | | | | | | | | | | | | |
| 194 | 1.5 | | | 1 | | | 1 | | | | | | v | | | | | | | v | |
| 195 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 196 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 197 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 198 | 5 | | | 1 | | | | | | | | 1 | | 1 | | | | | | | |
| 199 | 7 | | | 1 | | | | | 1 | | | | | 1 | | | | | | | |
| 200 | 7.4 | | | 1 | | | 1 | | | | | | | 2 | | | | | | | |
| 201 | 5.8 | | | | | | | | 1 | | | | | 1 | | | | | | | |
| 202 | 6.9 | | | 1 | | | 1 | | 1 | | | | | 1 | | | | 1 | | | |
| 203 | 6.7 | | | | | | 1 | | 1 | | | | | | | | | | | | |
| 204 | 6.8 | | | 1 | | | | | | | | | | | | | | | | | |
| 205 | 2.9 | | | | | | 1 | | | 1 | | 1 | | | | 1 | v | | | | |
| 206 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 207 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 208 | 5 | | | 1 | | | 1 | | | | | | | 3 | | | | | | | |
| 209 | 7.6 | | | 1 | | | 1 | | v | | | | | 1 | | | | | | | |
| 210 | 10.2 | | | 1 | | | | | 1 | | 1 | | | 1 | | | | | | | |
| 211 | 7.3 | | | 1 | | | | | 3 | | | | | | 1 | | | | | | |
| 212 | 8.1 | | | | | | | | 1 | | | | | | | | | | | | |
| 213 | 7.8 | | | 1 | | | 1 | | 1 | | | | | | | | | | | | |
| 214 | 3.2 | | | 2 | | | 1 | | 1 | v | | | | | | | | v | | v | |
| 215 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 216 | 1 | | | 1 | | | | | | | | v | | | | | 2 | | | | |
| 217 | 1 | | | 1 | | | | | 2 | | | | | | | | v | | | | |
| 218 | 5 | | | | | | | | 3 | | | v | | | | v | | | | | |
| 219 | 10.4 | | | 2 | | | | | 1 | | | | | 2 | | | | | | | |
| 220 | 7.6 | | | 1 | | | | | 1 | | | | | 1 | | | | | | | |
| 221 | 7.5 | | | 1 | | | | | 1 | | | | | 1 | | | | | | | |
| 222 | 7.6 | | | 1 | 1 | | | | | | | | | 2 | | | | | | | |
| 223 | 8.4 | | | | | | | | 1 | | | | | 1 | | | | | 1 | | |
| 224 | 4 | | | v | | | 1 | | | | | | | | | | | v | | 1 | |
| 225 | 5.5 | | | 1 | | | 1 | | 1 | | | | | | | | | | | | |
| 226 | 4 | | | 1 | | | 1 | | 1 | | | | | 1 | | | | | | | |
| 227 | 4 | | | v | | | 2 | | 1 | | | | | | | | | | | | |
| 228 | 5 | | | 2 | | | 1 | | 1 | | | | | 1 | | | | | | | |
| 229 | 6.5 | | | 1 | | | | | 2 | | | | | 1 | | | | | | | |

| sampling point | Depth (ft) | comments | PONA | POPU | PORI | POZO | RAAQ | SAGI | SPPO | STPE | TYLA | UTMI | UTVU | VAAM | WOCO | FIAL | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 184 | 7 | | | | | 1 | | | | | | | | | | | | | | | |
| 185 | 6.1 | | | | | | | | | | | | | | | 1 | | | | | |
| 186 | 4.2 | | | | | | | | | | | | | 2 | | | | | | | |
| 187 | 3.1 | | | | | | | | | | | | | v | | 1 | | | | | |
| 188 | 6.8 | | | | | 1 | | | | | | | | 1 | | 1 | | | | | |
| 189 | 6.4 | | | | 2 | 1 | | | | | | | | | | | | | | | |
| 190 | 5.7 | | | | | 1 | | | | | | | | | | 1 | | | | | |
| 191 | 5.6 | | | | | 1 | | | | | | | | | | 1 | | | | | |
| 192 | 5.6 | | | | | | | | | | | | | | | | | | | | |
| 193 | 5.5 | | | | | v | | | | | | | | | | | | | | | |
| 194 | 1.5 | | | | | 1 | | | | | | | | | | 1 | | | | | |
| 195 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 196 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 197 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 198 | 5 | | | | v | v | | | | | | | | 1 | | | | | | | |
| 199 | 7 | | | | | | | | | | | | | | | | | | | | |
| 200 | 7.4 | | | | v | | | | | | | | | | | | | | | | |
| 201 | 5.8 | | | | | | | | | | | | | 3 | | | | | | | |
| 202 | 6.9 | | | | | v | | | | | | | | 1 | | | | | | | |
| 203 | 6.7 | | | | | | | | | | | | | | | 1 | | | | | |
| 204 | 6.8 | | | | | v | | | | | | | | 1 | | | | | | | |
| 205 | 2.9 | | v | | | | | | | | | | v | v | | | | | | | |
| 206 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 207 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 208 | 5 | | | 1 | | | | | | | | | | | | | | | | | |
| 209 | 7.6 | | | v | | | | | | | | | | 1 | | | | | | | |
| 210 | 10.2 | | | | | | | | | | | | | 1 | | | | | | | |
| 211 | 7.3 | | | | | | | | | | | | | | | | | | | | |
| 212 | 8.1 | | | | | | | | | | | | | | | | | | | | |
| 213 | 7.8 | | | | | | | | | | | | | | | | | | | | |
| 214 | 3.2 | | v | | | v | | | | | | | 2 | | | | | | | | |
| 215 | | Not navigable | | | | | | | | | | | | | | | | | | | |
| 216 | 1 | | | | | | | | | | | 1 | | 1 | | | | | | | |
| 217 | 1 | | | | | | | | | | | | | v | | | | | | | |
| 218 | 5 | | | | | 1 | | | | | | | | v | | | | | | | |
| 219 | 10.4 | | | 1 | | | | | | | | | | | | 1 | | | | | |
| 220 | 7.6 | | | | | | | | | | | | | | | 1 | | | | | |
| 221 | 7.5 | | | | | | | | | | | | | | | | | | | | |
| 222 | 7.6 | | | | | | | | | | | | | 1 | | | | | | | |
| 223 | 8.4 | | | | | | | | | | | | | | | | | | | | |
| 224 | 4 | | | | | | | | | | | | | 1 | | | | | | | |
| 225 | 5.5 | | | | | | | | | | | | | v | | | | | | | |
| 226 | 4 | | | | 1 | | | | | | | | | 1 | | | | | | | |
| 227 | 4 | | | | | | | | | | | | v | v | | | | | | | |
| 228 | 5 | | | 1 | | 1 | | | | | | | | | | | | | | | |
| 229 | 6.5 | | | | | | | | | | | | | 1 | | | | | | | |

| sampling point | Depth (ft) | comments | ASIN | CEDE | CHAR | ELAC | ELCA | HEDU | LETR | MEBE | MOSS | MYSI | MYSP | NAFL | NITE | NUVA | NYOD | POAM | POCR | POEP | POFR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 230 | 7.8 | | | 1 | | | | | | | | | | 1 | | | | | | | |
| 231 | 7.9 | | | 1 | | | | | 1 | | | | | 2 | | | | | | | |
| 232 | 8.7 | | | | | | 1 | | | | | | | | | | | | | | |
| 233 | 5.3 | | | 3 | | | 1 | | 1 | | | | | 1 | | | | 1 | | | |
| 234 | 4 | | | | | | | | 1 | | | 1 | | 1 | | | | 1 | | | v |
| 235 | 4.5 | | | 1 | | | | | 1 | | | v | | | | | | v | 1 | | |
| 236 | 8.2 | | | | | | | | 1 | | 1 | | | 1 | | | | | | | |
| 237 | 3 | | | | | | | | | | | v | | 1 | | | | | | | 1 |
| 238 | 4 | | | | | | | | v | | | v | | | | | | | v | | |
| 239 | 4.5 | | | 3 | | | 1 | | 1 | | | | | 1 | | | | | | | |
| 240 | 9.9 | no plants | | | | | | | | | | | | | | | | | | | |
| 241 | 3.5 | | | | | | | | 1 | | | v | | | | | | | | | |
| 242 | 4.5 | | | 1 | | | | | 1 | | | | | 1 | | | | | | | |
| 243 | 6.8 | | | 2 | | | | | | | | | | | | | | | | | |
| 244 | 7.9 | | | | | | | | 1 | | | | | | | | | | | | |
| 245 | 6.7 | | | | | | 1 | | 1 | | | | | 1 | | | | | 1 | | |
| 246 | 3 | | | | | | 1 | | 3 | | | 1 | | | | | | | | | |
| 247 | 4 | | | 1 | | | | | 1 | | | v | | | | | | | | | |
| 248 | 7.3 | | | 1 | | | 1 | | 1 | | | | | 1 | | | | | | | |
| 249 | 7.8 | | | | | | | | 1 | | | | | | | | | | 1 | | |
| 250 | 6.1 | | | 1 | | | | | 1 | | | | | | | | | | 1 | | |
| 251 | 3 | | | 1 | | | 3 | | v | | | | | | | | | | | | |
| 252 | 4.5 | | | | | | | | | | | | | 1 | | | | | | | |
| 253 | 5.7 | | | | | | 1 | | 1 | | | | | 1 | | | | | | | |
| 254 | 9.5 | | | 1 | | | | | 1 | | | | | | | | | | | | |
| 255 | 7.5 | | | 1 | | | | | 1 | | | 1 | | 1 | | | | | | | |
| 256 | 8 | | | 1 | | | | | | | | 1 | | 1 | | | | | | | |
| 257 | 7.7 | | | 1 | | | | | | | | | | | | | | | | | |
| 258 | 2 | | | | | | | v | 1 | | | | | 1 | | | v | | | | |
| 259 | | not navigable | | | | | | | | | | | | | | | | | | | |
| 260 | 3.5 | | | 1 | | | 1 | | | | | | | | | | v | | | | |
| 261 | 1.5 | | | | 1 | | 1 | | 1 | | | | | 1 | | v | v | | | | |
| 262 | 3 | | | 1 | 1 | | 1 | | | | | | | 1 | | | | | | | |
| 263 | 4 | | | 1 | | | 1 | | 2 | | | | | | | | | | | | |
| 264 | 5.4 | | | 1 | | | | | 1 | | | | | 1 | | | | | | | |
| 265 | 8 | | | 1 | | | 1 | | 2 | | | 1 | | | | | | | | | |
| 266 | 10 | | | | | | | | 1 | | | | | 1 | | | | | | | |
| 267 | 7.8 | | | 1 | | | | | | | | | | | | | | | | | |
| 268 | 8.4 | no plants | | | | | | | | | | | | | | | | | | | |
| 269 | | not navigable | | | 2 | | | | | | | | | | | 1 | | | | | |
| 270 | 3 | | | 1 | 1 | | 1 | | 1 | | | | | | | 1 | v | | | | |
| 271 | 2 | | | | 2 | | 1 | | 1 | | | | | 1 | | 1 | | | v | | |
| 272 | 1 | | | | 1 | | 1 | | 1 | | | 1 | | 1 | | v | | | | | |
| 273 | 5.9 | | | 2 | 1 | | | | 1 | | | | | 1 | | | | | 1 | | |
| 274 | 6.6 | | | 1 | | | 1 | | 1 | | | | | | | | | | | | |
| 275 | 5.6 | | | 1 | | | | | | | | | | | | | | | | | |

| sampling point | Depth (ft) | comments | PONA | POPU | PORI | POZO | RAAQ | SAGI | SPPO | STPE | TYLA | UTMI | UTVU | VAAM | WOCO | FIAL | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 230 | 7.8 | | | | v | | | | | | | | | | | | | | | | |
| 231 | 7.9 | | | | | | | | | | | | | | | | | | | | |
| 232 | 8.7 | | | | | 1 | | | | | | | | | | | | | | | |
| 233 | 5.3 | | | v | | 1 | | | | | | | | 1 | | | | | | | |
| 234 | 4 | | | | | 1 | | | | | | | | 2 | | | | | | | |
| 235 | 4.5 | | | | | 1 | | | | | | | | 2 | | | | | | | |
| 236 | 8.2 | | | | | | | | | 1 | | | | | | | | | | | |
| 237 | 3 | | | | 1 | v | | | | | | | | 2 | | | | | | | |
| 238 | 4 | | | | | | | | | | | | | 1 | | | | | | | |
| 239 | 4.5 | | | | | | | | | | | | | v | | | | | | | |
| 240 | 9.9 | no plants | | | | | | | | | | | | | | | | | | | |
| 241 | 3.5 | | | v | | v | | | | | | | | 1 | | | | | | | |
| 242 | 4.5 | | | | | | | | | 1 | | | | 2 | | | | | | | |
| 243 | 6.8 | | | | | | | | | | | | | 3 | | v | | | | | |
| 244 | 7.9 | | | | 1 | | | | | | | | | | | | | | | | |
| 245 | 6.7 | | | | | | | | | | | | | | | | | | | | |
| 246 | 3 | | | | | 1 | | | | | | | | 1 | | | | | | | |
| 247 | 4 | | | | | | | | | | | | | 2 | | | | | | | |
| 248 | 7.3 | | | | | | | | | | | | | | | 1 | | | | | |
| 249 | 7.8 | | | | | 1 | | | | | | | | 1 | | | | | | | |
| 250 | 6.1 | | | | | | | | | | | | | 3 | | | | | | | |
| 251 | 3 | | | | | | | | v | | | | | | v | v | | | | | |
| 252 | 4.5 | | | | | v | | | | | | | | 3 | | | | | | | |
| 253 | 5.7 | | | | | | | | | | | | | 2 | | | | | | | |
| 254 | 9.5 | | | | | | | | | | | | | 1 | | | | | | | |
| 255 | 7.5 | | | | | | | | | | | | | 1 | | | | | | | |
| 256 | 8 | | | | | | | | | | | | | | | | | | | | |
| 257 | 7.7 | | | | | | | | | | | | | | | | | | | | |
| 258 | 2 | | | | | | | | v | | | | | 1 | v | | | | | | |
| 259 | | not navigable | | | | | | | | | | | | | | | | | | | |
| 260 | 3.5 | | | | | | | | | | | | | | | v | | | | | |
| 261 | 1.5 | | | | 1 | | | | v | | | | | 1 | v | 1 | | | | | |
| 262 | 3 | | | | | | | | | | | | | 2 | | | | | | | |
| 263 | 4 | | | | | | | | | | | | | 1 | | | | | | | |
| 264 | 5.4 | | | | | | | | | | | | | 3 | | | | | | | |
| 265 | 8 | | | | | | | | | | | | | | | | | | | | |
| 266 | 10 | | | | | | | | | | | | | | | | | | | | |
| 267 | 7.8 | | | | | | | | | | | | | | | | | | | | |
| 268 | 8.4 | no plants | | | | | | | | | | | | | | | | | | | |
| 269 | | not navigable | | 1 | | | | | | | | | | | | | | | | | |
| 270 | 3 | | | | | | | | | | | | | | | | | | | | |
| 271 | 2 | | | v | | | | | | | | | | | | 1 | | | | | |
| 272 | 1 | | | | | | | | | 1 | | | | | | | | | | | |
| 273 | 5.9 | | | | | | | | | | | | | | | 1 | | | | | |
| 274 | 6.6 | | | | | | | | | | | | | | | 1 | | | | | |
| 275 | 5.6 | | | | | | | | | | | | | 2 | | | | | | | |

| sampling point | Depth (ft) | comments | ASIN | CEDE | CHAR | ELAC | ELCA | HEDU | LETR | MEBE | MOSS | MYSI | MYSP | NAFL | NITE | NUVA | NYOD | POAM | POCR | POEP | POFR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 276 | 6.7 | | | | | | | | 1 | | | 1 | | 1 | | | | | | | |
| 277 | 7.9 | | | 1 | | | | | 1 | | | | | 1 | | | | | | | |
| 278 | 9.6 | | | | | | | | | | | | | | | | | | | | |
| 279 | 8.5 | | | 1 | | | | | | | | | | 1 | | | | | | | |
| 280 | 9 | | | | | | | | | | | | | | | | | | | | |
| 281 | 3.9 | | | 1 | | | 3 | | | | | | | | | | 1 | | | | |
| 282 | 4.4 | | | v | 1 | | 1 | | 1 | | | | | | | | | | | | |
| 283 | 1.9 | | | | 1 | | | | | | | v | | 1 | | v | | | | | |
| 284 | 4.8 | | | 1 | | | 1 | | 1 | | | 1 | | 1 | | | | | | | |
| 285 | 7.3 | | | 1 | | | 1 | | | | | | | 1 | | | | | | | |
| 286 | 5.4 | | | 2 | | | | | | | | | | 1 | | | | | | | |
| 287 | 1.5 | | | 1 | | | 1 | | | | | v | | 1 | | | | | | | |
| 288 | 5.2 | | | 1 | | | | | | | | | | 1 | | | | | | | |
| 289 | 9.9 | | | | | | 1 | | 1 | | | | | 1 | | | | | | | |
| 290 | 8.1 | | | | | | | | | | | | | | | | | | | | |
| 291 | 8 | | | | | | | | | | | | | | | | | | | | |
| 292 | 10 | no plants | | | | | | | | | | | | | | | | | | | |
| 293 | 3 | | | 1 | | | 1 | | 1 | | | | | | | | v | | | | |
| 294 | 4.6 | | | 3 | | | 1 | | | | | | | | | | | | | | |
| 295 | 4 | | | 1 | | | 1 | | | | | | | | | | | | | | |
| 296 | 7.4 | | | | | | 1 | | | | | | | 1 | | | | | | | |
| 297 | 4.3 | | | | | | 1 | | | | | | | | | | | | | | |
| 298 | 3 | | | 1 | | | 1 | | 1 | | | | | | | | | | | | |
| 299 | 3 | | | 1 | | | | | | | | 1 | | | | | | | | | |
| 300 | 6.7 | | | | | | | | | | | 1 | | 1 | | | | | | | |
| 301 | 8.4 | | | | | | | | | | | | | | | | | | | | |
| 302 | 8.3 | | | | | | 1 | | 1 | | | | | 1 | | | | | | | |
| 303 | 8.5 | | | | | | | | | | | | | | | | | | | | |
| 304 | 9.4 | | | 2 | | | | | | | | 1 | | | | | | | | | |
| 305 | 6.2 | | | | | | | | | | | | | | | | | | | | |
| 306 | 3.1 | | | 3 | | | 1 | | | | | | | 1 | | | v | | | | |
| 307 | 7.1 | | | | | | 1 | | 1 | | | | | 1 | | | 1 | | | | |
| 308 | 7.2 | | | | | | 1 | | | | | | | | | | | | | | 1 |
| 309 | 7.2 | | | 3 | | | | | | | | | | 1 | | | | | | | |
| 310 | 5.1 | | | v | | | | | | | | | | | | v | | | | | |
| 311 | 8.2 | | | 1 | | | | | 1 | | | | | 1 | | | | | | | |
| 312 | 8.3 | | | | 1 | | | | | | | | | 1 | | | | | | | |
| 313 | 9.2 | | | 1 | | | | | | | | | | 1 | | | | | | | |
| 314 | 6.1 | | | 1 | 1 | | 1 | | | | | v | | | | | | | | | |
| 315 | 7.1 | | | 3 | | | | | | | | | | | | | | | | | |
| 316 | 7.5 | | | 1 | | | 1 | | | | | | | 1 | | | | | | | |
| 317 | 7.9 | | | 2 | | | 1 | | | | | | | | | | | | | | |
| 318 | 8.2 | | | 1 | | | | | | | | | | 1 | | | | | | | |
| 319 | 8.1 | | | 1 | | | | | 1 | | | | | 1 | | | | | | | |
| 320 | 8.3 | | | | | | 1 | | 1 | | | | | 1 | | | | | | | |
| 321 | 3.1 | | | 3 | | | 1 | | | | | v | | 1 | | | | | | | |

| sampling point | Depth (ft) | comments | PONA | POPU | PORI | POZO | RAAQ | SAGI | SPPO | STPE | TYLA | UTMI | UTVU | VAAM | WOCO | FIAL | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 276 | 6.7 | | | | | | | | | | | | | | | | | | | | |
| 277 | 7.9 | | | | | | | | | | | | | | | | | | | | |
| 278 | 9.6 | | | | | | | | | | | | | | | | | | | | |
| 279 | 8.5 | | | | | 1 | | | | | | | | | | | | | | | |
| 280 | 9 | | | | | | | | | | | | | | | | | | | | |
| 281 | 3.9 | | | | | | | | | | | | | | | | | | | | |
| 282 | 4.4 | | | | | | | | | | | | | | | | | | | | |
| 283 | 1.9 | | | 1 | | | | | | | | | | | | | | | | | |
| 284 | 4.8 | | | | | 1 | | | | | | | | 1 | | | | | | | |
| 285 | 7.3 | | | | | | | | | | | | | | | 1 | | | | | |
| 286 | 5.4 | | | 1 | | | | | | | | | | v | | | | | | | |
| 287 | 1.5 | | | | | | | | | | | | | 1 | | | | | | | |
| 288 | 5.2 | | | | | | | | | | | | | 2 | | v | | | | | |
| 289 | 9.9 | | | | | | | | | | | | | | | | | | | | |
| 290 | 8.1 | | | | | 1 | | | | | | | | | | | | | | | |
| 291 | 8 | | | | | | | | | | | | | | | | | | | | |
| 292 | 10 | no plants | | | | | | | | | | | | | | | | | | | |
| 293 | 3 | | | | | | | | | | | | | v | | 1 | | | | | |
| 294 | 4.6 | | | | | | | | | | | | | | | | | | | | |
| 295 | 4 | | | 1 | | | | | | | | | | 1 | | | | | | | |
| 296 | 7.4 | | | | | | | | | | | | | | | 1 | | | | | |
| 297 | 4.3 | | | | | | | | | | | | | 3 | | | | | | | |
| 298 | 3 | | | | | | | | | | | | | 1 | | 1 | | | | | |
| 299 | 3 | | | 1 | | | | | | 1 | | | | 1 | | | | | | | |
| 300 | 6.7 | | | | | | | | | | | | | 3 | | | | | | | |
| 301 | 8.4 | | | | | | | | | | | | | | | | | | | | |
| 302 | 8.3 | | | | | | | | | | | | | | | | | | | | |
| 303 | 8.5 | | | | | | | | | | | | | | | | | | | | |
| 304 | 9.4 | | | | | | | | | | | | | 2 | | | | | | | |
| 305 | 6.2 | | | | | | | | | | | | | 2 | | | | | | | |
| 306 | 3.1 | | | | | | | | | | | | | | | 1 | | | | | |
| 307 | 7.1 | | | | | | | | | | | | | | | 1 | | | | | |
| 308 | 7.2 | | | | | | | | | | | | | | | | | | | | |
| 309 | 7.2 | | | | | | | | | | | | | | | | | | | | |
| 310 | 5.1 | | | v | | | | | | | | | | 1 | | | | | | | |
| 311 | 8.2 | | | | | | | | | | | | | | | | | | | | |
| 312 | 8.3 | | | | | | | | | | | | | | | | | | | | |
| 313 | 9.2 | | | | | | | | | | | | | | | | | | | | |
| 314 | 6.1 | | | | | | | | | | | | | 2 | | | | | | | |
| 315 | 7.1 | | | | | | | | | | | | | | | | | | | | |
| 316 | 7.5 | | | | | | | | | | | | | | | | | | | | |
| 317 | 7.9 | | | | | | | | | | | | | | | | | | | | |
| 318 | 8.2 | | | | | | | | | | | | | | | | | | | | |
| 319 | 8.1 | | | | | | | | | | | | | | | | | | | | |
| 320 | 8.3 | | | | | | | | | | | | | | | | | | | | |
| 321 | 3.1 | | | | | | | | | | | | | 1 | | | | | | | |

| sampling point | Depth (ft) | comments | ASIN | CEDE | CHAR | ELAC | ELCA | HEDU | LETR | MEBE | MOSS | MYSI | MYSP | NAFL | NITE | NUVA | NYOD | POAM | POCR | POEP | POFR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 322 | 4.9 | | | v | | | | | | | | 1 | | | | | | | | | |
| 323 | 8.8 | | | | | | | | | | | | 1 | 1 | | | | | | | |
| 324 | 8.5 | | | | | | 1 | | 1 | | | | | 1 | | | | | | | |
| 325 | 8.7 | | | 1 | | | | | 1 | | | | | | | | | | | | |
| 326 | 8.4 | | | 1 | | | | | 1 | | | | | 1 | | | | | | | |
| 327 | 2.1 | | | | 1 | | | | v | | | | | | | | v | | | | |
| 328 | 2.8 | | | | 3 | | 1 | | 1 | | | 1 | | 1 | | | | | | | |
| 329 | 3.2 | | | | 1 | | 1 | | | | | | | 1 | | | | | | | |
| 330 | 8.1 | | | 2 | | | | | | | | | | | | | | | | | |
| 331 | 8.5 | | | 1 | | | | | | | | | | | | | | | | | |
| 332 | 7.8 | | | 1 | | | 1 | | 1 | | | | | | | | | | | | |
| 333 | 8.1 | | | 1 | | | | | | | | | | 1 | | | | | | | |
| 334 | 7.8 | | | | | | | | 1 | | | | | | | | | | | | |
| 335 | 7.6 | | | 1 | | | 1 | | 1 | | | | | | | | | | | | |
| 336 | 9 | no plants | | | | | | | | | | | | | | | | | | | |
| 337 | 9 | | | 1 | | | 1 | | | | | | | 1 | | | | | | | |
| 338 | 9 | | | | | | | | 1 | | | | 1 | 1 | | | | | | | |
| 339 | 8.7 | | | | | | | | | | | | | 1 | | | | | | | |
| 340 | 9.8 | | | 1 | | | | | | | | | | 1 | | | | | | | |
| 341 | 5.6 | | | 3 | | | | | | | | | | | | | | | | | |
| 342 | 3 | | | 1 | | | 2 | | | | | | | | | | | | | | |
| 343 | 2.5 | | | 1 | | | 1 | | 3 | | | | | | | | | | | | |
| 344 | 2.5 | | | 3 | | | 1 | | | | | | | | | | | | | | |
| 345 | 3.2 | | | | | | | | | | | | | | | v | | | | | |
| 346 | 5.8 | | | 1 | | | 1 | | | | | | | | | | | | | | |
| 347 | 8.3 | | | 1 | | | | | | | | | | | | | | | | | |
| 348 | 7.2 | | | | | | 1 | | | | | | | | | | | | | | |
| 349 | 7.8 | | | | | | 1 | | 1 | | | | | | | | | | | | |
| 350 | 8 | | | 2 | | | | | | | | | | | | | | | | | |
| 351 | | not navigable | | | | | | | | | | | | | | | | | | | |
| 352 | 4.5 | | | 1 | | | | | | | | | | | | | | | | | |
| 353 | 8.3 | | | 1 | | | | | 1 | | | | | 1 | | | | | | | |
| 354 | 9 | no plants | | | | | | | | | | | | | | | | | | | |
| 355 | 8.2 | | | 1 | | | | | | | | 1 | 1 | | | | | | | | |
| 356 | 8.5 | | | 1 | | | | | | | | | 1 | 1 | | | | | | | |
| 357 | 10.8 | | | | | | | | | | | | | | | | | | | | |
| 358 | 5.7 | | | 1 | | | 1 | | | | | 1 | | 1 | | | | | | | |
| 359 | 8.7 | no plants | | | | | | | | | | | | | | | | | | | |
| 360 | 3 | | | | | | | | | | | | | 1 | | | | | | | |
| 361 | 4.5 | | | 2 | | | 2 | | | | | | | | | | | | | | |
| 362 | 2 | | | 3 | | | 1 | | | | | | | | | | v | | | | |
| 363 | | not navigable | | | | | | | | | | | | | | | | | | | |
| 364 | | not navigable | | | | | | | | | | | | | | | | | | | |
| 365 | 2 | | | 1 | | | | | 3 | | | | | | | v | | | | | |
| 366 | 3 | | | 1 | | | | | | | | | | | | | | | | | |
| 367 | 9.4 | | | | | | | | | | | | | | | | | | | | |

| sampling point | Depth (ft) | comments | PONA | POPU | PORI | POZO | RAAQ | SAGI | SPPO | STPE | TYLA | UTMI | UTVU | VAAM | WOCO | FIAL | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 322 | 4.9 | | | v | | | | | | | | | | 2 | | | | | | | |
| 323 | 8.8 | | | | | | | | | | | | | | | | | | | | |
| 324 | 8.5 | | | | | | | | | | | | | | | | | | | | |
| 325 | 8.7 | | | | | | | | | | | | | | | | | | | | |
| 326 | 8.4 | | | | | | | | | | | | | | | | | | | | |
| 327 | 2.1 | | | | | | | | | | | | | 1 | | v | | | | | |
| 328 | 2.8 | | | 1 | | | | | | | | | | | | | | | | | |
| 329 | 3.2 | | | | | | | | | | | | | | | | | | | | |
| 330 | 8.1 | | | | | | | | | | | | | | | | | | | | |
| 331 | 8.5 | | | | | | | | | | | | | | | | | | | | |
| 332 | 7.8 | | | | | | | | | | | | | | | | | | | | |
| 333 | 8.1 | | | | | | | | | | | | | | | | | | | | |
| 334 | 7.8 | | | | | | | | | | | | | | | | | | | | |
| 335 | 7.6 | | | | | | | | | | | | | | | | | | | | |
| 336 | 9 | no plants | | | | | | | | | | | | | | | | | | | |
| 337 | 9 | | | | | | | | | | | | | | | | | | | | |
| 338 | 9 | | | | | | | | | | | | | | | | | | | | |
| 339 | 8.7 | | | | | | | | | | | | | | | | | | | | |
| 340 | 9.8 | | | | | | | | | | | | | | | | | | | | |
| 341 | 5.6 | | | | | | | | | | | | | | | | | | | | |
| 342 | 3 | | | | | | | | | | | | | 1 | | | | | | | |
| 343 | 2.5 | | | | | | | | | | | | | | | 2 | | | | | |
| 344 | 2.5 | | | | | | | | | | | | | | | | | | | | |
| 345 | 3.2 | | | | | | | | | | | | | 1 | | v | | | | | |
| 346 | 5.8 | | | | | | | | | | | | | | | | | | | | |
| 347 | 8.3 | | | | | | | | | | | | | | | | | | | | |
| 348 | 7.2 | | | | | | | | | | | | | | | | | | | | |
| 349 | 7.8 | | | | | | | | | | | | | | | | | | | | |
| 350 | 8 | | | | | 1 | | | | | | | | 2 | | | | | | | |
| 351 | | not navigable | | | | | | | | | | | | | | | | | | | |
| 352 | 4.5 | | | v | | v | | | | | | | | 2 | | | | | | | |
| 353 | 8.3 | | | | | | | | | | | | | | | | | | | | |
| 354 | 9 | no plants | | | | | | | | | | | | | | | | | | | |
| 355 | 8.2 | | | | | | | | | | | | | | | | | | | | |
| 356 | 8.5 | | | | | 1 | | | | | | | | | | | | | | | |
| 357 | 10.8 | | | | | v | | | | | | | | | | | | | | | |
| 358 | 5.7 | | | | | | | | | | | | | 1 | | | | | | | |
| 359 | 8.7 | no plants | | | | | | | | | | | | | | | | | | | |
| 360 | 3 | | | | | | | | | | | | | 1 | | | | | | | |
| 361 | 4.5 | | | | | | | | | | | | | | | | | | | | |
| 362 | 2 | | | | | | | | | | | | | | | | | | | | |
| 363 | | not navigable | | | | | | | | | | | | | | | | | | | |
| 364 | | not navigable | | | | | | | | | | | | | | | | | | | |
| 365 | 2 | | | | | | | | | | | | | | | | | | | | |
| 366 | 3 | | | v | | | | | | | | | | 3 | | | | | | | |
| 367 | 9.4 | | | | | | | | | | | | | 1 | | | | | | | |

| sampling point | Depth (ft) | comments | ASIN | CEDE | CHAR | ELAC | ELCA | HEDU | LETR | MEBE | MOSS | MYSI | MYSP | NAFL | NITE | NUVA | NYOD | POAM | POCR | POEP | POFR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 368 | 11.5 | no plants | | | | | | | | | | | | | | | | | | | |
| 369 | 11.4 | | | | | | 1 | | | | | | | | | | | | | | |
| 370 | 8.2 | | | 2 | | | | | | | | v | | | | | | | | | |
| 371 | | not navigable | | | | | | | | | | | | | | | | | | | |
| 372 | 1.5 | | | | | | 1 | | 1 | | | | | 1 | | v | | | | | |
| 373 | 3.5 | | | | | | | | | | | v | | | | | | | | | |
| 374 | 9.1 | | | | | | | | | | | 1 | | | | | | | | | |
| 375 | 7.8 | | | 1 | | | | | | | | | | | | | | | | | |
| 376 | 8.8 | no plants | | | | | | | | | | | | | | | | | | | |
| 377 | 9.6 | | | 1 | | | | | | | | | | | | | | | | | |
| 378 | 8.1 | | | 1 | | | | | | | | | | 1 | | | | | | | |
| 379 | 9.1 | no plants | | | | | | | | | | | | | | | | | | | |
| 380 | 10.9 | no plants | | | | | | | | | | | | | | | | | | | |
| 381 | 3 | | | | 1 | | 1 | | | | | 1 | | | | | | | | | |
| 382 | 1.5 | | | v | 3 | | | | | | | v | | | | v | v | | | | |
| 383 | 3 | | | 2 | | | | | 1 | | | 1 | | | | | v | | | | |
| 384 | 3.1 | | | 1 | 2 | | 2 | | 2 | | | | | | | | v | | | | |
| 385 | 1.5 | | | | 1 | | 1 | | 1 | | | | | 1 | | v | v | | 1 | | |
| 386 | 8.9 | | | 1 | | | | | | | | 1 | | | | | | | | | |
| 387 | 12.7 | no plants | | | | | | | | | | | | | | | | | | | |
| 388 | 13.8 | | | 1 | | | | | 1 | | | | | | | | | | | | |
| 389 | 10.2 | | | | | | | | 1 | | | | | | | | | | | | |
| 390 | 5.3 | | | 1 | | | | | | | | | | | | | | | | | |
| 391 | 3.5 | | | | | | | | v | | | 1 | | | | 1 | v | | | | |
| 392 | 7.6 | | | 1 | | | | | 1 | | | | | | | | | | | | |
| 393 | 7.6 | no plants | | | | | | | | | | | | | | | | | | | |
| 394 | 9.2 | | | 1 | | | 1 | | | | | | | 1 | | | | | | | |
| 395 | 10.8 | no plants | | | | | | | | | | | | | | | | | | | |
| 396 | 8.5 | no plants | | | | | | | | | | | | | | | | | | | |
| 397 | 7.2 | no plants | | | | | | | | | | | | | | | | | | | |
| 398 | 8.7 | | | 3 | | | | | | | | | | | | | | | | | |
| 399 | 4.8 | | | 2 | | | 2 | | | | | | | | | | | | | | |
| 400 | 6.2 | | | 1 | | | | | 1 | | | | | | | | | | | | |
| 401 | 14.2 | no plants | | | | | | | | | | | | | | | | | | | |
| 402 | 15.2 | no plants | | | | | | | | | | | | | | | | | | | |
| 403 | 14.8 | no plants | | | | | | | | | | | | | | | | | | | |
| 404 | 10.6 | no plants | | | | | | | | | | | | | | | | | | | |
| 405 | 8.2 | | | 1 | 1 | | | | | | | | | | | | | | | | |
| 406 | 8.3 | | | | | | | | 1 | | | | | | | | | | | | |
| 407 | 8.7 | | | | | | | | 1 | | | | | | | | | | | | |
| 408 | 9.5 | no plants | | | | | | | | | | | | | | | | | | | |
| 409 | 9.5 | no plants | | | | | | | | | | | | | | | | | | | |
| 410 | 9.6 | no plants | | | | | | | | | | | | | | | | | | | |
| 411 | 8.2 | | | 1 | | | | | 1 | | | | | 1 | | | | | | | |
| 412 | 9.1 | no plants | | | | | | | | | | | | | | | | | | | |
| 413 | 9.2 | | | | | | | | 1 | | | | | | | | | | | | |

| sampling point | Depth (ft) | comments | PONA | POPU | PORI | POZO | RAAQ | SAGI | SPPO | STPE | TYLA | UTMI | UTVU | VAAM | WOCO | FIAL | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 368 | 11.5 | no plants | | | | | | | | | | | | | | | | | | | |
| 369 | 11.4 | | | | | | | | | | | | | | | | | | | | |
| 370 | 8.2 | | | | | | | | | | | | | | | | | | | | |
| 371 | | not navigable | | | | | | | | | | | | | | | | | | | |
| 372 | 1.5 | | | | | | | | | v | | | | | | | | | | | |
| 373 | 3.5 | | | | | | | | | | | | | 1 | | | | | | | |
| 374 | 9.1 | | | | | | | | | | | | | | | | | | | | |
| 375 | 7.8 | | | | | | | | | | | | | | | | | | | | |
| 376 | 8.8 | no plants | | | | | | | | | | | | | | | | | | | |
| 377 | 9.6 | | | | | | | | | | | | | | | | | | | | |
| 378 | 8.1 | | | | | | | | | | | | | | | | | | | | |
| 379 | 9.1 | no plants | | | | | | | | | | | | | | | | | | | |
| 380 | 10.9 | no plants | | | | | | | | | | | | | | | | | | | |
| 381 | 3 | | | | | | | | | | | | | 1 | | | | | | | |
| 382 | 1.5 | | | | | v | | | | | | | | v | | | | | | | |
| 383 | 3 | | | | | | | | | | | | | | | 1 | | | | | |
| 384 | 3.1 | | | | | | | | | | | | | 1 | | 3 | | | | | |
| 385 | 1.5 | | | | | | | | | | | | | 1 | | | | | | | |
| 386 | 8.9 | | | | | | | | | | | | | 1 | | | | | | | |
| 387 | 12.7 | no plants | | | | | | | | | | | | | | | | | | | |
| 388 | 13.8 | | | | | | | | | | | | | | | | | | | | |
| 389 | 10.2 | | | | | | | | | | | | | | | | | | | | |
| 390 | 5.3 | | | | | | | | | | | | | | | | | | | | |
| 391 | 3.5 | | | | | | | | | | | | | | | | | | | | |
| 392 | 7.6 | | | 1 | | | | | | | | | | | | | | | | | |
| 393 | 7.6 | no plants | | | | | | | | | | | | | | | | | | | |
| 394 | 9.2 | | | | | v | | | | 1 | | | | | | | | | | | |
| 395 | 10.8 | no plants | | | | | | | | | | | | | | | | | | | |
| 396 | 8.5 | no plants | | | | | | | | | | | | | | | | | | | |
| 397 | 7.2 | no plants | | | | | | | | | | | | | | | | | | | |
| 398 | 8.7 | | | | | | | | | | | | | | | | | | | | |
| 399 | 4.8 | | | | | | | | | | | | | | | | | | | | |
| 400 | 6.2 | | | | | | | | | | | | | 1 | | | | | | | |
| 401 | 14.2 | no plants | | | | | | | | | | | | | | | | | | | |
| 402 | 15.2 | no plants | | | | | | | | | | | | | | | | | | | |
| 403 | 14.8 | no plants | | | | | | | | | | | | | | | | | | | |
| 404 | 10.6 | no plants | | | | | | | | | | | | | | | | | | | |
| 405 | 8.2 | | | | | | | | | | | | | 1 | | | | | | | |
| 406 | 8.3 | | | | | | | | | | | | | | | | | | | | |
| 407 | 8.7 | | | | | | | | | | | | | | | | | | | | |
| 408 | 9.5 | no plants | | | | | | | | | | | | | | | | | | | |
| 409 | 9.5 | no plants | | | | | | | | | | | | | | | | | | | |
| 410 | 9.6 | no plants | | | | | | | | | | | | | | | | | | | |
| 411 | 8.2 | | | | | | | | | | | | | | | | | | | | |
| 412 | 9.1 | no plants | | | | | | | | | | | | | | | | | | | |
| 413 | 9.2 | | | | | | | | | | | | | | | | | | | | |

| sampling point | Depth (ft) | comments | ASIN | CEDE | CHAR | ELAC | ELCA | HEDU | LETR | MEBE | MOSS | MYSI | MYSP | NAFL | NITE | NUVA | NYOD | POAM | POCR | POEP | POFR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 414 | 4.2 | | | | | | 1 | | | | | v | | | | | | | | | |
| 415 | 3.5 | | | | v | | 3 | | | | | | | | | | v | | | | |
| 416 | 6 | | | | | | | | | | | 1 | | 1 | | | | | | | |
| 417 | 14.3 | no plants | | | | | | | | | | | | | | | | | | | |
| 418 | 15.6 | no plants | | | | | | | | | | | | | | | | | | | |
| 419 | 16.7 | no plants | | | | | | | | | | | | | | | | | | | |
| 420 | 15 | no plants | | | | | | | | | | | | | | | | | | | |
| 421 | 12.6 | no plants | | | | | | | | | | | | | | | | | | | |
| 422 | 9.7 | no plants | | | | | | | | | | | | | | | | | | | |
| 423 | 8.5 | | | 1 | | | | | | | | | | | | | | | | | |
| 424 | 9.6 | | | 1 | | | | | | | | | | | | | | | | | |
| 425 | 11 | | | | | | | | 1 | | 1 | | | | | | | | | | |
| 426 | 9.8 | no plants | | | | | | | | | | | | | | | | | | | |
| 427 | 8.6 | | | 1 | | | | | | | | | | | | | | | | | |
| 428 | 8.3 | | | 1 | | | | | | | | | | | | | | | | | |
| 429 | 8.9 | no plants | | | | | | | | | | | | | | | | | | | |
| 430 | 6.2 | | | 1 | | | | | 1 | | | | | | | | | | | | |
| 431 | 4 | | | 1 | | | | | | | | | | | | | | | | | |
| 432 | 2.5 | | | 2 | | | 1 | | | | | | | | | | | | | | 1 |
| 433 | 4 | | | 1 | 1 | | 1 | | | | | | | | | | | | | | |
| 434 | 9 | | | | | | | | 1 | | | 1 | | | | | | | | | |
| 435 | 16.4 | no plants | | | | | | | | | | | | | | | | | | | |
| 436 | 16.8 | no plants | | | | | | | | | | | | | | | | | | | |
| 437 | 15.7 | no plants | | | | | | | | | | | | | | | | | | | |
| 438 | 15.4 | no plants | | | | | | | | | | | | | | | | | | | |
| 439 | 14.4 | no plants | | | | | | | | | | | | | | | | | | | |
| 440 | 11.3 | | | | | | | | | | 1 | | 1 | | | | | | | | |
| 441 | 7.9 | | | 1 | | | | | 1 | | 1 | | | | | | | | | | |
| 442 | 9.1 | | | 1 | | | 1 | | | | 1 | | | | | | | | | | |
| 443 | 8.5 | | | | | | 1 | | 1 | | | 1 | | | | | | | | | |
| 444 | 8.1 | | | 1 | | | | | | | | | | | | | | | | | |
| 445 | 8.3 | | | 1 | | | 1 | | 1 | | | | | 1 | | | | | | | |
| 446 | 2 | | | | 1 | | | | | | | | | | | | | | | | |
| 447 | 1.5 | | v | 1 | | | | | 1 | | | | | | | v | v | | | | |
| 448 | 1.5 | | v | 1 | | | 1 | | 1 | | | 1 | | | | | | | | | 1 |
| 449 | 1.5 | | v | 1 | | | | | 2 | | | 1 | | | | | | | 1 | | v |
| 450 | | not navigable | | | | | | | | | | | | | | | | | | | |
| 451 | | not navigable | | | | | | | | | | | | | | | | | | | |
| 452 | 2 | | | | 1 | | 2 | | | | | | | | | | v | | v | | |
| 453 | 5.4 | | | 1 | | | | | | | | | | | | | | | | | |
| 454 | 6.2 | | | 3 | | | | | | | | | | | | | | | 1 | | |
| 455 | 5.5 | | | 3 | | | | | | | | | | | | | | | | | |
| 456 | 3.6 | | | 1 | | | 1 | | | | | | | | | | | | | | |
| 457 | 7.4 | | | 1 | | | 1 | | | | | | | | | | | | | | |
| 458 | 7.8 | | | 2 | | | 1 | | | | | | | | | | | | 1 | | |
| 459 | 1 | | | 1 | | | 1 | | | | | 1 | | | | | | | | | |

| sampling point | Depth (ft) | comments | PONA | POPU | PORI | POZO | RAAQ | SAGI | SPPO | STPE | TYLA | UTMI | UTVU | VAAM | WOCO | FIAL | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 414 | 4.2 | | | | | | | | | | | | | 1 | | | | | | | |
| 415 | 3.5 | | | | | | | | | | | | | v | | | | | | | |
| 416 | 6 | | | | | | | | | | | | | 1 | | | | | | | |
| 417 | 14.3 | no plants | | | | | | | | | | | | | | | | | | | |
| 418 | 15.6 | no plants | | | | | | | | | | | | | | | | | | | |
| 419 | 16.7 | no plants | | | | | | | | | | | | | | | | | | | |
| 420 | 15 | no plants | | | | | | | | | | | | | | | | | | | |
| 421 | 12.6 | no plants | | | | | | | | | | | | | | | | | | | |
| 422 | 9.7 | no plants | | | | | | | | | | | | | | | | | | | |
| 423 | 8.5 | | | | | | | | | | | | | | | | | | | | |
| 424 | 9.6 | | | | | | | | | | | | | | | | | | | | |
| 425 | 11 | | | | | | | | | | | | | | | | | | | | |
| 426 | 9.8 | no plants | | | | | | | | | | | | | | | | | | | |
| 427 | 8.6 | | | | | | | | | | | | | | | | | | | | |
| 428 | 8.3 | | | | | | | | | | | | | | | | | | | | |
| 429 | 8.9 | no plants | | | | | | | | | | | | | | | | | | | |
| 430 | 6.2 | | | | | | | | | | | | | 1 | | | | | | | |
| 431 | 4 | | | | | | | | | | | | | 1 | | | | | | | |
| 432 | 2.5 | | | | | | | | | | | | | 1 | | | | | | | |
| 433 | 4 | | | 1 | | | | | | | | | | 1 | | | | | | | |
| 434 | 9 | | | | | | | | | | | | | | | | | | | | |
| 435 | 16.4 | no plants | | | | | | | | | | | | | | | | | | | |
| 436 | 16.8 | no plants | | | | | | | | | | | | | | | | | | | |
| 437 | 15.7 | no plants | | | | | | | | | | | | | | | | | | | |
| 438 | 15.4 | no plants | | | | | | | | | | | | | | | | | | | |
| 439 | 14.4 | no plants | | | | | | | | | | | | | | | | | | | |
| 440 | 11.3 | | | | | | | | | | | | | | | | | | | | |
| 441 | 7.9 | | | | | | | | | | | | | | | | | | | | |
| 442 | 9.1 | | | | | | | | | | | | | | | | | | | | |
| 443 | 8.5 | | | | | | | | | | | | | | | | | | | | |
| 444 | 8.1 | | | | | | | | | | | | | | | | | | | | |
| 445 | 8.3 | | | | | | | | | | | | | | | | | | | | |
| 446 | 2 | | | | | | | | | 1 | | | | | | | | | | | |
| 447 | 1.5 | | | | | | | | | | v | | | | | v | | | | | |
| 448 | 1.5 | | | | | | | | | | v | | | | | | | | | | |
| 449 | 1.5 | | | | | | | | | | v | | | | | 1 | | | | | |
| 450 | | not navigable | | | | | | | | | | | | | | | | | | | |
| 451 | | not navigable | | | | | | | | | | | | | | | | | | | |
| 452 | 2 | | | v | | | | | | | | | | 1 | | | | | | | |
| 453 | 5.4 | | | | | 3 | | | | | | | | 1 | | | | | | | |
| 454 | 6.2 | | | v | | | | | | | | | | v | | | | | | | |
| 455 | 5.5 | | | | | | | | | | | | | | | | | | | | |
| 456 | 3.6 | | | 1 | | | | | | | | | | 1 | | | | | | | |
| 457 | 7.4 | | | 1 | | | | | | | | | | | | | | | | | |
| 458 | 7.8 | | | | | | | | | | | | | | | | | | | | |
| 459 | 1 | | | | | | | | | | | | | 1 | | | | | | | |

| sampling point | Depth (ft) | comments | ASIN | CEDE | CHAR | ELAC | ELCA | HEDU | LETR | MEBE | MOSS | MYSI | MYSP | NAFL | NITE | NUVA | NYOD | POAM | POCR | POEP | POFR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 460 | 9.1 | | | | | | 1 | | | | | | | | | | | | | | |
| 461 | 7.8 | no plants | | | | | | | | | | | | | | | | | | | |
| 462 | 9 | no plants | | | | | | | | | | | | | | | | | | | |
| 463 | 16.1 | no plants | | | | | | | | | | | | | | | | | | | |
| 464 | 16.1 | no plants | | | | | | | | | | | | | | | | | | | |
| 465 | 15.4 | no plants | | | | | | | | | | | | | | | | | | | |
| 466 | 14.6 | no plants | | | | | | | | | | | | | | | | | | | |
| 467 | 11.6 | no plants | | | | | | | | | | | | | | | | | | | |
| 468 | 10.1 | | | 1 | | | | | | | | | | | | | | | | | |
| 469 | 8.1 | | | | | | | | | | | | | | | | | | | | |
| 470 | 8.5 | | | 1 | | | | | | | | 1 | | | | | | | | | |
| 471 | 7.2 | | | 1 | | | 1 | | 1 | | 1 | | | | | | | | 1 | | |
| 472 | 6.8 | | | | | | | | | | | | | | | | | | | | |
| 473 | | not navigable | | | | | | | | | | | | | | | | | | | |
| 474 | | not navigable | | | | | | | | | | | | | | | | | | | |
| 475 | 7.4 | | | 1 | | | 1 | | | | | | | | | | | | | | |
| 476 | 7.8 | | | 1 | | | 1 | | | | | | | 1 | | | | | | | |
| 477 | 7.7 | | | | | | 1 | | | | | | | | | | | | | | |
| 478 | 7.9 | | | | | | | | 1 | | | | | | | | | | | | |
| 479 | 7.8 | | | | | | | | | | | | | | | | | | | | |
| 480 | 8.2 | no plants | | | | | | | | | | | | | | | | | | | |
| 481 | 7 | | | 3 | | | 2 | | | | | | | | | | | | | | |
| 482 | 11.1 | | | | | | | | | | 1 | | | | | | | | | | |
| 483 | 11.5 | no plants | | | | | | | | | | | | | | | | | | | |
| 484 | 11.5 | no plants | | | | | | | | | | | | | | | | | | | |
| 485 | 14 | no plants | | | | | | | | | | | | | | | | | | | |
| 486 | 16.3 | no plants | | | | | | | | | | | | | | | | | | | |
| 487 | 15.7 | no plants | | | | | | | | | | | | | | | | | | | |
| 488 | 15.2 | no plants | | | | | | | | | | | | | | | | | | | |
| 489 | 12.4 | no plants | | | | | | | | | | | | | | | | | | | |
| 490 | 8.6 | | | | | | | | | | | | | | | | | | | | |
| 491 | 2.9 | | | 1 | | | 1 | | | | | | | | | | | | | | |
| 492 | 7.1 | | | | | | | | | | | | | | | | | | | | |
| 493 | 9.3 | | | | | | 1 | | | | | | | | | | | | | | |
| 494 | 11.6 | no plants | | | | | | | | | | | | | | | | | | | |
| 495 | 10.2 | | | | | | 1 | | | | | | | | | | | | | | |
| 496 | 8.1 | | | 1 | | | 1 | | 1 | | 1 | | | | | | | | 1 | | |
| 497 | 7.6 | | | 1 | | | 1 | | | | | | | | | | | | | | |
| 498 | 3.3 | | | 1 | | | | | | | | | | | | | | | | | 1 |
| 499 | 11.2 | no plants | | | | | | | | | | | | | | | | | | | |
| 500 | 12.9 | no plants | | | | | | | | | | | | | | | | | | | |
| 501 | 12.3 | no plants | | | | | | | | | | | | | | | | | | | |
| 502 | 9.4 | | | | | | | | | | | | | | | | | | | | |
| 503 | 8.6 | | | | | | | | | | | | | 1 | | | | | | | |
| 504 | 11.9 | no plants | | | | | | | | | | | | | | | | | | | |
| 505 | 15.8 | no plants | | | | | | | | | | | | | | | | | | | |

| sampling point | Depth (ft) | comments | PONA | POPU | PORI | POZO | RAAQ | SAGI | SPPO | STPE | TYLA | UTMI | UTVU | VAAM | WOCO | FIAL | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 460 | 9.1 | | | | | | | | | | | | | | | | | | | | |
| 461 | 7.8 | no plants | | | | | | | | | | | | | | | | | | | |
| 462 | 9 | no plants | | | | | | | | | | | | | | | | | | | |
| 463 | 16.1 | no plants | | | | | | | | | | | | | | | | | | | |
| 464 | 16.1 | no plants | | | | | | | | | | | | | | | | | | | |
| 465 | 15.4 | no plants | | | | | | | | | | | | | | | | | | | |
| 466 | 14.6 | no plants | | | | | | | | | | | | | | | | | | | |
| 467 | 11.6 | no plants | | | | | | | | | | | | | | | | | | | |
| 468 | 10.1 | | | | | | | | | | | | | | | | | | | | |
| 469 | 8.1 | | | | | | | | | | | | | 1 | | | | | | | |
| 470 | 8.5 | | | | | | | | | | | | | | | | | | | | |
| 471 | 7.2 | | | | 1 | | | | | | | | | | | | | | | | |
| 472 | 6.8 | | | | | | | | | | | | | 2 | | | | | | | |
| 473 | | not navigable | | | | | | | | | | | | | | | | | | | |
| 474 | | not navigable | | | | | | | | | | | | | | | | | | | |
| 475 | 7.4 | | | | | | | | | | | | | | | | | | | | |
| 476 | 7.8 | | | | | | | | | | | | | | | | | | | | |
| 477 | 7.7 | | | | | | | | | | | | | | | | | | | | |
| 478 | 7.9 | | | | | | | | | | | | | | | 1 | | | | | |
| 479 | 7.8 | | | | | | | | | | | | | | | 1 | | | | | |
| 480 | 8.2 | no plants | | | | | | | | | | | | | | | | | | | |
| 481 | 7 | | | | | | | | | | | | | | | | | | | | |
| 482 | 11.1 | | | | | | | | | | | | | | | | | | | | |
| 483 | 11.5 | no plants | | | | | | | | | | | | | | | | | | | |
| 484 | 11.5 | no plants | | | | | | | | | | | | | | | | | | | |
| 485 | 14 | no plants | | | | | | | | | | | | | | | | | | | |
| 486 | 16.3 | no plants | | | | | | | | | | | | | | | | | | | |
| 487 | 15.7 | no plants | | | | | | | | | | | | | | | | | | | |
| 488 | 15.2 | no plants | | | | | | | | | | | | | | | | | | | |
| 489 | 12.4 | no plants | | | | | | | | | | | | | | | | | | | |
| 490 | 8.6 | | | 1 | | | | | | | | | | 1 | | | | | | | |
| 491 | 2.9 | | | | | | | | | | | | | 1 | | | | | | | |
| 492 | 7.1 | | | | | | | | | | | | | | | | | | | | |
| 493 | 9.3 | | | | | | | | | | | | | | | | | | | | |
| 494 | 11.6 | no plants | | | | | | | | | | | | | | | | | | | |
| 495 | 10.2 | | | | | | | | | | | | | | | | | | | | |
| 496 | 8.1 | | | | | | | | | | | | | | | | | | | | |
| 497 | 7.6 | | | | | | | | | | | | | | | | | | | | |
| 498 | 3.3 | | | | | | | | | | | | | | | | | | | | |
| 499 | 11.2 | no plants | | | | | | | | | | | | | | | | | | | |
| 500 | 12.9 | no plants | | | | | | | | | | | | | | | | | | | |
| 501 | 12.3 | no plants | | | | | | | | | | | | | | | | | | | |
| 502 | 9.4 | | | | | | | | | | | | | 1 | | | | | | | |
| 503 | 8.6 | | | | | | | | | | | | | 1 | | | | | | | |
| 504 | 11.9 | no plants | | | | | | | | | | | | | | | | | | | |
| 505 | 15.8 | no plants | | | | | | | | | | | | | | | | | | | |

| sampling point | Depth (ft) | comments | ASIN | CEDE | CHAR | ELAC | ELCA | HEDU | LETR | MEBE | MOSS | MYSI | MYSP | NAFL | NITE | NUVA | NYOD | POAM | POCR | POEP | POFR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 506 | 16.4 | no plants | | | | | | | | | | | | | | | | | | | |
| 507 | 16.7 | no plants | | | | | | | | | | | | | | | | | | | |
| 508 | 11.9 | no plants | | | | | | | | | | | | | | | | | | | |
| 509 | 1.5 | | | | | | 1 | | | | | 1 | | 1 | | | | | | | |
| 510 | 2.4 | | | | | | 1 | | | | | | | | | | | | | | |
| 511 | 6.8 | | | 1 | | | | | | | | | | | | | | | | | 1 |
| 512 | 12.3 | | | | | | 1 | | | | | | | | | | | | | | |
| 513 | 13.1 | | | 1 | | | | | | | | | | | | | | | | | |
| 514 | 11.5 | | | | | | 1 | | | | | | | | | | | | | | |
| 515 | 9.7 | | | | | | 1 | | | | | | | | | | | | | | |
| 516 | 7.2 | | | | | | | | | | | | | | | | | | | | |
| 517 | 8.2 | | | 1 | | | 1 | | | | 1 | | | | | | | | | | |
| 518 | 8.4 | | | 1 | | | 1 | | 1 | | | | | | | | | | | | |
| 519 | 9.6 | no plants | | | | | | | | | | | | | | | | | | | |
| 520 | 12.5 | no plants | | | | | | | | | | | | | | | | | | | |
| 521 | 11.2 | no plants | | | | | | | | | | | | | | | | | | | |
| 522 | 11.9 | no plants | | | | | | | | | | | | | | | | | | | |
| 523 | 15 | no plants | | | | | | | | | | | | | | | | | | | |
| 524 | 15.4 | no plants | | | | | | | | | | | | | | | | | | | |
| 525 | 16.1 | no plants | | | | | | | | | | | | | | | | | | | |
| 526 | 15.9 | no plants | | | | | | | | | | | | | | | | | | | |
| 527 | 14.5 | no plants | | | | | | | | | | | | | | | | | | | |
| 528 | 10.5 | no plants | | | | | | | | | | | | | | | | | | | |
| 529 | 7 | | | 1 | | | | | | | | | | | | | | | | | |
| 530 | 9.8 | | | 1 | | | | | | | | | | | | | | | | | |
| 531 | 13.1 | no plants | | | | | | | | | | | | | | | | | | | |
| 532 | 13.1 | | | | | | 1 | | | | | | | | | | | | 1 | | |
| 533 | 7 | | | 2 | 1 | | | | | | | | | | | | | | 1 | | |
| 534 | 5 | | | v | | | | | | | | | | | | v | | | | | |
| 535 | 7.7 | | | 3 | | | 1 | | | | | | | | | | | | 1 | | |
| 536 | 8.5 | | | | | | | | | | | | | 1 | | | | | | | |
| 537 | 9.5 | | | 1 | | | 1 | | 1 | | | | | | | | | | | | |
| 538 | 12.8 | no plants | | | | | | | | | | | | | | | | | | | |
| 539 | 14.2 | no plants | | | | | | | | | | | | | | | | | | | |
| 540 | 14.8 | no plants | | | | | | | | | | | | | | | | | | | |
| 541 | 13.4 | no plants | | | | | | | | | | | | | | | | | | | |
| 542 | 12.4 | no plants | | | | | | | | | | | | | | | | | | | |
| 543 | 13.8 | no plants | | | | | | | | | | | | | | | | | | | |
| 544 | 12.9 | no plants | | | | | | | | | | | | | | | | | | | |
| 545 | 10.6 | no plants | | | | | | | | | | | | | | | | | | | |
| 546 | 5.5 | | | 1 | | | 1 | | | | | | | | | | | | | | |
| 547 | 7.3 | | | 1 | | | 1 | | | | | | | | | | | | | | |
| 548 | 6.7 | | | 1 | | | 1 | | | | | | | | | | | | | | |
| 549 | 3.3 | | | 1 | 1 | | | | | | | 1 | | | | v | | | | | |
| 550 | 8.3 | | | 1 | | | 1 | | | | | | | | | | | | 1 | | |
| 551 | 8.6 | | | | | | 1 | | | | | | | | | | | | | | |

| sampling point | Depth (ft) | comments | PONA | POPU | PORI | POZO | RAAQ | SAGI | SPPO | STPE | TYLA | UTMI | UTVU | VAAM | WOCO | FIAL | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 506 | 16.4 | no plants | | | | | | | | | | | | | | | | | | | |
| 507 | 16.7 | no plants | | | | | | | | | | | | | | | | | | | |
| 508 | 11.9 | no plants | | | | | | | | | | | | | | | | | | | |
| 509 | 1.5 | | | 1 | | | | | | | | | | 1 | | 1 | | | | | |
| 510 | 2.4 | | | | | | | | | | | | | 1 | | 1 | | | | | |
| 511 | 6.8 | | | | | | | | | | | | | | | | | | | | |
| 512 | 12.3 | | | | | | | | | | | | | | | | | | | | |
| 513 | 13.1 | | | | | | | | | | | | | | | | | | | | |
| 514 | 11.5 | | | | | | | | | | | | | | | | | | | | |
| 515 | 9.7 | | | 1 | | | | | | | | | | | | | | | | | |
| 516 | 7.2 | | | 1 | | | | | | | | | | | | | | | | | |
| 517 | 8.2 | | | | | | | | | | | | | | | 1 | | | | | |
| 518 | 8.4 | | | | | | | | | | | | | 2 | | | | | | | |
| 519 | 9.6 | no plants | | | | | | | | | | | | | | | | | | | |
| 520 | 12.5 | no plants | | | | | | | | | | | | | | | | | | | |
| 521 | 11.2 | no plants | | | | | | | | | | | | | | | | | | | |
| 522 | 11.9 | no plants | | | | | | | | | | | | | | | | | | | |
| 523 | 15 | no plants | | | | | | | | | | | | | | | | | | | |
| 524 | 15.4 | no plants | | | | | | | | | | | | | | | | | | | |
| 525 | 16.1 | no plants | | | | | | | | | | | | | | | | | | | |
| 526 | 15.9 | no plants | | | | | | | | | | | | | | | | | | | |
| 527 | 14.5 | no plants | | | | | | | | | | | | | | | | | | | |
| 528 | 10.5 | no plants | | | | | | | | | | | | | | | | | | | |
| 529 | 7 | | | | | | | | | | | | | | | 1 | | | | | |
| 530 | 9.8 | | | | | | | | | | | | | | | | | | | | |
| 531 | 13.1 | no plants | | | | | | | | | | | | | | | | | | | |
| 532 | 13.1 | | | | | | | | | | | | | | | | | | | | |
| 533 | 7 | | | | | | | | | | | | | | | | | | | | |
| 534 | 5 | | | | | | | | | | | | | 1 | | 1 | | | | | |
| 535 | 7.7 | | | | | | | | | | | | | | | | | | | | |
| 536 | 8.5 | | | | | | | | | | | | | | | | | | | | |
| 537 | 9.5 | | | | | | | | | | | | | | | | | | | | |
| 538 | 12.8 | no plants | | | | | | | | | | | | | | | | | | | |
| 539 | 14.2 | no plants | | | | | | | | | | | | | | | | | | | |
| 540 | 14.8 | no plants | | | | | | | | | | | | | | | | | | | |
| 541 | 13.4 | no plants | | | | | | | | | | | | | | | | | | | |
| 542 | 12.4 | no plants | | | | | | | | | | | | | | | | | | | |
| 543 | 13.8 | no plants | | | | | | | | | | | | | | | | | | | |
| 544 | 12.9 | no plants | | | | | | | | | | | | | | | | | | | |
| 545 | 10.6 | no plants | | | | | | | | | | | | | | | | | | | |
| 546 | 5.5 | | | | | | | | | | | | | 2 | | | | | | | |
| 547 | 7.3 | | | | | | | | | | | | | | | | | | | | |
| 548 | 6.7 | | | | | | | | | | | | | | | | | | | | |
| 549 | 3.3 | | | 1 | | | | | | | | | | 1 | | | | | | | |
| 550 | 8.3 | | | | | | | | | | | | | | | | | | | | |
| 551 | 8.6 | | | | | | | | | | | | | | | 1 | | | | | |

| sampling point | Depth (ft) | comments | ASIN | CEDE | CHAR | ELAC | ELCA | HEDU | LETR | MEBE | MOSS | MYSI | MYSP | NAFL | NITE | NUVA | NYOD | POAM | POCR | POEP | POFR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 552 | 10.3 | no plants | | | | | | | | | | | | | | | | | | | |
| 553 | 11.8 | no plants | | | | | | | | | | | | | | | | | | | |
| 554 | 15.9 | no plants | | | | | | | | | | | | | | | | | | | |
| 555 | 14 | no plants | | | | | | | | | | | | | | | | | | | |
| 556 | 10.8 | no plants | | | | | | | | | | | | | | | | | | | |
| 557 | 7.2 | | | 2 | | | | | | | | | | | | | | | | | |
| 558 | 7.7 | | | 3 | | | | | | | | | | | | | | | 1 | | |
| 559 | 8 | | | | | | | | | | | | | | | | | | | | |
| 560 | 8.7 | no plants | | | | | | | | | | | | | | | | | | | |
| 561 | 11 | no plants | | | | | | | | | | | | | | | | | | | |
| 562 | 12.8 | no plants | | | | | | | | | | | | | | | | | | | |
| 563 | 11.3 | no plants | | | | | | | | | | | | | | | | | | | |
| 564 | 5.8 | | | | | | | | 1 | | | | | | | | | | | | |
| 565 | 4 | | | | | | | | | | | | | 1 | | | | | | | |
| 566 | 7.7 | no plants | | | | | | | | | | | | | | | | | | | |
| 567 | 8 | | | | 1 | | 1 | | | | | | | | | | | | | | |
| 568 | 7.5 | | | 2 | | | | | | | | | | | | | | | | | |
| 569 | 6.2 | | | | | | | | | | | | | | | | | | | | |
| 570 | 8.3 | no plants | | | | | | | | | | | | | | | | | | | |
| 571 | 8.4 | no plants | | | | | | | | | | | | | | | | | | | |
| 572 | 8.7 | | | 1 | | | | | | | | | | | | | | | | | |
| 573 | 7.2 | | | 3 | | | | | | | | | | | | | | | | | |
| 574 | 7.1 | | | 1 | | | 1 | | | | | | | | | | | | | | |
| 575 | 5.1 | | | 1 | | | 1 | | | | | | | | | | | | | | |
| 576 | 4.5 | | | 3 | | | | | | | | | | | | | | | | | |
| 577 | 3.5 | | | 2 | 1 | | 2 | | | | | | | | | | | | | | |

| sampling point | Depth (ft) | comments | PONA | POPU | PORI | POZO | RAAQ | SAGI | SPPO | STPE | TYLA | UTMI | UTVU | VAAM | WOCO | FIAL | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 552 | 10.3 | no plants | | | | | | | | | | | | | | | | | | | |
| 553 | 11.8 | no plants | | | | | | | | | | | | | | | | | | | |
| 554 | 15.9 | no plants | | | | | | | | | | | | | | | | | | | |
| 555 | 14 | no plants | | | | | | | | | | | | | | | | | | | |
| 556 | 10.8 | no plants | | | | | | | | | | | | | | | | | | | |
| 557 | 7.2 | | | | | | | | | | | | | | | | | | | | |
| 558 | 7.7 | | | | | | | | | | | | | | | | | | 1 | | |
| 559 | 8 | | | | | | | | | | | | | | | 1 | | | | | |
| 560 | 8.7 | no plants | | | | | | | | | | | | | | | | | | | |
| 561 | 11 | no plants | | | | | | | | | | | | | | | | | | | |
| 562 | 12.8 | no plants | | | | | | | | | | | | | | | | | | | |
| 563 | 11.3 | no plants | | | | | | | | | | | | | | | | | | | |
| 564 | 5.8 | | | | | | | | | | | | | 2 | | | | | | | |
| 565 | 4 | | | 1 | | | | | | | | | | 2 | | | | | | | |
| 566 | 7.7 | no plants | | | | | | | | | | | | | | | | | | | |
| 567 | 8 | | | | | | | | | | | | | | | | | | | | |
| 568 | 7.5 | | | | | | | | | | | | | | | | | | | | |
| 569 | 6.2 | | | | | | | | | | | | | 1 | | 1 | | | | | |
| 570 | 8.3 | no plants | | | | | | | | | | | | | | | | | | | |
| 571 | 8.4 | no plants | | | | | | | | | | | | | | | | | | | |
| 572 | 8.7 | | | | | | | | | | | | | | | | | | | | |
| 573 | 7.2 | | | | | | | | | | | | | 1 | | | | | | | |
| 574 | 7.1 | | | | | | | | | | | | | | | | | | | | |
| 575 | 5.1 | | | | | | | | | | | | | 1 | | | | | | | |
| 576 | 4.5 | | | | | | | | | | | | | 1 | | | | | | | |
| 577 | 3.5 | | | | | v | | | | | | | | 1 | | | | | | | |

# Appendix E

- The Importance of Aquatic Plants

# The Importance of Aquatic Plants

Plant information was gathered from Borman et al. (1997), Eggers and Reed (1997), Fasset (1940), Fink (1994), Nichols and Vennie (1991), and Whitley et al. (1999).

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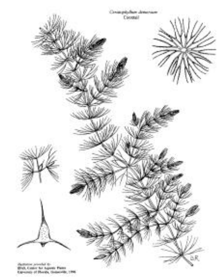
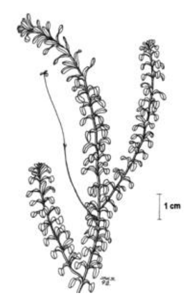
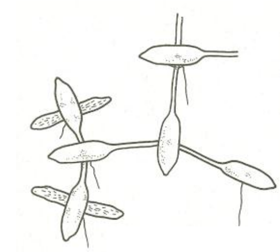


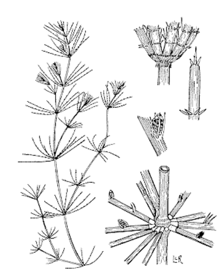
**Coontail** *(Ceratophyllum demersum)* produces whorls of narrow, toothed leaves on a long trailing stem that often resembles the tail of a raccoon. The leaves tend to be more crowded toward the tip. Coontail blankets the bottom, which helps to stabilize bottom sediments. Tolerant to nutrient rich environments, coontail filters a high amount of phosphorus out of the water column. Coontail provides a home for invertebrates and juvenile fish. Seeds are consumed by waterfowl, but are not of high preference.




**Elodea** (*Elodea canadensis*) or **common waterweed** is made up of slender stems with small, lance-shaped leaves that attach directly to the stem. Leaves are found in whorls of two or three and are more crowded toward the stem tip. The branching stems of elodea provide valuable cover for fish and are home for many insects that fish feed upon. Elodea also provides food for muskrats and waterfowl.

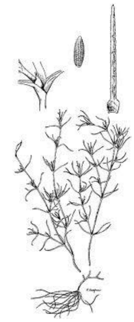


**Star Duckweed** (*Lemna trisulca*) individuals are called fronds. Each frond consists of a small, green, floating body with a single root that extends into the water from the undersurface, but is not rooted to the soil. Star duckweed can grow rapidly, reproducing not by seeds, but by simple division of a frond to produce new "daughter" fronds. The developing daughter fronds remain attached to the "mother" frond for a short time as shown above, but eventually break apart. Star duckweed is a good food sources for waterfowl. Large amounts of star duckweed can provide cover and habitat for fish and invertebrates.



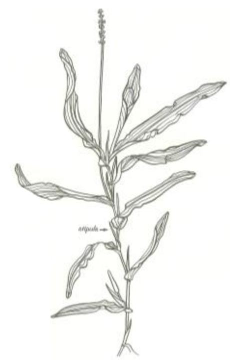
**Muskgrass** (*Chara* spp.) is a complex algae that resemble higher plants. Muskgrass is identified by its pungent, skunk-like odor with whorls of branched leaves. Ecologically, musk grass provides shelter for juvenile fish and is associated with black crappie spawning sites. Waterfowl love to feast on musk grass when the plant bears its seed-like oogonia. This species serves an important role in stabilizing bottom sediments, tying up nutrients in the water column, and maintaining water clarity.

**Bushy pondweed** (*Najas flexilis*) also known as **slender naiad** has a finely branched stem that grows from a rootstock. Leaves are short (1-4 cm), pointed and grow in pairs. Bushy pondweed is an annual and must grow from seed each year. It tends to establish well in disturbed areas. Bushy pondweed is a one of waterfowl's favorite foods and considered very important. Waterfowl, marsh birds, and muskrats relish seeds, leaves and stems. Bushy pondweed stabilizes bottom sediment and offers cover for fish.



**Sago Pondweed** (*Potamogeton pectinatus*) is a perennial herb that emerges from a slender rhizome that contains many starchy tubers. Leaves are sharp, thin, and resemble a pine needle. Reddish nutlets (seeds) that resemble beads on a string rise to the water surface in mid-summer. Sago pondweed produces a large crop of seeds and tubers that are valued by waterfowl. Juvenile fish and invertebrates utilize sago pondweed for cover.

Although **native pondweeds** (*Potamogeton spp.*) may vary in appearance, there are a number of key features members of this genus have in common. Pondweed leaves are alternate with a noticeable midvein. The nutlets, leaves, and stipules of a particular species can often be used to reliably identify it. The pondweeds grow in a wide range of aquatic habitats. They all emerge from rhizomes, which help the plants overwinter. The pondweeds are a valuable food source for waterfowl and a number of mammals. They also provide a home for fish and invertebrates.



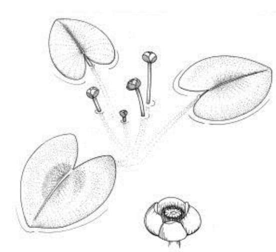
**Flat-stem Pondweed** (*Potamogeton zosteriformis*) emerges from a rhizome, which has strongly flattened stems. The leaves are narrow and grow 4-8 inches long. Leaves contain a prominent mid-vein and many fine parallel veins. Ecologically, flat-stem pondweed provides a home for fish and invertebrates, and is grazed by waterfowl and muskrats.


**Small pondweed** (*Potamogeton pusillus*) and **Frie's pondweed** (*Potamogeton friesii*) have long with has slender stems which emerge form slight rhizomes that branch repeatedly. Submersed leaves are linear and attach directly to the stem. These species can be a valuable food source for waterfowl and a number of mammals. They can also provide a home for fish and invertebrates.

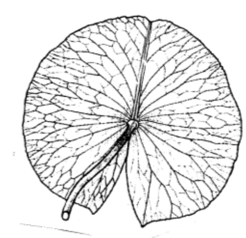
**Large-Leaf Pondweed** (*Potamogeton amplifolius*) also referred to by fisherman as **cabbage weed**, is a perennial herb that emerges from a ridged black rhizome. This pondweed is the largest of all pondweeds. The sturdy stem supports large broad leaves that are numerously veined (25-37). Growing upright throughout most of the water column, large-leaf pondweed provides excellent shade, shelter, and foraging habitat for fish. Producing a large number of nutlets, cabbage weed is also valued by waterfowl.


**Floating Leaf Pondweed** (*Potamogeton natans*) is a perennial that emerges from a red-spotted rhizome. Leaves that rest at the waters surface are heart shaped. Submerged leaves tend to be longer and skinnier than floating leaves. Fish find this pondweed to be useful for foraging opportunities and shelter. Growing upright in the water column, floating leaf pondweed attracts many aquatic invertebrates. Muskrats, ducks, and geese all graze on the plant.

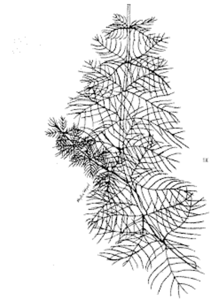

**Spatterdock** (*Nuphar variegata*) is a perennial herb that produces yellow, rounded flowers. Large (4-10 inches) long, heart-shaped leaves float at the waters surface. Leaf stalks have flattened wings and emerge from a buried spongy rhizome. With large buried rhizomes, spatterdock helps stabilize bottom sediment. The large leaves also help buffer the impact of wave action on the shoreline. Like lilies, spatterdock offers excellent fish habitat. Seeds are eaten by waterfowl; leaves, rhizomes, and flowers are relished by muskrats, beaver, and deer.



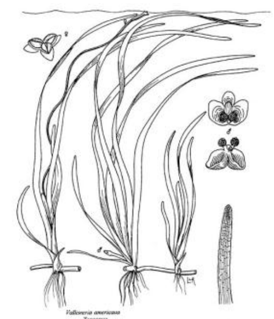
**White Water Lily** (*Nymphaea odorata*) emerges from a buried rhizome. Durable round stalks grow up from the rhizome. This perennial herb supports large round leaves (4-10 inches) wide that float at the water's surface. Leaves appear waxy green on top and reddish-purple on their undersides. At mid-summer showy white flowers float at the waters surface. Lilies serve as important fish cover, especially for largemouth bass. White water lily seeds are eaten by waterfowl. Rhizomes, flowers, and leaves are consumed by muskrats, beaver, and deer. With large broad leaves, lilies also help prevent shoreline erosion by slowing wave action.



**Northern Watermilfoil** (*Myriophyllum sibiricum*) produces whorls of feather-like leaflets from a fairly stout stem. Northern watermilfoil is identified by its 5 to 12 pairs of leaflets that become progressively longer near the base of the leaf – giving the leaf a candelabra-like appearance. The leaves and fruit of this plant are eaten by a variety of waterfowl. Its finely divided leaves are habitat for numerous invertebrates that fish feed upon. Northern watermilfoil is an indicator of good water quality, as the plant seldom survives in more eutrophic environments.



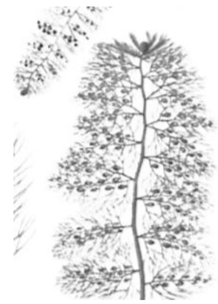
**Wild Celery** (*Vallisneria americana*) also known as **eelgrass** has long ribbon-like leaves that emerge in clusters. Leaves have a prominent central stripe and leaf tips tend to float gracefully at the water's surface. In the fall, a vegetative portion of the rhizome will break free and float to other locations. Wild celery is considered one of the best all natural waterfowl foods. The entire plant is relished by waterfowl, especially canvasbacks. Eelgrass beds serve as an important food source for sea ducks, marsh birds, and shore birds. Fish also find wild celery to be a popular hiding spot.



**Water Stargrass** (*Heteranthera dubia*) resembles some of the narrow-leaved pondweeds. It is dark green to brown with thread-like leaves scattered on flexible stems. A close examination of the leaves will show that they have several veins but no obvious midvein. It reproduces from plant fragments. Water stargrass usually becomes abundant in late summer. It settles to the bottom in late autumn where it forms a decaying mat in the winter that provides habitat to many small aquatic animals. Water stargrass provides valuable habitat for fish and serves as a source of macroinvertebrates for fish.

**White Water Crowfoot** (*Ranunculus aquatilis*) produces white flowers with 5 petals that emerge above the water's surface. Leaves are finely cut into thread-like divisions and are in an alternate arrangement along the stem. White water crowfoot is not tolerant to pollution and considered an indicator of good water quality. Waterfowl graze on both fruit and plant foliage. Crowfoot provides habitat for invertebrates, which in turn are fed upon by fish.

**Common Bladderwort** (*Utricularia vulgaris*) and **Small Bladderwort** (*Utricularia minor*) are carnivorous plants that can supplement their diet with insects or other small organisms. Bladderworts do not root to the sediment. Usually, most of the plants hang in the water near the bottom. Bladderworts have finely divided leaves. Scattered on these leaves are bladders that trap prey. When prey touches trigger hairs, the bladder expands, sucking in the animal. It is then dissolved within the bladder. Bladderwort stems provide cover for fish. This is particularly important in areas not readily colonized by rooted plants.

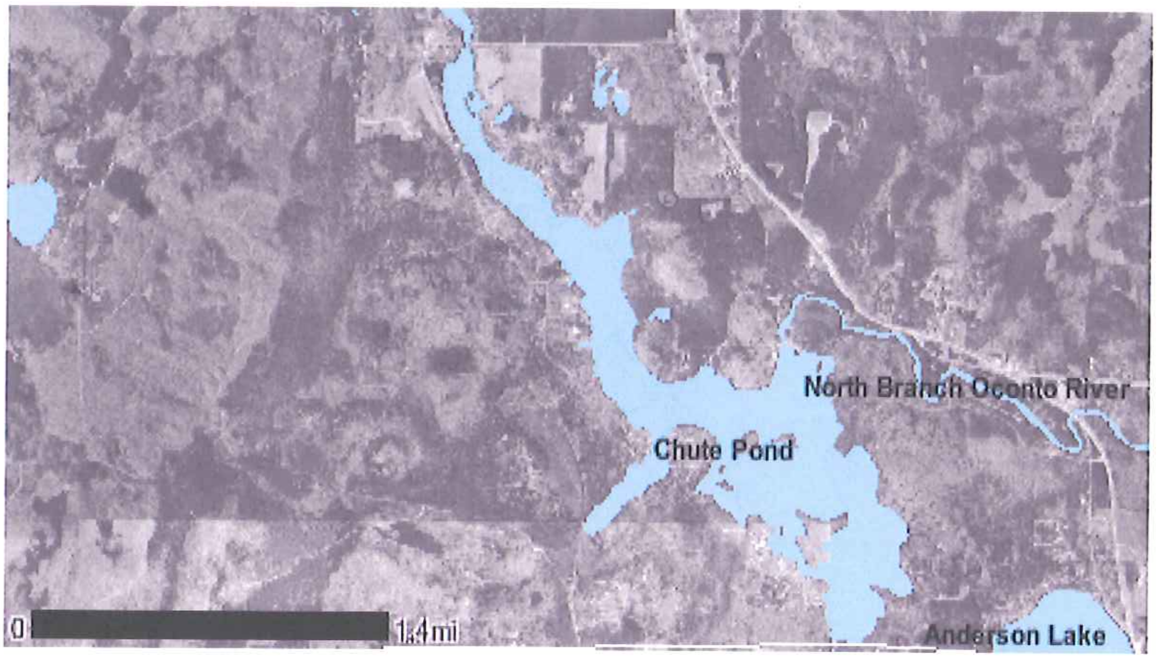


# Appendix F

- **Comprehensive Fisheries Survey of Chute Pond, Oconto County, Wisconsin, during 2002**

# Comprehensive Fisheries Survey of Chute Pond, Oconto County, Wisconsin, during 2002

Waterbody Identification Code 462520




Lee Meyers
Fisheries Biologist
Wisconsin Department of Natural Resources
Green Bay
January 2007

# Fisheries Survey of Christie Lake, Oconto County, Wisconsin during 2005

**Report Approval signatures**

1/09/07
Lee Meyers, Fisheries Biologist, Date

1/11/07
Michael Donofrio, Fisheries Supervisor, Date

1-12-07
George Boronow, Regional Fisheries Supervisor, Date

Steve Hewett, FM Bureau Section Chief, Date

**Comprehensive Fisheries Survey of Chute Pond, Oconto County, Wisconsin During 2002**

Lee Meyers
Fisheries Biologist
December 2006

Executive Summary

A comprehensive fisheries survey of Chute Pond was conducted during the 2002 field season. The dominant game fish species in the lake are largemouth bass (population estimate = 380), northern pike (population estimate = 1,419 ) with a few muskellunge present. Bluegill, black crappie and yellow perch are the most abundant panfish species. I recommend managing Chute Pond for largemouth bass, northern pike and panfish.

Lake and Location:
Chute Pond, Oconto County, T31N R16E Sec 25
Located in north central Oconto County in the Township of Mountain.

Physical / Chemical attributes (Carlson, Andrews and Threinen, 1977 ):
**Mophometry:** 417 acres, maximum depth 18 feet, shoreline 9.9 miles.
**Lake type:** drainage
**Watershed:** 198 square miles with 10 acres of wetland adjoining the flowage
**Basic Water Chemistry**: Hard water impoundment having slightly alkaline, light brown water of medium transparency. Secchi disk reading 7.8 feet, PH 7.9, 100 MPA
**Trophic Status:** Mesotrophic (moderate fertility)
**Littoral Substrate:** 48% muck, 40% sand, 5% gravel, 5% rubble, and 2% boulder.
**Aquatic Vegetation:** A diverse aquatic plant population is present throughout the lake that has caused nuisance conditions. Mechanical vegetation removal occurs.
**Other Features:** The lake is formed by an impoundment on the North Branch of the Oconto River.

Purpose of Survey: Assess the fishery status

Dates of fieldwork:
Fyke netting (all species and ages) – April 18 - 26, 2002
Electroshocking – October 1 and 14, 2002

## BACKGROUND

Chute Pond has a well developed shoreline with about 200 dwellings and a county park with good boat landing access and camping facilities on the north shoreline that is maintained by Oconto County. About 30 percent of the 10-mile shoreline is in public ownership by Chequanegon-Nicolet National Forest and Oconto County. A major portion of the shoreline is managed by Oconto County which operates a 100 site campground, picnic area, public swim beach and the dam. A surface discharge dam, operated by Oconto County was built in 1937, maintains a 13 foot head during the summer months and is drawn down about one foot during the winter months to relieve pressure on the dam. Extensive aquatic macrophyte harvesting has been carried out for about 20 years on Chute Pond by the Chute Pond Rehabilitation Association and has improved mobility for boat traffic and increased "edge" habitat for predator fish species. The number of people recreating on Chute Pond has increased over the years and it is a multiple use lake with anglers, water skiers and personal watercraft. A motor boat slow-no-wake (6PM-10AM) ordinance was established in 1997.

Previous fisheries surveys were conducted on Chute Pond in 1970, 1972, 1977, and 1986. For this report, comparisons have been made only to the information collected from the 1986 survey (Heizer, 1987). Previous surveys showed the fishery to consist of largemouth bass, northern pike, walleye, muskellunge, bluegill, black crappie, and yellow perch, along with several forage fish species. Although several walleye stocking introductions occurred in the past, a walleye population never developed as indicated by fish surveys in the 1970's and the 1986 survey.

In 1938 muskellunge fry and fingerling were stocked for the first time. Between 1939 and 1953 muskellunge, yellow perch, largemouth bass, and northern pike were periodically planted. From 1954 to 1966 yearly stocking of muskellunge fingerlings occurred. Between 1968 and 1974 alternate year stocking of walleye and muskellunge fingerlings took place. Chute pond was last stocked with walleye in 1976 and muskellunge in 2003 (Table 1).

Table1. *DNR funded fish stocking 1972 through 2005 in Chute Pond, Oconto County, Wisconsin.*

| Year | Species | Size (average) | Number |
|---|---|---|---|
| 1972 | Walleye | Fingerling (3 inches) | 9,000 |
| 1973 | Muskellunge | Fingerling (11 inches) | 1,000 |
| 1974 | Walleye | Fingerling (3 inches) | 12,600 |
| 1976 | Walleye | Fingerling (3 inches) | 22,500 |
| 1977 | Muskellunge | Fingerling (9 inches) | 800 |
| 2003 | Muskellunge | Large Fingerling (11 inches) | 497 |

## METHODS

Ten standard fyke nets (3/4" bar, 1.5 inch stretch mesh) were set on April 17th 2002 and lifted daily from April 18 to 26, 2002 (Appendix Figure 1). A Wisconsin DNR standard direct current full size electrofishing boat was used on October 1, 2002, along 3.0 miles of the south shoreline and October 14, 2002, along 1.5 miles of north shoreline (Appendix Figure 2). During the spring fyke netting survey, all game fish were given a top caudal fin clip (for mark recapture population estimate); an ageing structure was collected from 5 fish per 0.5 inch group per sex with a length to the nearest 0.1 inch and weight in grams. An additional 250 individuals per species had length measurements to the nearest 0.1 inch and all others were counted. An ageing structure was collected from 10 panfish per 0.5 inch group per species with a length to the nearest 0.1 inch and a weight in grams. An additional 250 lengths per species were taken to the nearest 0.1 inch and all additional fish were counted. The Schnabel population multiple recapture estimation technique was used for gamefish and was calculated using only the fyke net caught fish during spring 2002 period.

During the fall electroshocking run, all species were collected for the entire length of shoreline shocked. The first 250 individuals of each species were measured to the nearest 0.1 of an inch and a total count of all fish caught was made.

Length-at-age comparisons by species were made to the previous 1986 survey and to other northeast Wisconsin lakes sampled for relevant species (reference data updated in 2003). These serve as comparisons for growth rates in this report and help judge the condition of the fish populations.

RESULTS AND DISCUSSION

Catch per unit effort results for all survey methods used in 2002 and fyke net survey only from 1986 are shown in Table 1 with respective analysis for each major species written below.

Table 2. *Catch per unit effort of major game fish and panfish species during fishery surveys in 1986 and 2002 on Chute Pond, Oconto County, Wisconsin.*

| Species | Spring 1986 Fyke net | April 2002 Fyke net | October 1 2002 Electrofishing | October 14 2002 Electrofishing |
|---|---|---|---|---|
| Black crappie | 2.7 | 2.5 | 9.0 | 19.3 |
| Bluegill | 4.6 | 4.3 | 36.7 | 78.0 |
| Largemouth bass | 2.5 | 1.1 | 22.9 | 12.0 |
| Muskellunge | 0.01 | 0.05 | 0 | 1.7 |
| Northern pike | 7.0 | 1.7 | 1.7 | 6.7 |
| Pumpkinseed | 0.5 | 0.4 | 2.0 | 2.7 |
| Rock bass | 0.7 | 1.1 | 2.0 | 4.0 |
| Walleye | 0.2 | 0.01 | 0 | 0 |
| Yellow perch | 3.4 | 2.5 | 4.7 | 3.3 |
| Hybrid bluegills | 0 | 0 | 1.3 | 0 |
| Bullhead | 0 | 0.2 | 0 | 0 |
| **Effort** | 110 net nights | 82 net nights | 3.0 miles | 1.5 miles |

**Gamefish species**

Largemouth bass

Electroshocking during the Fall of 2002 produced 19.1 largemouth bass per mile. In the spring 2002 fyke netting survey, we captured 90 adult largemouth bass averaging 14.3 inches, ranging in size from 6.5 to 20.4 inches in length (Figure 1), not counting the recaptured fish (6), for a catch per effort of 1.1 largemouth bass per net night. A population estimate of 380 adult largemouth bass with a 95% confidence interval 189 to 713 fish (Schnabel estimate) for a total density of 0.9 bass per acre. In 1986, 275 largemouth bass, not including recaptured fish, were caught in fyke nets averaging 10.6 inches in length, ranging in size from 5.4 to 20.6 inches (Figure 1) for a catch per effort of 2.5 largemouth bass per net night. A total population estimate for bass was not calculated during the 1986 survey.

The length-at-age of largemouth bass sampled in 1986 and 2002 showed comparable growth rates and was also similar to the bass growth rates of other northeast Wisconsin lakes for all ages sampled (Table 3). In 2002, the age composition of the bass population had shifted from age 3 (8 and 9-inch size ranges) to slight increases of age 5 and 6 (13 to 16- inch lengths) and a 10% increase in age 10+ (bass over 18 inches) when compared to 1986 survey data (Figure 1 and Table 3).

Figure 1. *Length frequency of largemouth bass captured by fyke net in spring 2002 compared to 1986, Chute Pond, Oconto County, Wisconsin.*

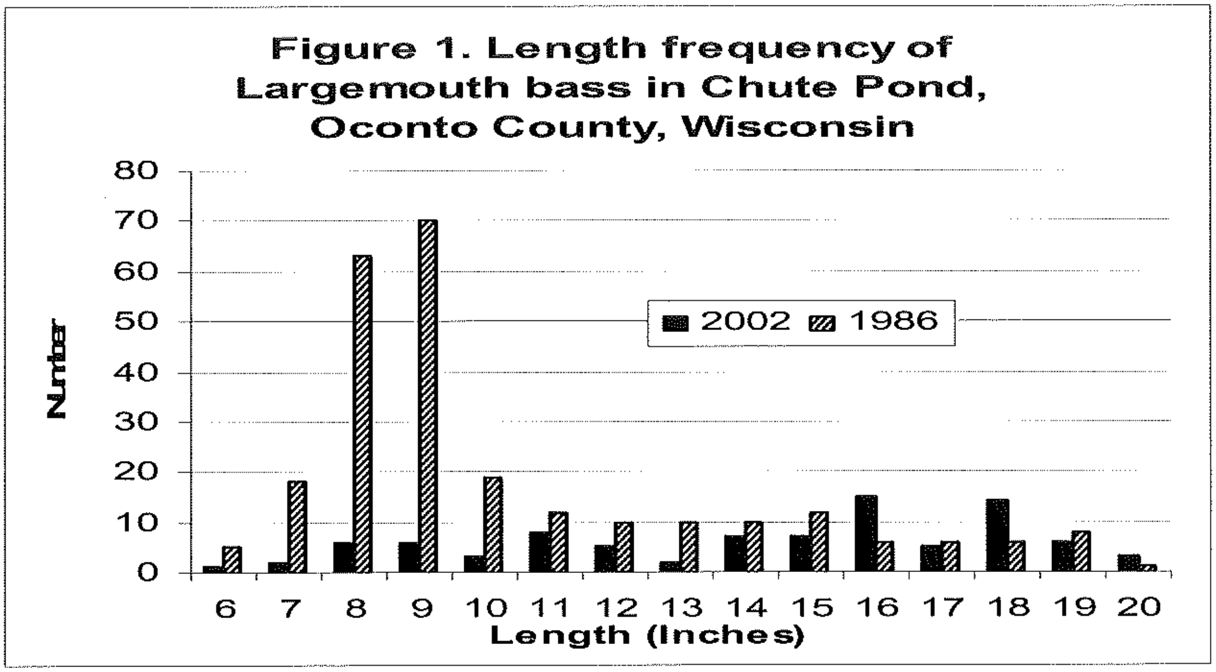


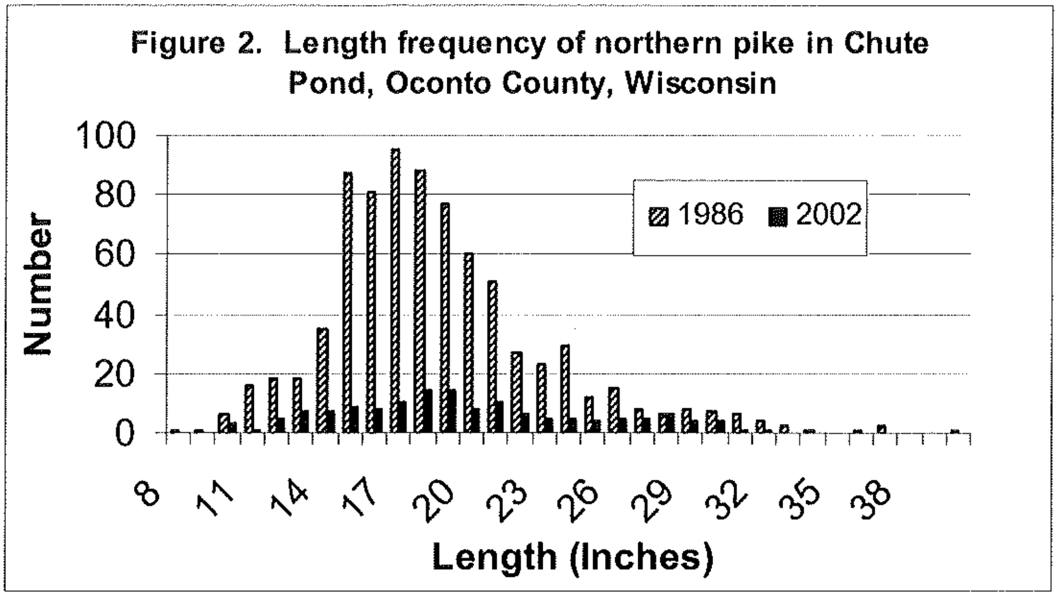

Table 3. *2002 Age- length distribution of largemouth bass from Chute Pond, Oconto County, Wisconsin compared to northeast (NER) Wisconsin average length-at-age data and 1986 survey information. Sample size equals (N).*

| Age | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|
| NER Average | - | 9.9 | 12.3 | 14.2 | 15.8 | 17.1 | 18.5 | 18.6 | 19.9 | - |
| 2002 Survey | 7.7 | 9.2 | 10.8 | 13.2 | 15.7 | 16.8 | 17.4 | 18.7 | 18.7 | 17.8 |
| 2002 (N) | 3 | 10 | 8 | 12 | 14 | 5 | 4 | 6 | 8 | 2 |
| 1986 survey | 6.1 | 8.7 | 10.7 | 13.5 | 15.7 | 17.4 | 17.9 | 18.4 | 19.3 | - |
| 1986 (N) | 6 | 38 | 17 | 19 | 14 | 6 | 3 | 7 | 5 | - |

Northern Pike

Night electroshocking during the fall of 2002 produced 3.3 northern pike per shoreline mile. In the 2002 spring fyke netting survey, we captured 142 northern pike averaging 20.1 inches, ranging in size from 10.0 to 32.2 inches in length (Figure 2), not counting the low number of recaptured fish (7), for a catch per effort of 1.7 northern pike per net night. A population estimate of 1,419 adult northern pike with a 95% confidence interval of 744 to 15,628 fish (Schnabel estimate) for a density of 3.4 northern pike per acre. In 1986, 767 northern pike were captured by fyke net, averaging 18.6 inches in length and ranged from 10.5 to 40.0 inches (Figure 2) with a catch per effort of 7.0 per net night. The 1986 population estimate was 2,698 adult northern pike with a 95% confidence interval of 2,270 to 3,325 fish (Schumacher formula) for a total population density of 6.4 northern per acre.

Figure 2. *Length frequency of northern pike captured by fyke net in spring 2002 compared to 1986, Chute Pond, Oconto County, Wisconsin.*




The length-at-age of northern pike sampled in 2002 showed similar growth rates when compared to other northeast Wisconsin lakes for all ages sampled (Table 4). However, the growth rate in 2002 was considerably faster than the 1986 growth rate. Northern pike averaged an inch larger at ages 3 through 6 compared to 1986 (Table 4), indicating improved grow likely due to fewer pike present in 2002. Between 1986 and 2002, it appears that the population was reduced by approximately half. During this time frame, northern pike fishing regulations in southern Wisconsin were changed to a 26-inch minimum length and 2 daily bag limit, however the regulations remained at no minimum length limit and a 5 daily bag for Chute Pond.

Table 4. *2002 Age- length distribution of northern pike from Chute Pond, Oconto County, Wisconsin, compared to other northeast (NER) Wisconsin lakes average length-at-age and the 1986 survey information. Sample size equals (N).*

| Age | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| NER Average | 11.4 | 15.3 | 18.4 | 21.5 | 24.4 | 27.4 | 30.0 | 30.9 | - | - |
| 2002 Survey | 12.0 | 14.7 | 18.6 | 20.4 | 23.5 | 26.3 | 27.1 | 30.9 | - | 29.7 |
| 2002 (N) | 4 | 28 | 22 | 22 | 25 | 9 | 4 | 3 | - | 1 |
| 1986 survey | - | 11.5 | 16.9 | 19.2 | 21.7 | 27.3 | 27.9 | 30.3 | - | - |
| 1986 (N) | - | 19 | 82 | 73 | 35 | 11 | 6 | 3 | - | - |

Muskellunge

Four muskellunge were captured in the 2002 spring fyke nets (catch rate 0.05 per net night). All were large fish; 39.0 (age 8), 44.8 (age 10), 49.3 (age 12) and 50.1 inches (not aged) in length. These were unmarked and not in spawning condition. During the fall electrofishing, two yearling size muskies were captured; 17.5 and 18.2 inches.

Walleye

Only one walleye was captured during the 2002 sampling efforts, which was a 20.3-inch male, 6 years old.

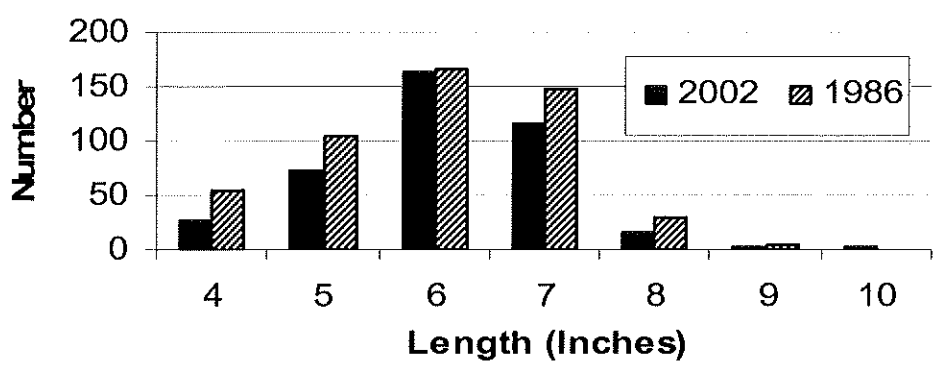
**Panfish**

Electroshocking in the fall of 2002 captured bluegill, yellow perch, black crappie, pumpkinseed and rock bass (Table 2). During the spring 2002 fyke netting survey, bluegill was the most abundant panfish with a catch per effort of 4.3 fish per net night. Other abundant pan fish included yellow perch with a catch rate of 2.5 and black crappie captured at a rate of 2.5 fish per net night (Table 2). Other notable panfish caught included rockbass (1.1 fish per net night) and pumpkinseed sunfish (0.4 fish per net night, Table 2). No total population estimates were made for panfish during the 2002 surveys.

Bluegill

During the 2002 spring fyke netting survey, we captured 350 bluegill for a catch per effort of 4.3 fish per net (Table 2). Bluegill averaged 6.4 inches, ranging in length from 4.3 to 10.2 inches and 75% were greater than 6 inches (Figure 3). In the 1986 fyke netting survey, 505 bluegill were caught averaging 6.3 inches, ranging in size from 4.0 to 9.3 inches and 68 percent over 6 inches in length (Figure 3). The bluegill catch per effort in 1986 was 4.6 per net night (Table 2).

**Figure 3. Length frequency of bluegill in Chute Pond, Oconto County, Wisconsin.**




The length-at-age of bluegill sampled in 2002 showed above average growth when compared to other northeast Wisconsin lakes for ages 1 to 9 (Table 5). The length-at-age for bluegill collected during surveys in 1986 were slower than 2002, but comparable to growth for ages 2 to 8 of other northeast Wisconsin lakes (Table 5).

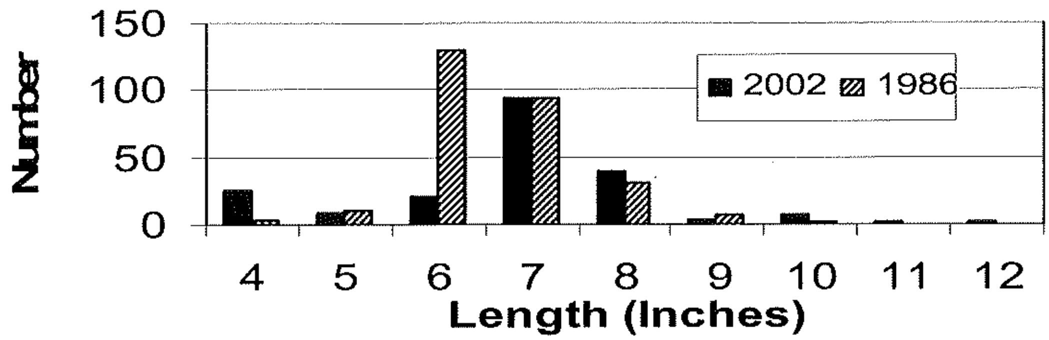
Table 5. *2002 Age- length distribution of bluegill from Chute Pond, Oconto County, Wisconsin compared to other northeast (NER) Wisconsin bluegill average length-at-age data. (N) equals sample size.*

| Age | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| NER Average | 3.0 | 4.0 | 4.8 | 5.8 | 6.6 | 7.2 | 7.9 | 8.3 | 8.7 |
| 2002 Survey | - | - | 4.9 | 6.1 | 7.2 | 7.7 | 8.5 | 10.2 | - |
| 2005 (N) | - | - | 15 | 63 | 34 | 8 | 6 | 1 | - |
| 1986 Survey | - | - | 4.7 | 5.9 | 6.6 | 7.3 | 8.1 | 8.5 | 8.9 |
| 1983 (N) | - | - | 14 | 9 | 5 | 11 | 5 | 3 | 4 |

Black crappie

During the 2002 spring fyke netting survey, we captured 203 black crappie for a catch per effort of 2.5 fish per net night (Table 2). Black crappie averaged 7.3 inches, ranging from 4.2 to 10.2 inches in length and 26% were greater than 8 inches (Figure 6). In the 1986 fyke netting survey, 298 (2.7 per net night) black crappie were caught, averaging 6.8 inches, ranging in size from 4.4 to 10.8 inches and only 14 percent were greater than 8 inches (Figure 6).

**Figure 6. Length frequency of Black Crappie in Chute Pond, Oconto County, Wisconsin.**




The length-at-age of black crappie sampled in 2002 and 1986 showed slower growth rates for most age classes when compared to other northeast Wisconsin lakes (Table 6).

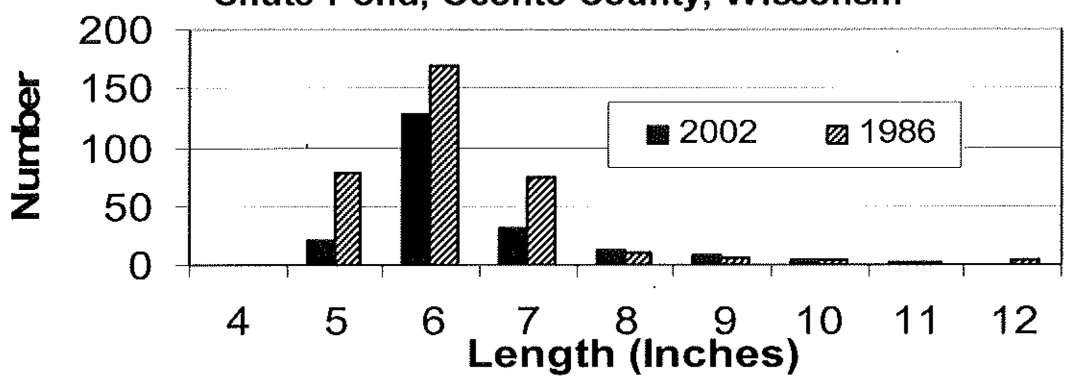
Table 6. *2002 Age- length distribution of black crappie from Chute Pond, Oconto County Wisconsin compared to other northeast (NER) Wisconsin crappie average length-at-age data. (N) equals sample size.*

| Age | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|
| NER Average | 5.4 | 7.2 | 8.6 | 9.6 | 10.4 | 11.2 | 12.2 | 13.0 | 14.0 |
| 2002 Survey | 4.6 | 6.9 | 7.8 | 9.9 | 11.8 | - | - | - | - |
| 2002 (N) | 15 | 9 | 31 | 9 | 2 | - | - | - | - |
| 1986 Survey | 4.8 | 6.5 | 7.9 | 8.8 | 9.1 | 9.9 | 11.2 | 12.0 | - |
| 1986 (N) | 9 | 21 | 11 | 4 | 4 | 5 | 2 | 1 | - |

Yellow Perch

During the 2002 spring fyke netting survey, we captured 207 yellow perch for a catch per effort of 2.5 fish per net night (Table 2). Yellow perch averaged 6.9 inches, ranging from 5.4 to 11.6 inches in length and 29% were greater than 7 inches (Figure 5). During the 1986 fyke netting survey, 353 yellow perch (catch per effort of 3.4 per net night) were caught, averaging 6.4 inches, ranging in size from 4.5 to 12.6 inches (Figure 5) with 29% greater than 7 inches.

**Figure 5. Length frequency of yellow perch in Chute Pond, Oconto County, Wisconsin**




The length-at-age of Chute Pond yellow perch sampled in 2002 was a small sample size, but those checked continued to exhibit good growth compared to the 1986 survey and both years were similar in growth to yellow perch from other Wisconsin lakes (Table7).

Table 7. *2002 Age- length distribution of yellow perch from Chute Pond, Oconto County, Wisconsin compared to the Wisconsin state average length-at-age data (no NER average data was available). (N) equals sample size.*

| Age | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|
| State Average | 4.2 | 5.3 | 6.3 | 7.1 | 8.0 | 8.5 | 9.0 | 9.5 | 9.7 |
| 2002 Survey | 6.4 | - | 8.4 | 8.8 | 9.9 | - | 11.7 | - | - |
| 2002 (N) | 1 | | 4 | 3 | 3 | - | 2 | - | - |
| 1986 Survey | 5.1 | 6.4 | 7.4 | 8.4 | 9.4 | 9.7 | 10.7 | 11.6 | 11.2 |
| 1986 (N) | 7 | 29 | 39 | 20 | 13 | 9 | 6 | 5 | 4 |

Other fish species

Other fish species caught during the 2002 netting survey included 93 rockbass (3.8 – 10.4 inches in length) and 32 pumpkinseed sunfish (4.0- 7.2 inches in length). Also captured during the 2002 surveys were yellow bullheads and hybrid bluegills. Bluntnose minnow, brown bullhead, golden shiner, Iowa darter, and white sucker were captured in the 1986 survey but not documented in 2002.

## CONCLUSIONS AND RECOMMENDATIONS

Chute Pond supports a diverse fishery with adequate natural reproduction of the species present that can continue to support a quality fishing experience. A low density muskellunge population is present which developed from periodic stockings. The yearling muskies captured in the fall shocking survey indicate some natural reproduction is occurring. The 2002 comprehensive fish survey indicates some change in the game fish populations since 1986, with fewer numbers of northern pike and largemouth bass, however with larger average sizes of those present in 2002. Although panfish catch rates were down slightly in the 2002 survey, I do not consider this a significant decrease and may be just difference in the netting efforts. The dominant panfish species of Chute Pond continue to be bluegill, yellow perch and black crappie through natural reproduction. In 2007, the 51st Annual Winter Fisheree will be held with catch prizes for the five fore-mentioned fish species. Thus, there is a long tradition of ice fishing for the dominant fish species indicated in the 2002 survey.

Chute Pond is a moderately fertile lake and therefore has the capability of sustaining a quality size fishery as seen in our survey results. Growth rates of most fish species within Chute Pond are comparable to other northeast Wisconsin lakes. A major shift to a larger size structure of the largemouth bass population occurred between 1986 and 2002, which I believe are the result of fishing regulation changes with the 14-inch size limit implemented in the late 1980's. This appears to have resulted in a more stable year class recruitment and age representation throughout the population, as bass are protected from harvest through age 5, and this has lead to increased numbers of larger fish in the population (average bass size increased from 10.6 to 14.3 inches).

On the other hand, northern pike fishing regulations did not change for Chute Pond and the zero length limit, 5 daily bag harvest regulation stayed in place throughout this time period, although regulations became more restrictive in other parts of the state. The northern pike population in 2002 had only half the numbers of the 1986 population, however with no length limit protection, as with the bass population, there are less mid-size northern pike and no resulting increase in the larger size ranges of the northern population. If at some point in the future, more protection from harvest is desired for the northern pike population, the 26 inch, 2 bag regulations would result in more protection of the mid-size range pike. The harvest fishing regulations present on other the fish species in Chute Pond are consider a "quality opportunity".

However, at present a compliment to the top fish predator populations of Chute Pond is a low density of large-size muskellunge that appears to have become established. Periodic stocking of low numbers of muskellunge should continue with emphasis on better documenting the muskellunge population in future fish surveys. The next comprehensive fish survey is planned for 2009.

The high recreational use of this lake during the summer months by all users including anglers and the number of dwellings located around the lake shoreline along with the park facility may play a major roll in the quality of the fishery. Maintaining as much shoreline in a natural condition is important to good fish habitat and the future fishery. Private and public riparian shoreline owners should be encouraged to maintain as much shoreline as possible in a natural condition (such as, allowing shore vegetation to grow, or leaving tree drops in the water (attached to shore)).

The macrophyte harvesting presently being conducted should be monitored and managed so that the amount of aquatic macophytes being removed does not result in less than 25 percent weed coverage of the Chute Pond surface acres (no less than 100 acres of macrophytes are needed to support the fishery). If future fish surveys show a negative impact of the weed removal on the natural recruitment in order support the desired sport fish populations, than the amounts of macrophytes being removed should be reduced.

Public access to Chute Pond is excellent with four access points. A boat landing with ample parking space and bathroom facilities are located on the north side of the lake in the Oconto County Park adjacent to the dam and a gravel launch in the park south of the dam. There is a boat launch with parking on south shore off Bonita Road. Public access is also attainable at the upper end of the flowage off Kingston Road. I do not recommend any changes for public access.

ACKNOWLEDGEMENTS
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LITERATURE CITED

Carlson, H., Lloyd M. Andrews and C.W. Threinen. 1977. Surface waters of Oconto County. Department of Natural Resources, Madison, Wisconsin. 104 pages.

Cover image courtesy of WebView and the Wisconsin Department of Natural Resources.

Heizer, Russ. 1987. Draft Walleye and Muskellunge Stocking Evaluation, Chute Pond, Oconto County. Wisconsin DNR Memo.

Appendix

Figure 1. General location (arrows) of 10 standard fyke nets for the comprehensive fishery survey April 17th – 26th, 2002.

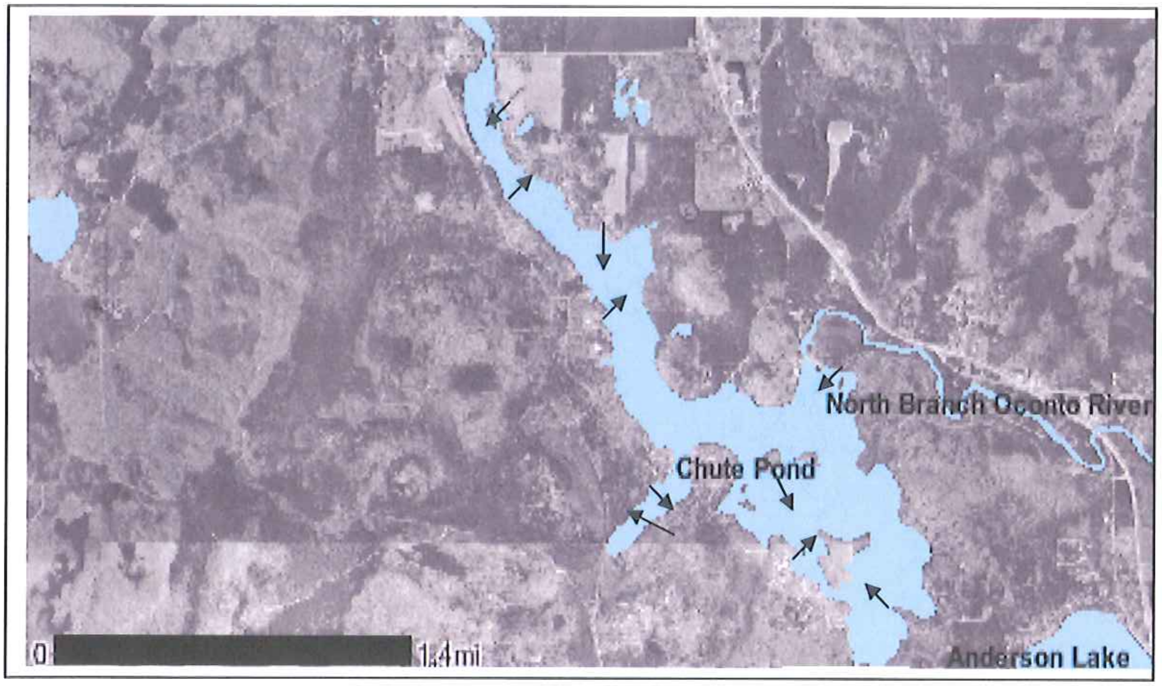
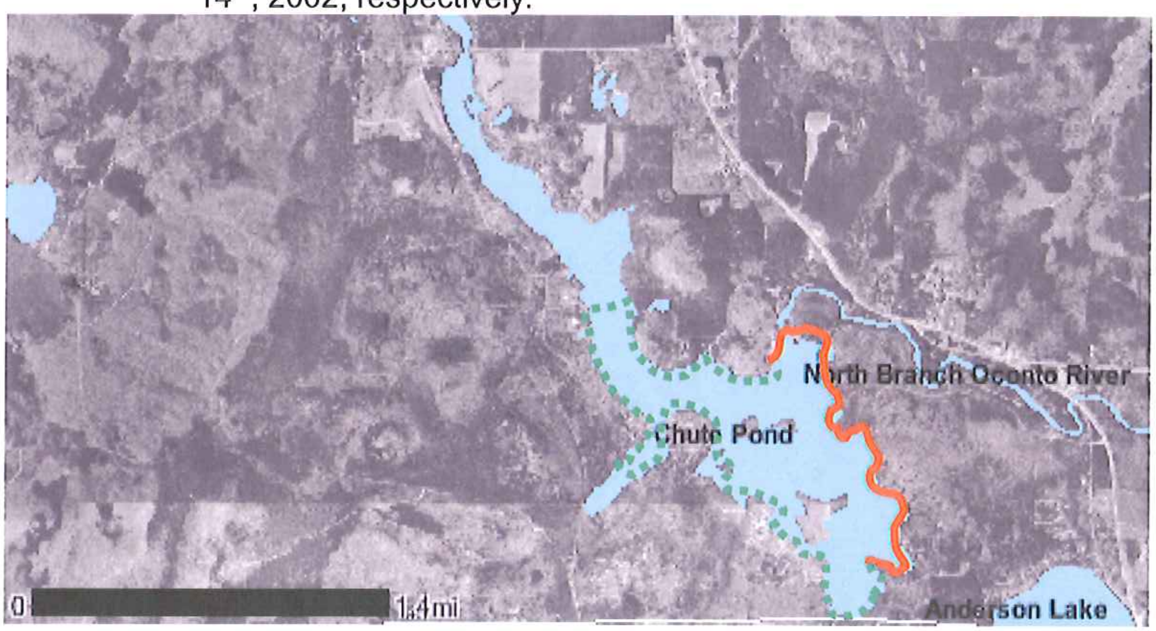



Figure 2. Location of the 3 mile (green line, south shore) and 1.5 mile (red line, northeast shore) electroshocking surveys on October 1st and 14th, 2002, respectively.



# Appendix G

- Threat of exotic aquatic species to Chute Pond

# Exotic Species

It is important that members of the Chute Lake P & R District familiarize themselves with some of the existing and additional threats posed by invasive species. The following descriptions are given to promote awareness of exotic species.

## Eurasian Watermilfoil

Eurasian watermilfoil (*Myriophyllum spicatum*) produces long spaghetti-like stems that often grow up to the water's surface. Leaves are feather-like and resemble bones on a fish. Three to five leaves are arranged in whorls around the stem, and each leaf contains 12-21 pairs of leaflets. At mid-summer small reddish flower spikes may emerge above the water's surface. Perhaps the most distinguishing characteristic though, is the plant's ability to form dense, impenetrable beds that inhibit boating, swimming, fishing, and hunting.

Eurasian watermilfoil is native to Europe, Asia and Northern Africa. Of the eight milfoil (*Myriophyllum*) species found in Wisconsin, Eurasian watermilfoil is the only exotic. The plant was first introduced into U.S. waters in 1940. By 1960, it had reached Wisconsin's lakes. Since then, its expansion has been exponential (Brakken, 2000).

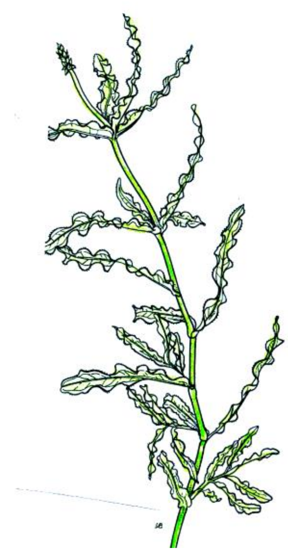
Eurasian watermilfoil begins growing earlier than native plants, giving it a competitive advantage. The dense surface mats formed by the plant block sunlight and have been found to displace nearly all native submergent plants. Over 200 studies link declines in native plants with increases in Eurasian watermilfoil (Madsen, 2001). The resultant loss of plant diversity degrades fishery habitat (Pullman, 1993), and reduces foraging opportunities for waterfowl and aquatic mammals. Eurasian watermilfoil has been found to reduce predatory success of fish such as largemouth bass (Engel, 1985), and spawning success for trout (*Salmonidae spp.*) (Newroth, 1985).

The continued spread of Eurasian watermilfoil can produce significant economic consequences. In the Truckee River Watershed below Lake Tahoe, located in western Nevada and northeastern California, economic damages caused by Eurasian watermilfoil to the recreation industry have been projected at $30 to $45 million annually (Eiswerth et al., 2003). In Tennessee Valley Authority Reservoirs, Eurasian watermilfoil was found to depress real estate values, stop recreational activities, clog municipal and industrial water intakes and increase mosquito breeding (Smith, 1971).

Eurasian watermilfoil has been found to reduce water quality in lakes by several means. Dense mats of Eurasian watermilfoil have been found to alter temperature and oxygen profiles – producing anoxic conditions in bottom water layers (Unmuth et al., 2000). These anoxic conditions can cause localized die-offs of mollusks and other invertebrates. Eurasian watermilfoil has also been found to increase phosphorus concentration in lakes through accelerated internal nutrient cycling (Smith and Adams, 1986). Increased phosphorus concentrations released by dead and dying Eurasian watermilfoil have been linked to algae blooms and reduced water clarity.

## Curly-leaf Pondweed

Curly-leaf pondweed (*Potamogeton crispus*) has oblong leaves that are two to four inches long and attach to a slightly flattened stem in an alternate pattern. The most distinguishing characteristics are the curled appearance of the leaves, and the serrated leaf edges. Curly-leaf pondweed also produces a seed-like turion, which resembles a miniature pinecone. Curly-leaf pondweed produces turions in early summer allowing the plant to regenerate annually. Turion production begins when water temperatures reach above 60º F.



This exotic pondweed is a cold-water specialist. Curly-leaf pondweed can begin growing under the ice, giving it a competitive advantage over native plants, which are still lying dormant. By mid-summer when water temperatures reach the upper 70° F range, it begins to die off.

Curly-leaf pondweed has been found in the U.S. since at least 1910. A native of Europe, Asia, Africa and Australia, this plant is now found throughout much of the U.S. (Baumann et al., 2000).

As with Eurasian watermilfoil, curly-leaf pondweed's aggressive early season growth allows it to out compete native species and grow to nuisance levels. Because the plant dies back during the peak of the growing season for other plants though, it is better able to coexist with native species than Eurasian watermilfoil. Perhaps the most significant problem associated with curly-leaf pondweed involves internal nutrient cycling. The die-off and decomposition of the plant during the warmest time of year often leads to a sudden nutrient release in the water. This often leads to nuisance algae blooms and poor water quality.

## Purple Loosestrife

Purple loosestrife (*Lythrum salicaria*) forms bright purple flowers in a spike atop stems that reach 2 to 7 feet in height. Lance-shaped leaves are arranged oppositely along the stem. Purple loosestrife can be found in a wide variety of habitats from shallow water to moist soils. Like Eurasian watermilfoil it is a very aggressive plant that can displace many native wetland plants including cattails (*Typha spp.*). Purple loosestrife plants produce hundreds of thousands of tiny seeds. When purple loosestrife is cut, seeds stick to mowing equipment and are spread to new locations. This invasive plant causes significant economic damage by clogging waterways and irrigation canals. Unlike cattails, purple loosestrife has little food or cover value for wildlife (Borman et. al. 1997).

## Zebra Mussels


Zebra mussels (*Dreissena polymorpha*) are small (1/4” to 2”) mollusks with elongated shells marked by alternating light and dark markings. They produce dense elastic strands, called byssal threads, by which they can securely attach to nearly any surface, often forming barnacle-like incrustations. Mussels spawn in the early spring when water temperatures reach 54º F. Fertilized eggs develop into microscopic free-swimming larvae called veligers. After three to four weeks, the surviving veligers settle onto firm objects where they quickly attach themselves. Within a year the young grow into adults that can live four to six years.

Zebra mussels were introduced to the Great Lakes region in the late 1980s through discharged ballast water of ships traveling the Saint Lawrence Seaway. These ships originated from European ports. Zebra mussels are native to the Ukraine and Russia near the Black and Caspian Seas. Since the 1700s zebra mussels have spread throughout European river systems.

Although zebra mussels do not cause much harm to the surrounding environment, they can negatively impact recreation and business by clogging water intake pipes, encrust boat hulls and piers, and wash up on beaches.

## Zebra Mussel Management Options

Currently there is no lake-wide control option that isn't deadly to other aquatic life forms. In some areas of Europe and Lake Erie large populations of diving ducks have been shown to significantly decrease the population of zebra mussels each year. However, given the zebra mussel's high reproductive capacity, populations are able to recover each summer. In addition, diving duck populations in the Great Lakes region are low since they are only prevalent in the region during winter and summer migrations.

A number of fish species have been known to feed on zebra mussels. These include the freshwater drum, round goby, yellow perch, catfish, and carp. Certain fish species will feed on the adults while others eat the free-swimming juveniles. Although fish predation occurs, it is not significant enough to significantly decrease zebra mussel populations.

In recent years scientists have noted that native freshwater sponges in Lake Michigan appear to be increasing in number and attaching themselves to zebra mussels. In doing so, the sponges can kill the zebra mussels by cutting off the mussel's food and water supply.

Some success has been achieved by manually removing mussels from a lake. Although this method can dramatically reduce populations, it does not eradicate the mussels. In addition, it should be noted that this option is also very labor intensive.

Current research is focused on studying the environmental cues and physiological pathways that coordinate zebra mussel spawning. If the timing of male and female spawning can be disrupted, the numbers of fertilized eggs would be greatly reduced.

## Mystery Snails

Two nonnative mystery snails have been identified in Wisconsin lakes. They are the Chinese mystery snail (*Bellamya chinensis*) and the banded mystery snail (*Viviparus georgianus*). Little is currently known about these species. However, it appears these exotic species can have an indirect negative impact to native snail populations.


**Banded Mystery Snail**

Mystery snails are larger in size to many native species. They also have thick hard shells and hard opercula which cover the opening in their shells. These features make them less edible or desirable to predators.


**Chinese Mystery Snail**

The banded mystery snail is native to the southeastern US. Chinese mystery snails are native to Asia. They were first imported into the US in the late nineteenth century. Both species have likely spread through the U.S. via the aquarium trade and as hitchhikers on boats and trailers.

Mystery snails are tolerant of pollution and can survive in stagnant water conditions. Mystery snails do not eat plants (macrophytes). Instead, they feed on detritus and in lesser amounts algae and phytoplankton.
Lakes with high densities of mystery snails often see large die-offs of the snails usually associated with low oxygen conditions.

Current research is focused on the life-cycle of these snails and the environmental conditions under which population growth is hindered or promoted.

## Mystery Snail Management Options

Currently there is no control option for mystery snails that would not be detrimental to native snail populations. Individuals can physically remove these snails from their lake frontages. However, care should be taken to ensure they are the nonnative species. Also, the snails should be disposed of in a way that does not encourage their spread or attract unwanted pests.

More information regarding the life-cycle and monitoring of mystery snails in Wisconsin can be found at: www.uwsp.edu/cnr/uwexlakes/clmn/AIS-Manual/7Snails09.pdf.

## Rusty Crayfish


Rusty crayfish *(Orconectes rusticus)* are native to streams in the Ohio River Basin. They likely reached the lakes of Wisconsin by anglers who used them as live bait. They are still caught and sold as bait and by biological supply companies. In Wisconsin it is illegal to possess both live crayfish and fishing equipment in a boat while on the water. It is also illegal to release crayfish into a lake or stream in the State without a permit. A fishing license is required to harvest crayfish in Wisconsin.

Rusty crayfish prefer areas that offer rocks, logs, or other debris as cover. Bottom types may be clay, silt, sand, gravel, or rock. Rusty crayfish inhabit both pools and fast water areas of streams.

Rusty crayfish are prolific and aggressive. They eat small fish, insects, fish eggs and aquatic vegetation. Invading rusty crayfish can displace native crayfish, reduce the amount and kinds of aquatic plants, decrease the density and variety of invertebrates, and reduce some fish populations. By eating aquatic vegetation, rusty crayfish can damage lake habitats that are important for fish spawning, cover, and food.

## Rusty Crayfish Management Options

It is difficult to control rusty crayfish without detrimentally impacting native crayfish populations. Some lakes have had success trapping and removing these crayfish. This can be and often is a very labor intensive undertaking that does not ensure long-term control. Care must be taken to remove only the rusty crayfish and leave the native species. As with all nuisance exotic species, preventing or slowing the spread of this species into new waters is the best way to prevent the ecological problems they cause.