Pleasant Lake

Waushara and Marquette Counties, Wisconsin

Aquatic Plant Survey Report

December 2009



Sponsored by:

Pleasant Lake Improvement Corporation

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Lake Management Planning

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Aquatic Plants

Introduction

Although the occasional lake user considers aquatic macrophytes to be "weeds" and a nuisance to the recreational use of the lake, the plants are actually an essential element in a healthy and functioning lake ecosystem. It is very important that lake stakeholders understand the importance of lake plants and the many functions they serve in maintaining and protecting a lake ecosystem. With increased understanding and awareness, most lake users will recognize the importance of the aquatic plant community and their potential negative affects on it.

Diverse aquatic vegetation provides habitat and food for many kinds of aquatic life, including fish, insects, amphibians, waterfowl, and even terrestrial wildlife. For instance, wild celery (*Vallisneria americana)* and wild rice (*Zizania aquatica* and *Z. palustris*) both serve as excellent food sources for ducks and geese. Emergent stands of vegetation provide necessary spawning habitat for fish such as northern pike (*Esox lucius*) and yellow perch (*Perca flavescens*) In addition, many of the insects that are eaten by young fish rely heavily on aquatic plants and the *periphyton* attached to them as their primary food source. The plants also provide cover for feeder fish and *zooplankton*, stabilizing the predator-prey relationships within the system.



Furthermore, rooted aquatic plants prevent shoreline erosion and the resuspension of sediments and nutrients by absorbing wave energy and locking sediments within their root masses. In areas where plants do not exist, waves can resuspend bottom sediments decreasing water clarity and increasing plant nutrient levels that may lead to algae blooms. Lake plants also produce oxygen through photosynthesis and use nutrients that may otherwise be used by *phytoplankton*, which helps to minimize nuisance algal blooms.

Under certain conditions, a few species may become a problem and require control measures. Excessive plant growth can limit recreational use by deterring navigation, swimming, and fishing activities. It can also lead to changes in fish population structure by providing too much cover for feeder fish resulting in reduced numbers of predator fish and a stunted pan-fish population. *Exotic* plant species, such as Eurasian water-milfoil (*Myriophyllum spicatum*) and curly-leaf pondweed (*Potamogeton crispus*) can also upset the delicate balance of a lake ecosystem by out competing *native* plants and reducing *species diversity*. These *invasive* plant species can form dense stands that are a nuisance to humans and provide low-value habitat for fish and other wildlife.

When plant abundance negatively affects the lake ecosystem and limits the use of the resource, plant management and control may be necessary. The management goals should always include the control of invasive species and restoration of native communities through environmentally sensitive and economically feasible methods. No aquatic plant management plan should only contain methods to control plants, they should also contain methods on how to protect and possibly enhance the important plant communities within the lake. Unfortunately, the latter is often neglected and the ecosystem suffers as a result.

Aquatic Plant Management and Protection

Many times an aquatic plant management plan is aimed at only controlling nuisance plant growth that has limited the recreational use of the lake, usually navigation, fishing, and swimming. It is important to remember the vital benefits that native aquatic plants provide to lake users and the lake ecosystem, as described above. Therefore, all aquatic plant management plans also need to address the enhancement and protection of the aquatic plant community. Below are general descriptions of the many techniques that can be utilized to control and enhance aquatic plants. Each alternative has benefits and limitations that are explained in its description. Please note that only legal and commonly used methods are included. For instance, the herbivorous grass carp (*Ctenopharyngodon idella*) is illegal in Wisconsin and rotovation, a process by which the lake bottom is tilled, is not a commonly accepted practice. Unfortunately, there are no "silver bullets" that can completely cure all aquatic plant problems, which makes planning a crucial step in any aquatic plant management activity. Many of the plant management and protection techniques commonly used in Wisconsin are described below.

Important Note:
Even though most of these techniques are not applicable to Pleasant Lake, it is still important for lake users to have a basic understanding of all the techniques so they can better understand why particular methods are or are not applicable in their lake**.** The techniques applicable to Pleasant Lake are discussed in Summary and Conclusions section and the Implementation Plan found near the end of this document.

Permits

The signing of the 2001-2003 State Budget by Gov. McCallum enacted many aquatic plant management regulations. The rules for the regulations have been set forth by the Wisconsin Department of Natural Resources as NR 107 and 109. A major change includes that all forms of aquatic plant management, even those that did not require a permit in the past, require a permit now, including manual and mechanical removal. Manual cutting and raking are exempt from the permit requirement if the area of plant removal is no more than 30 feet wide and any piers, boatlifts, swim rafts, and other recreational and water use devices are located within that length. Furthermore, installation of aquatic plants, even natives, requires approval from the Wisconsin Department of Natural Resources. It is important to note that local permits and U.S. Army Corps of Engineers regulations may also apply. For more information on permit requirements, please contact the Wisconsin Department of Natural Resources Regional Water Management Specialist or Aquatic Plant Management and Protection Specialist.

Native Species Enhancement



The development of Wisconsin's shorelands has increased dramatically over the last century and with this increase in development a decrease in water quality and wildlife habitat has occurred. Many people that move to or build in shoreland areas attempt to replicate the suburban landscapes they are accustomed to by converting natural shoreland areas to the "neat and clean" appearance of manicured lawns and flowerbeds. The conversion of these areas immediately leads to destruction of habitat utilized by birds, mammals, reptiles, amphibians, and insects (Jennings et al. 2003).. The maintenance of the newly created area helps to decrease water quality by

considerably increasing inputs of phosphorus and sediments into the lake. The negative impact of human development does not stop at the shoreline. Removal of native plants and dead, fallen timbers from shallow, near-shore areas for boating and swimming activities destroys habitat used by fish, mammals, birds, insects, and amphibians, while leaving bottom and shoreline sediments vulnerable to wave action caused by boating and wind (Jennings et al. 2003, Radomski and Goeman 2001, and Elias & Meyer 2003). Many homeowners significantly decrease the number of trees and shrubs along the water's edge in an effort to increase their view of the lake (. However, this has been shown to locally increase water temperatures, and decrease infiltration rates of potentially harmful nutrients and pollutants. Furthermore, the dumping of sand to create beach areas destroys spawning, cover and feeding areas utilized by aquatic wildlife (Scheuerell and Schindler 2004).

In recent years, many lakefront property owners have realized increased aesthetics, fisheries, property values, and water quality by restoring portions of their shoreland to mimic its unaltered state. An area of shore restored to its natural condition, both in the water and on shore, is commonly called a *shoreland buffer zone*. The shoreland buffer zone creates or restores the ecological habitat and benefits lost by traditional suburban landscaping. Simply not mowing within the buffer zone does wonders to restore some of the shoreland's natural function.

Enhancement activities also include additions of *submergent*, *emergent*, and *floating-leaf* plants within the lake itself. These additions can provide greater species diversity and may compete against exotic species.

Cost

The cost of native, aquatic and shoreland plant restorations is highly variable and depend on the size of the restoration area, planting densities, the species planted, and the type of planting (e.g. seeds, bare-roots, plugs, live-stakes) being conducted. Other factors may include extensive grading requirements, removal of shoreland stabilization (e.g., rip-rap, seawall), and protective measures used to guard the newly planted area from wildlife predation, wave-action, and erosion. In general, a restoration project with the characteristics described below would have an estimated materials and supplies cost of approximately $4,200.

- The single site used for the estimate indicated above has the following characteristics:
  - An upland buffer zone measuring 35' x 100'.
  - An aquatic zone with shallow-water and deep-water areas of 10' x 100' each.
  - Site is assumed to need little invasive species removal prior to restoration.
  - Site has a moderate slope.
  - Trees and shrubs would be planted at a density of 435 plants/acre and 1210 plants/acre, respectively.
  - Plant spacing for the aquatic zone would be 3 feet.
  - Each site would need 100' of biolog to protect the bank toe and each site would need 100' of wavebreak and goose netting to protect aquatic plantings.
  - Each site would need 100' of erosion control fabric to protect plants and sediment near the shoreline (the remainder of the site would be mulched).
  - There is no hard-armor (rip-rap or seawall) that would need to be removed.
  - The property owner would maintain the site for weed control and watering.

Advantages

Improves the aquatic ecosystem through species diversification and habitat enhancement.
Assists native plant populations to compete with exotic species.
Increases natural aesthetics sought by many lake users.
Decreases sediment and nutrient loads entering the lake from developed properties.
Reduces bottom sediment resuspension and shoreline erosion.
Lower cost when compared to rip-rap and seawalls.
Restoration projects can be completed in phases to spread out costs.
Many educational and volunteer opportunities are available with each project.

Disadvantages

Property owners need to be educated on the benefits of native plant restoration before they are willing to participate.
Stakeholders must be willing to wait 3-4 years for restoration areas to mature and fill-in.
Monitoring and maintenance are required to assure that newly planted areas will thrive.
Harsh environmental conditions (e.g., drought, intense storms) may partially or completely destroy project plantings before they become well established.

Manual Removal



Manual removal methods include hand-pulling, raking, and hand-cutting. Hand-pulling involves the manual removal of whole plants, including roots, from the area of concern and disposing them out of the waterbody. Raking entails the removal of partial and whole plants from the lake by dragging a rake with a rope tied to it through plant beds. Specially designed rakes are available from commercial sources or an asphalt rake can be used. Hand-cutting differs from the other two manual methods because the entire plant is not removed, rather the plants are cut similar to mowing a lawn; however Wisconsin law states that all plant fragments must be removed. One manual cutting technique involves throwing a specialized "V" shaped cutter into the plant bed and retrieving it with a rope. The raking method entails the use of a two-sided straight blade on a telescoping pole that is swiped back and forth at the base of the undesired plants.

In addition to the hand-cutting methods described above, powered cutters are now available for mounting on boats. Some are mounted in a similar fashion to electric trolling motors and offer a 4-foot cutting width, while larger models require complicated mounting procedures, but offer an 8-foot cutting width.

When using the methods outlined above, it is very important to remove all plant fragments from the lake to prevent re-rooting and drifting onshore followed by decomposition. It is also important to preserve fish spawning habitat by timing the treatment activities after spawning. In Wisconsin, a general rule would be to not start these activities until after June 15th.

Cost

Commercially available hand-cutters and rakes range in cost from $85 to $150. Power-cutters range in cost from $1,200 to $11,000.

Advantages

Very cost effective for clearing areas around docks, piers, and swimming areas.
Relatively environmentally safe if treatment is conducted after June 15th.
Allows for selective removal of undesirable plant species.
Provides immediate relief in localized area.
Plant biomass is removed from waterbody.

Disadvantages

Labor intensive.
Impractical for larger areas or dense plant beds.
Subsequent treatments may be needed as plants recolonize and/or continue to grow.
Uprooting of plants stirs bottom sediments making it difficult to harvest remaining plants
May disturb *benthic* organisms and fish-spawning areas.
Risk of spreading invasive species if fragments are not removed.

Bottom Screens

Bottom screens are very much like landscaping fabric used to block weed growth in flowerbeds. The gas-permeable screen is placed over the plant bed and anchored to the lake bottom by staking or weights. Only gas-permeable screen can be used or large pockets of gas will form under the mat as the result of plant decomposition. This could lead to portions of the screen becoming detached from the lake bottom, creating a navigational hazard. Normally the screens are removed and cleaned at the end of the growing season and then placed back in the lake the following spring. If they are not removed, sediments may build up on them and allow for plant colonization on top of the screen.

Cost

Material costs range between $.20 and $1.25 per square-foot. Installation cost can vary largely, but may roughly cost $750 to have 1,000 square feet of bottom screen installed. Maintenance costs can also vary, but an estimate for a waterfront lot is about $120 each year.

Advantages

Immediate and sustainable control.
Long-term costs are low.
Excellent for small areas and around obstructions.
Materials are reusable.
Prevents fragmentation and subsequent spread of plants to other areas.

Disadvantages

Installation may be difficult over dense plant beds and in deep water.
Not species specific.
Disrupts benthic fauna.
May be navigational hazard in shallow water.
Initial costs are high.
Labor intensive due to the seasonal removal and reinstallation requirements.
Does not remove plant biomass from lake.
Not practical in large-scale situations.

Water Level Drawdown

The primary manner of plant control through water level drawdown is the exposure of sediments and plant roots/tubers to desiccation and either heating or freezing depending on the timing of the treatment. Winter drawdowns are more common in temperate climates like that of Wisconsin and usually occur in reservoirs because of the ease of water removal through the outlet structure. An important fact to remember when considering the use of this technique is that only certain species are controlled and that some species may even be enhanced. Furthermore, the process will likely need to be repeated every two or three years to keep target species in check.

Cost

The cost of this alternative is highly variable. If an outlet structure exists, the cost of lowering the water level would be minimal; however, if there is not an outlet, the cost of pumping water to the desirable level could be very expensive.

Advantages

Inexpensive if outlet structure exists.
May control populations of certain species, like Eurasian water-milfoil for up to two years.
Allows some loose sediments to consolidate.
May enhance growth of desirable emergent species.
Other work, like dock and pier repair may be completed more easily and at a lower cost while water levels are down.

Disadvantages

May be cost prohibitive if pumping is required to lower water levels.
Has the potential to upset the lake ecosystem and have significant affects on fish and other aquatic wildlife.
Adjacent wetlands may be altered due to lower water levels.
Disrupts recreational, hydroelectric, irrigation and water supply uses.
May enhance the spread of certain undesirable species, like common reed (*Phragmites australis*) and reed canary grass (*Phalaris arundinacea*).
Permitting process requires an environmental assessment that may take months to prepare.
Unselective.

Harvesting

Aquatic plant harvesting is frequently used in Wisconsin and involves the cutting and removal of plants much like mowing and bagging a lawn. Harvesters are produced in many sizes that can cut to depths ranging from 3 to 6 feet with cutting widths of 4 to 10 feet. Plant harvesting speeds vary with the size of the harvester, density and types of plants, and the distance to the off-loading area. Equipment requirements do not end with the harvester. In addition to the harvester, a shore-conveyor would be required to transfer plant material from the harvester to a dump truck for transport to a landfill or compost site. Furthermore, if off-loading sites are limited and/or the lake is large, a transport barge may be needed to move the harvested plants from the harvester to the shore in order to cut back on the time that the harvester spends traveling to the shore conveyor.

Some lake organizations contract to have nuisance plants harvested, while others choose to purchase their own equipment. If the latter route is chosen, it is especially important for the lake group to be very organized and realize that there is a great deal of work and expense involved with the purchase, operation, maintenance, and storage of an aquatic plant harvester. In either case, planning is very important to minimize environmental effects and maximize benefits.



Costs

Equipment costs vary with the size and features of the harvester, but in general, standard harvesters range between $45,000 and $100,000. Larger harvesters or stainless steel models may cost as much as $200,000. Shore conveyors cost approximately $20,000 and trailers range from $7,000 to $20,000. Storage, maintenance, insurance, and operator salaries vary greatly.

Advantages

Immediate results.
Plant biomass and associated nutrients are removed from the lake.
Select areas can be treated, leaving sensitive areas intact.
Plants are not completely removed and can still provide some habitat benefits.
Opening of cruise lanes can increase predator pressure and reduce stunted fish populations.
Removal of plant biomass can improve the oxygen balance in the littoral zone.
Harvested plant materials produce excellent compost.

Disadvantages

Initial costs and maintenance are high if the lake organization intends to own and operate the equipment.
Multiple treatments may be required during the growing season because lower portions of the plant and root systems are left intact.
Many small fish, amphibians and invertebrates may be harvested along with plants.
There is little or no reduction in plant density with harvesting.
Invasive and exotic species may spread because of plant fragmentation associated with harvester operation.
Larger harvesters are not easily maneuverable in shallow water or near docks and piers.
Bottom sediments may be resuspended leading to increased turbidity and water column nutrient levels.

Chemical Treatment

There are many herbicides available for controlling aquatic macrophytes and each compound is sold under many brand names. Aquatic herbicides fall into two general classifications:

1. *Contact herbicides* act by causing extensive cellular damage, but usually do not affect the areas that were not in contact with the chemical. This allows them to work much faster, but does not result in a sustained effect because the root crowns, roots, or rhizomes are not killed.
2. *Systemic herbicides* spread throughout the entire plant and often result in complete mortality if applied at the right time of the year.

Both types are commonly used throughout Wisconsin with varying degrees of success. The use of herbicides is potentially hazardous to both the applicator and the environment, so all lake organizations should seek consultation and/or services from professional applicators with training and experience in aquatic herbicide use.

Below are brief descriptions of the aquatic herbicides currently registered for use in Wisconsin.

Fluridone (Sonar®, Avast!®) Broad spectrum, systemic herbicide that is effective on most submersed and emergent macrophytes. It is also effective on duckweed and at low concentrations has been shown to selectively remove Eurasian water-milfoil. Fluridone slowly kills macrophytes over a 30-90 day period and is only applicable in whole lake treatments or in bays and backwaters were dilution can be controlled. Required length of contact time makes this chemical inapplicable for use in flowages and impoundments. Irrigation restrictions apply.

Glyphosate (Rodeo®) Broad spectrum, systemic herbicide used in conjunction with a *surfactant* to control emergent and floating-leaved macrophytes. It acts in 7-10 days and is not used for submergent species This chemical is commonly used for controlling purple loosestrife (*Lythrum salicaria*).. Glyphosate is also marketed under the name Roundup®; this formulation is not permitted for use near aquatic environments because of its harmful effects on fish, amphibians, and other aquatic organisms.

Diquat (Reward®, Weedtrine-D®) Broad spectrum, contact herbicide that is effective on all aquatic plants and can be sprayed directly on foliage (with surfactant) or injected in the water. It is very fast acting, requiring only 12-36 hours of exposure time. Diquat readily binds with clay particles, so it is not appropriate for use in turbid waters. Consumption restrictions apply.

Endothal (Hydrothol®, Aquathol®) Broad spectrum, contact herbicides used for spot treatments of submersed plants. The mono-salt form of Endothal (Hydrothol®) is more toxic to fish and aquatic invertebrates, so the dipotassium salt (Aquathol®) is most often used. Fish consumption, drinking, and irrigation restrictions apply.

2,4-D (Navigate®, DMA IV®, etc.) Selective, systemic herbicide that only works on broad-leaf plants. The selectivity of 2,4-D towards broad-leaved plants (dicots) allows it to be used for Eurasian water-milfoil without affecting many of our native plants, which are monocots. Drinking and irrigation restrictions apply.

Advantages

Herbicides are easily applied in restricted areas, like around docks and boatlifts.
If certain chemicals are applied at the correct dosages and at the right time of year, they can selectively control certain invasive species, such as Eurasian water-milfoil.
Some herbicides can be used effectively in spot treatments.

Disadvantages

Fast-acting herbicides may cause fishkills due to rapid plant decomposition if not applied correctly.
Many people adamantly object to the use of herbicides in the aquatic environment; therefore, all stakeholders should be included in the decision to use them.
Many herbicides are nonselective.
Most herbicides have a combination of use restrictions that must be followed after their application.
Many herbicides are slow-acting and may require multiple treatments throughout the growing season.

Cost

Herbicide application charges vary greatly between $400 and $1000 per acre depending on the chemical used, who applies it, permitting procedures, and the size of the treatment area.

Biological Controls

There are many insects, fish and pathogens within the United States that are used as biological controls for aquatic macrophytes. For instance, the herbivorous grass carp has been used for years in many states to control aquatic plants with some success and some failures. However, it is illegal to possess grass carp within Wisconsin because their use can create problems worse than the plants that they were used to control. Other states have also used insects to battle invasive plants, such as waterhyacinth weevils (*Neochetina spp.*) and hydrilla stem weevil (*Bagous spp.*) to control waterhyacinth (*Eichhornia crassipes*) and hydrilla (*Hydrilla verticillata),* respectively. Fortunately, it is assumed that Wisconsin's climate is a bit harsh for these two invasive plants, so there is not need for either biocontrol insect. However, Wisconsin, along with many other states, is currently experiencing the expansion of lakes infested with Eurasian water-milfoil and as a result has supported the experimentation and use of the milfoil weevil (*Euhrychiopsis lecontei*) within its lakes. The milfoil weevil is a native weevil that has shown promise in reducing Eurasian water-milfoil stands in Wisconsin, Washington, Vermont, and other states. Research is currently being conducted to discover the best situations for the use of the insect in battling Eurasian water-milfoil. Currently the milfoil weevil is not a Wisconsin Department of Natural Resources grant eligible method of controlling Eurasian Water Milfoil. Wisconsin is also using two species of leaf-eating beetles (*Galerucella calmariensis* and *G. pusilla*) to battle purple loosestrife. These biocontrol insects are not covered here because purple loosestrife is predominantly a wetland species.

Advantages

Milfoil weevils occur naturally in Wisconsin.
This is likely an environmentally safe alternative for controlling Eurasian water-milfoil.

Disadvantages

Stocking and monitoring costs are high.
This is an unproven and experimental treatment.
There is a chance that a large amount of money could be spent with little or no change in Eurasian water-milfoil density.

Cost

Stocking with adult weevils costs about $1.20/weevil and they are usually stocked in lots of 1000 or more.

Analysis of Current Aquatic Plant Data

Aquatic plants are an important element in every healthy lake. Changes in lake ecosystems are often first seen in the lake's plant community. Whether these changes are positive, like variable water levels or negative, like increased shoreland development or the introduction of an exotic species, the plant community will respond. Plant communities respond in a variety of ways; there may be a loss of one or more species, certain life forms, such as emergents or floating-leaf communities may disappear from certain areas of the lake, or there may be a shift in plant dominance between species. With periodic monitoring and proper analysis, these changes are relatively easy to detect and provide very useful information for management decisions.

As described in more detail below, multiple aquatic plant surveys were completed on Pleasant Lake; the first looked systematically at the entire lake's aquatic plant population, the others that followed assessed both native and non-native communities. Combined, these surveys produce a great deal of information about the aquatic vegetation of the lake. These data are analyzed and presented in numerous ways; each is discussed in more detail below. The raw data from the point-intercept survey is contained in Appendix A and has been provided to the Wisconsin Department of Natural Resources.

Primer on Data Analysis & Data Interpretation

Species List

The species list is simply a list of all of the species that were found within the lake, both exotic and native. The list also contains the life-form of each plant found, its scientific name, and its coefficient of conservatism. The latter is discussed in more detail below. Changes in this list over time, whether it is differences in total species present, gains and losses of individual species, or changes in life-forms that are present, can be an early indicator of changes in the health of the lake ecosystem.

Frequency of Occurrence

Frequency of occurrence describes how often a certain species is found within a lake. Obviously, all of the plants cannot be counted in a lake, so samples are collected from pre-determined areas. In the case of Pleasant Lake, plant samples were collected from plots laid out on a grid that covered the entire lake. Using the data collected from these plots, an estimate of occurrence of each plant species can be determined. In this section, relative frequency of occurrence is used to describe how often each species occurred in the plots that contained vegetation. These values are presented in percentages and if all of the values were added up,

they would equal 100%. For example, if water lily had a relative frequency of 0.1 and we described that value as a percentage, it would mean that water lily made up 10% of the population.

In the end, this analysis indicates the species that dominate the plant community within the lake. Shifts in dominant plants over time may indicate disturbances in the ecosystem. For instance, low water levels over several years may increase the occurrence of emergent species while decreasing the occurrence of floating-leaf species. Introductions of invasive exotic species may result in major shifts as they crowd out native plants within the system.

Species Diversity

Species diversity is probably the most misused value in ecology because it is often confused with species richness. Species richness is simply the number of species found within a system or community. Although these values are related, they are far from the same because diversity also takes into account how evenly the species occur within the system. A lake with 25 species may not be more diverse than a lake with 10 if the first lake is highly dominated by one or two species and the second lake has a more even distribution.

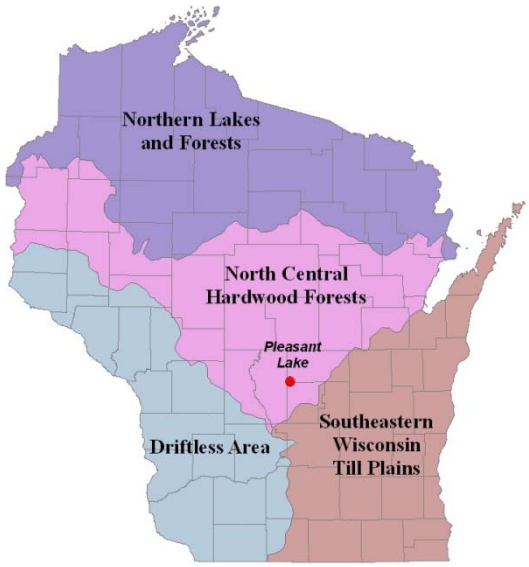


Figure 1. Location of Pleasant Lake within the ecoregions of Wisconsin. After Nichols (1999) and Omernick and. Gallant (1988).

A lake with high species diversity is much more stable than a lake with a low diversity. This is analogous to a diverse financial portfolio in that a diverse lake plant community can withstand environmental fluctuations much like a diverse portfolio can handle economic fluctuations. For example, a lake with a diverse plant community is much better suited to compete against exotic infestation than a lake with a lower diversity.

Floristic Quality Index

The Floristic Quality Index (FQI) is used to evaluate the closeness of a lake's aquatic plant community to that of an undisturbed, or pristine, lake. The higher the floristic quality, the closer a lake is to an undisturbed system. The FQI is an excellent tool for comparing individual lakes and the same lake over time. In this section, the floristic quality of Pleasant Lake will be compared to lakes in the same ecoregion and in the state (Figure 1).

Ecoregions are areas related by similar climate, physiography, hydrology, vegetation and wildlife potential. Comparing ecosystems in the same ecoregion is sounder than comparing systems within manmade boundaries such as counties, towns, or states.

The floristic quality of a lake is calculated using its species richness and average species conservatism. As mentioned above, species richness is simply the number of species that occur in the lake, for this analysis, only native species are utilized. Average species conservatism utilizes the coefficient of conservatism values for each of those species in its calculation. A

species coefficient of conservatism value indicates that species likelihood of being found in an undisturbed (pristine) system. The values range from one to ten. Species that are normally found in disturbed systems have lower coefficients, while species frequently found in pristine systems have higher values. For example, cattail, an invasive native species, has a value of 1, while common hard and softstem bulrush have values of 5, and Oakes pondweed, a sensitive and rare species, has a value of 10. On their own, the species richness and average conservatism values for a lake are useful in assessing a lake's plant community; however, the best assessment of the lake's plant community health is determined when the two values are used to calculate the lake's floristic quality.

Community Mapping

A key component of the aquatic plant survey is the creation of an aquatic plant community map. The map represents a snapshot of the important plant communities in the lake as they existed during the survey and is valuable in the development of the management plan and in comparisons with surveys completed in the future. A mapped community can consist of submergent, floating-leaf, or emergent plants, or a combination of these life-forms. Examples of submergent plants include wild celery and pondweeds; while emergents include cattails, bulrushes, and arrowheads, and floating-leaf species include white and yellow pond lilies. Emergents and floating-leaf communities lend themselves well to mapping because there are distinct boundaries between communities. Submergent species are often mixed throughout large areas of the lake and are seldom visible from the surface; therefore, mapping of submergent communities is more difficult and often impossible.

Exotic Plants

Because of their tendency to upset the natural balance of an aquatic ecosystem, exotic species are paid particular attention to during the aquatic plant surveys. Two exotics, curly-leaf pondweed and Eurasian water milfoil are the primary targets of this extra attention.

Eurasian water-milfoil is an invasive species, native to Europe, Asia and North Africa, that has spread to most Wisconsin counties (Figure 2). Eurasian water-milfoil is unique in that its primary mode of propagation is not by seed. It actually spreads by shoot fragmentation, which has supported its transport between lakes via boats and other equipment. In addition to its propagation method, Eurasian water-milfoil has two other competitive advantages over native aquatic plants, 1) it starts growing very early in the spring when water temperatures are too cold for most native plants to grow, and 2) once its stems reach the water surface, it does not stop growing like most native plants, instead it continues to grow along the surface creating a canopy that blocks light from reaching native plants. Eurasian water-milfoil can create dense stands and dominate

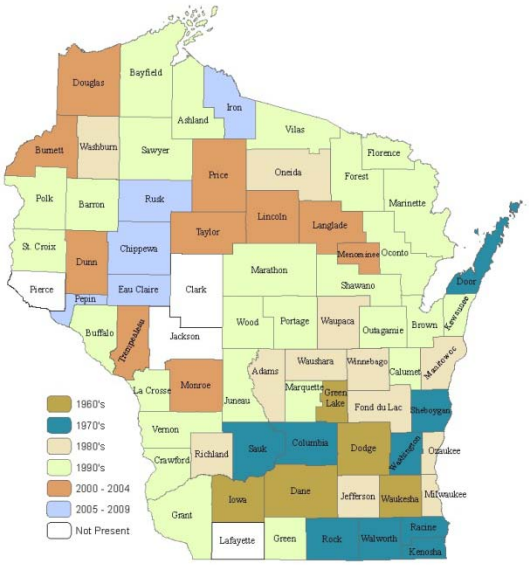


Figure 2. Spread of Eurasian water milfoil within WI counties. Wisconsin Department of Natural Resources Data 2009 mapped by Onterra.

submergent communities, reducing important natural habitat for fish and other wildlife, and impeding recreational activities such as swimming, fishing, and boating.

Curly-leaf pondweed is a European exotic first discovered in Wisconsin in the early 1900's that has an unconventional lifecycle giving it a competitive advantage over our native plants. Curly – leaf pondweed begins growing almost immediately after ice-out and by mid-June is at peak biomass. While it is growing, each plant produces many turions (asexual reproductive shoots) along its stem. By mid-July most of the plants have senesced, or died-back, leaving the turions in the sediment. The turions lie dormant until fall when they germinate to produce winter foliage, which thrives under the winter snow and ice. It remains in this state until spring foliage is produced in early May, giving the plant a significant jump on native vegetation. Like Eurasian water-milfoil, curly-leaf pondweed can become so abundant that it hampers recreational activities within the lake. Furthermore, its mid-summer die back can cause algal blooms spurred from the nutrients released during the plant's decomposition.

Because of its odd life-cycle, a special survey is typically conducted early in the growing season to inventory and map curly-leaf pondweed occurrence within the lake. Although Eurasian water milfoil starts to grow earlier than our native plants, it is at peak growth (biomass) during most of the summer, so it is inventoried during the comprehensive aquatic plant survey completed in mid to late summer.

Aquatic Plant Survey Results

As mentioned above, numerous plant surveys were completed as a part of this project. The point intercept survey was conducted on Pleasant Lake in July 2009 by Onterra (Map 1). Additional surveys were completed by Onterra on Pleasant Lake to create the aquatic plant community map (Map 2) during September 2009.

During the point-intercept and aquatic plant mapping surveys, 22 species of plants were located in Pleasant Lake (Table 1), two are considered non-native species: Eurasian water milfoil and curly-leaf pondweed. Because of its frequency within the lake, Eurasian water milfoil will be discussed in depth within a separate section below.

Median Value This is the value that roughly half of the data are smaller and half the data are larger. A median is used when a few data are so large or so small that they skew the average value to the point that it would not represent the population as a whole.

Due to the start date of this project (when Onterra was contracted), the timeframe had passed for conducting a survey specifically aimed at understanding the occurrence curly-leaf pondweed within Pleasant Lake. As mentioned above, a survey focused upon curly-leaf pondweed would be completed in mid June. Curly-leaf pondweed was located at only a single point-intercept location during the late-July survey. Reliable anecdotal reports from district members indicate that this plant species has existed in Pleasant Lake for many years; however, this survey's finding is the first official documentation of curly-leaf pondweed within Pleasant Lake. A pressed specimen of this species was sent to Dr. Robert Freckmann at University of Wisconsin – Steven's Point for vouchering. In order to fully understand the extent of curly-leaf pondweed within Pleasant Lake, a meander-based survey should be completed during June to correspond with the peak biomass of this species.

Of the 20 native species found on Pleasant Lake, 16 are narrow-leaf species (monocot), three are broad-leaf (dicot) species (coontail, northern water milfoil, and white water lily), and one is a macro-algae (muskgrasses). Wild celery is a turbidity tolerant species that is a premiere food source for ducks, marsh birds, shore birds and muskrats. Pleasant Lake contains numerous "fine-leaved" pondweeds (leafy pondweed, Fries' pondweed, and stiff pondweed) which offer valuable shallow water habitat for invertebrates and provide foraging opportunities for various fish species. Northern water milfoil is usually found in soft sediments and its feathery foliage traps filamentous algae and detritus, providing valuable invertebrate habitat. Because northern water milfoil prefers high water clarity, its populations are declining state-wide as lakes are becoming more eutrophic. The prevalence of marl (calcium carbonate) in Pleasant Lake likely buffers the effects of eutrophication, as phosphorus becomes bound to this molecule as it precipitates making it unusable to most aquatic plants and algae.

Table 1. Aquatic plant species located on Pleasant Lake during the July 23, 2009 survey.



Pleasant Lake has a high number of aquatic plant species, and because of this, one may assume that the system would also have a very high diversity. As discussed earlier, how evenly the species are distributed throughout the system also influences the diversity. The diversity index (Simpson's 1-D) for Pleasant Lake's plant community (0.75) shows that the lake has an uneven

distribution (relative frequency) of plant species throughout the lake. Figure 3 clearly shows that the lake is dominated by muskgrasses (*Chara sp.)*. By removing muskgrasses from the analysis, the diversity of the lake increases greatly (0.91) demonstrating that aside from being dominated by muskgrasses, the other plants in the lake are proportional in their abundances relative to each other.

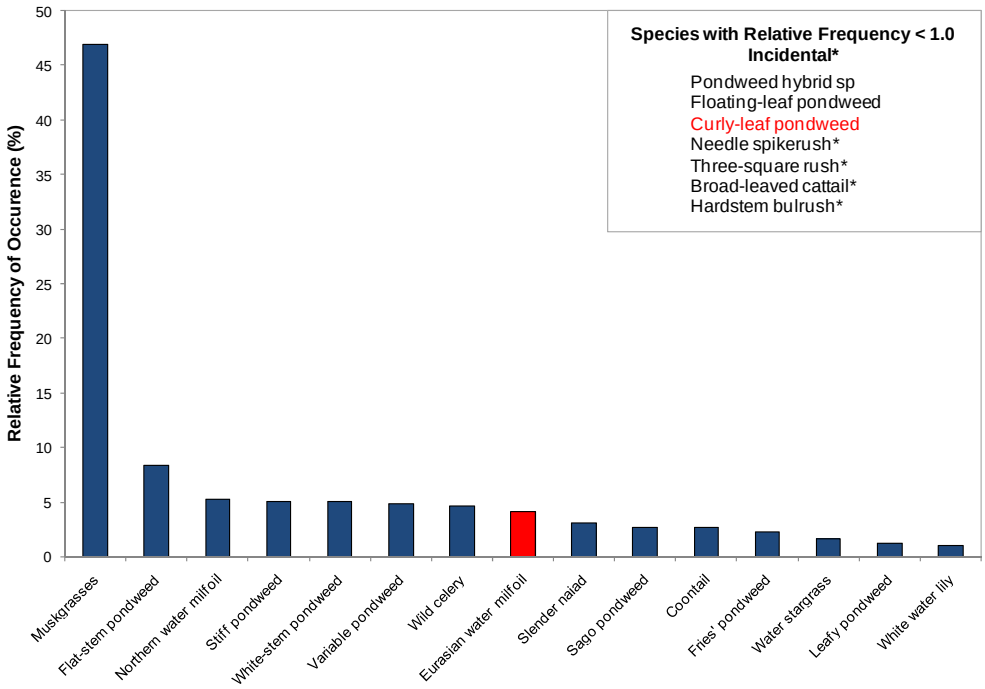


Figure 3. Pleasant Lake aquatic plant occurrence analysis. Created using data from July 23, 2009 survey. Exotic species indicated with red.

Muskgrasses do very well in clear, calcium-rich systems like Pleasant Lake. Actually, of the 419 point-intercept sample locations on Pleasant Lake, 260 contained aquatic plants; and approximately 88% (230) of those locations contained muskgrasses (Map 3). While some may have a negative view regarding the carpet of muskgrasses on the lake, these plants are beneficial to hold sediments in place and likely serve as a barrier to compete against the rapid spread of exotic species within the lake.

The 2009 community map indicates that there are many areas (approximately 4.3 acres) of the lake where important floating-leaf and emergent communities can be found (Map 2). Each of these areas provides valuable fish and wildlife habitat important to the ecosystem of the lake. It is important to note that water levels were low at the time of the survey and numerous emergent communities were observed growing above the waterline and therefore are not displayed on the map (community mapping stopped at shoreline margins). It is likely that if water levels remain at this level for an extended period, these communities will expand lakeward and may recede on the shoreward side as these plants lose exposure to the moist soils they require. Continuing the analogy that the community map represents a 'snapshot' of the important plant communities, a replication of this survey in the future will provide a valuable understanding of the dynamics of these communities within Pleasant Lake.

This is important, because these communities are often negatively affected by recreational use and shoreland development. Radomski and Goeman (2001) found a 66% reduction in vegetation coverage on developed shorelines when compared to undeveloped shorelines in Minnesota Lakes. Furthermore, they also found a significant reduction in abundance and size of northern pike (*Esox lucius*), bluegill (*Lepomis macrochirus*), and pumpkinseed (*Lepomis gibbosus*) associated with these developed shorelines. Many studies have documented the adverse affects of motorboat traffic on aquatic plants (e.g. Murphy and Eaton 1983, Vermaat and de Bruyne 1993, Mumma et al. 1996, Asplund and Cook 1997). In all of these studies, lower plant biomasses and higher turbidity were associated with motorboat traffic. While motorboat activity is prevalent on Pleasant Lake, designated slow-no-wake hours are in place only allowing high speed boating during the middle of the day (11 am to 3 pm).

Data collected from the aquatic plant surveys indicate that the number of native plants in Pleasant Lake is higher than the state median and the North Central Lakes and Flowages ecoregion median (Figure 4). However, Pleasant Lake's aquatic plant community contains a lower average conservatism value than both comparative datasets. These data show that while many species exist within the lake, many are indicative of a disturbed system. This is not surprising due to the large amount of development within Pleasant Lake's watershed and along its shoreline. Combining the lake's species richness and average conservatism values to produce its Floristic Quality Index (FQI) results in an high value of 24.1 (calculation shown below); again, above the median values of the state and ecoregion (Figure 4).

FQI = Average Coefficient of Conservatism (5.4) * √ Number of Native Species (20)
FQI = 24.1

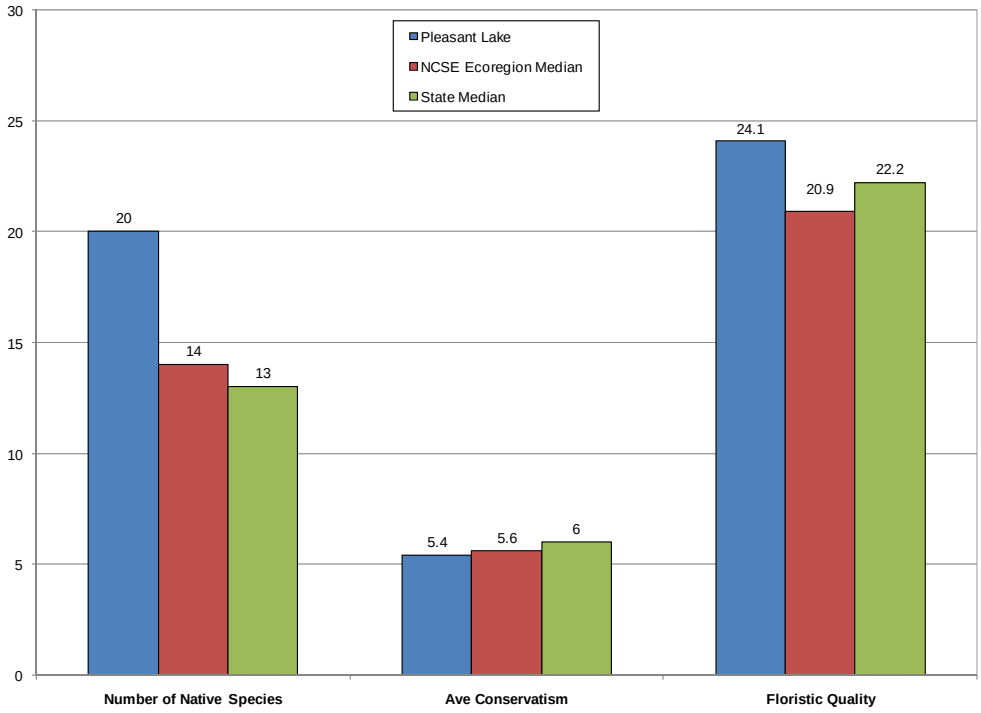


Figure 4. Pleasant Lake Floristic Quality Assessment. Created using data from July and

September, 2009 surveys. Analysis following Nichols (1999).

Eurasian Water Milfoil

Eurasian water milfoil was first suspected to exist in Pleasant Lake during the summer of 2007. Samples of the suspect plant were sent to Dr. Susan Knight (University of Wisconsin Extension), Dr. Robert Freckmann (University of Wisconsin – Steven's Point), and Dr. Stanly Nichols (Wisconsin Geological and Natural History Survey). The plant was confirmed as Eurasian water milfoil and perhaps being a hybrid (Eurasian water milfoil x northern water milfoil) variety. Although Eurasian water milfoil and the hybrid are handled the same way in terms of their management, it is still important to understand if an exotic strain exists within Pleasant Lake. There is a high occurrence of the hybrid within Waushara County. Since dried and pressed specimens are unable to be processed for DNA, a live sample collected during the summer should be submitted for this analysis after consultation with the Wisconsin Department of Natural Resources Regional Lakes Coordinator.

In response to this finding, the district successfully applied for a Wisconsin Department of Natural Resources Aquatic Invasive Species Rapid Response Grant to partially cover the costs associated with the control and monitoring of this pioneer infestation. Clean Boats Clean Waters watercraft monitoring activities conducted by the district were also included within this project. Northern Environmental Technology was contracted by the district to conduct the 2008 herbicide treatment and associated monitoring needs. A pretreatment survey completed on May 1, 2008 verified approximately 2 acres of Eurasian water milfoil in the lake warranting treatment (Map 4). A herbicide treatment was conducted on May 13, 2008 using granular 2,4-D (Navigate®) at a dose of 150 lbs per surface acre. A post treatment survey was conducted on June 24, 2008 and approximately 1/3 of an acre of Eurasian water milfoil was located. A follow-up treatment using the same herbicide and dose was performed on June 25, 2008.

Onterra was contracted in 2009 to conduct various plant surveys on Pleasant Lake, including surveys aimed at understanding the Eurasian water milfoil population in the lake. As discussed above, a point-intercept survey was completed in late-July and Eurasian water milfoil was observed from 20 sample locations (Map 4). On September 3, 2009, Eurasian water milfoil was mapped by Onterra on Pleasant Lake (Map 4). Two types of data were collected during this survey, point-based mapping and area-based mapping.

Point-based mapping, like the name suggests, is when single GPS points are taken to represent the exotic location Two categories were used to assess Eurasian water milfoil in point-based mapping during this survey: single or few plants and clump of plants.

Single or Few Plants When a single or a few Eurasian water milfoil plants were observed in relatively close proximity, the point was designated with this label. Five or more exotic plants in close proximity were too many to represent in this manner.

Clump of Plants A clump is an indistinguishable number of exotic plants growing in a specific location giving it a shrub-like appearance and may roughly approach the size of an automobile. An area larger than that can be better represented using the area-based mapping technique described below. When mapping a clump of plants, the point was taken in the center of the clump.

Area-based mapping techniques are used when the extents of the exotic colony are too large to map with a single point. These areas are delineated by collecting data in the form of a polygon. This is accomplished by boating around the colony while a sub-meter GPS unit, in a continuous data gathering mode, draws a line displaying the colony's margins. Similar to point-based mapping, a density rating is given to the delineated colony. Determining the density rating of an exotic colony is somewhat subjective and in order to accurately assess the continuum of densities, the four categories described below were used.

Scattered If the target plant occurred in an area that could be enclosed by some geographic boundary, such as a shoreline and a depth contour or being found in a small bay and the Eurasian water milfoil's aerial coverage did not meet the density descriptions described below, then the area was labeled as "scattered".

Dominant This rating was used when the colony boundaries are distinct and this exotic appears to be at roughly 50 percent aerial coverage (meaning it is likely the dominant plant in the area).

Highly Dominant These colonies have exotic aerial coverage clearly exceeding 50 percent. The exotic was obviously the dominant species in these colonies, but there was no surface matting.

Surface Matting This rating is reserved only for the densest colonies. In these colonies, exotic aerial coverage approaches 100 percent and the plants are canopied and matted on the surface. Boating in these areas may be difficult due to the mass of exotic plants at the surface. No areas receiving this designation were located on Pleasant Lake during the early-September survey.

Map 4 shows that Eurasian water milfoil was located throughout much of the littoral zone (part of the lake in which plants grow) of the lake, occurring at depths between 2 feet and in excess of 10 feet. The heaviest infestations occurred in the northeastern part of the lake and along the western shoreline of the lake. Within the remaining parts of the lake, a *scattering* of single or clumps of Eurasian water milfoil were found.

Most people involved with Eurasian Water Milfoil management, whether professionals or laypersons, understand that the eradication of Eurasian water milfoil from a lake, or even a specific area of a lake, is nearly, if not totally, impossible. Formulating a plan for treatment is always a difficult and somewhat subjective task. One strategy for Pleasant Lake would be to target the large continuous colonies within the lake in an attempt to reduce the density of Eurasian water milfoil in these areas and restore a level of ecological function within them. As shown on Map 4, these areas are referred to as *Primary Treatment Areas*.

If the goal of the district is to reduce the occurrence and density of this species throughout the lake, a more aggressive approach would be needed. *Secondary Treatment Areas* have also been created that target close aggregations of Eurasian water milfoil locations mapped using point-based techniques. While Eurasian water milfoil locations were located in other areas of the lake, the use of herbicide is likely not justified in these areas as numerous acres of herbicide would need to be applied to target a relatively low number of target plants. These areas may be more applicable to hand-removal techniques at this time. Targeting both primary and secondary treatment areas would exceed the 10-acre threshold making it a large-scale treatment. This would require special permitting needs to be met. Additional treatment monitoring activities may also be required as a condition of the large-scale permit.

The recommended herbicide to control Eurasian water milfoil is 2,4-D, sold under the trade names Navigate (granular formulation) and DMA IV (liquid formulation). When applied correctly by a licensed-applicator, the use of this herbicide does not pose a risk to aquatic wildlife. 2,4-D is a systemic herbicide that when applied under the appropriate rates, only affects broad-leaf (dicot) plants. The selectivity of 2,4-D towards broad-leaved plants allows it to be used for Eurasian water milfoil without affecting many of the lake's native plants, which are monocots. In order to further reduce the risk to native plants, especially native dicots, a control strategy using 2,4-D should be completed during the early spring when Eurasian Water Milfoil is growing, but the native plants are not. Eurasian water milfoil will begin growing soon following ice-out, while our native plants do not start to grow until the water is warmer and approaching 60º F. Because the district believes that the 2008 treatment was successful, Map 4 displays the treatment strategy utilizing the same herbicide and dose used in 2008. However, the success of this treatment is arguable as Eurasian water milfoil has greatly expanded since this treatment was conducted. But this could be a result of differences in survey techniques between 2008 and 2009. Further consultation with the district's applicator should occur to determine the most appropriate 2,4-D formulation and dose for the 2010 herbicide application.

Similar to the approach Northern Environmental Technology took in 2008, a pretreatment survey should be conducted just previous to the 2010 treatment to verify its occurrence and refine the colony margins to reflect the Eurasian water milfoil at the time of the herbicide treatment. A peak-biomass survey conducted in the late-summer after the treatment can be compared with the 2009 survey to evaluate the control measures and setup the following year's treatment (if needed).

While this report details the aquatic plant community of Pleasant Lake, it does not include all of the components necessary to qualify as a comprehensive lake management plan, including a long-term control strategy for Eurasian water milfoil. Eventually the Wisconsin Department of Natural Resources will request an approved lake management plan for Pleasant Lake to be in place if large-scale manipulations like chemical treatments continue, so it may be in the district's best interest to start this process before it becomes a road block to Eurasian water milfoil management.

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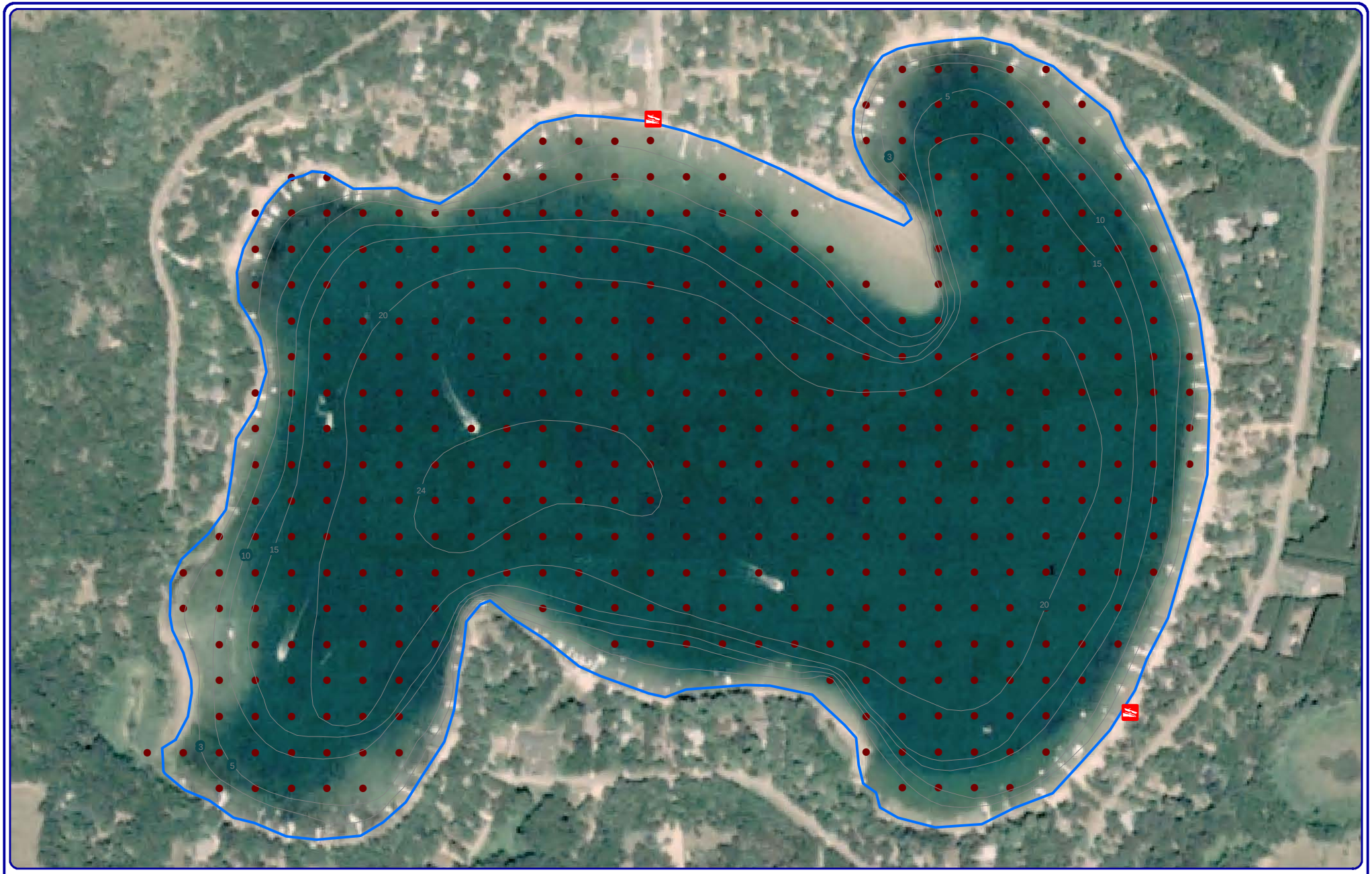
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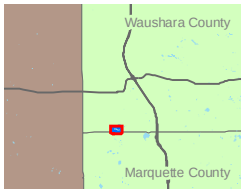
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Feet

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Sources:
Roads and Hydro: WDNR
Orthophotography: NAIP, 2006
Aquatic Plants: Onterra, 2009

Map Date: December, 21 2009

File Name: Map1_Pleasant_Location.mxd



Extent of large map shown in red.

Legend

Pleasant Lake ~ 127 acres
WDNR Definition

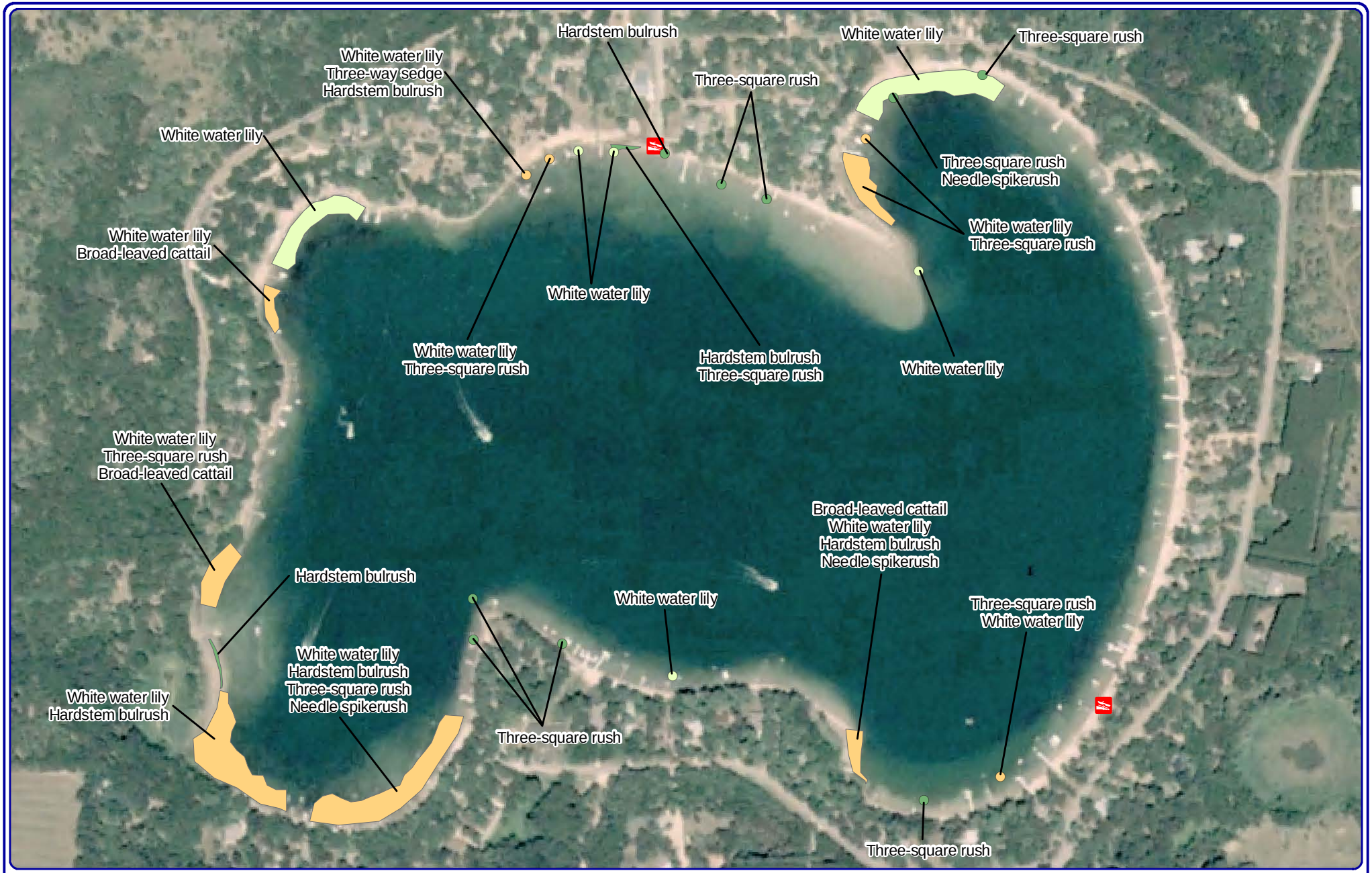
Point-intercept Survey Location
34-meter spacing - 419 total points

Map 1

Pleasant Lake

Waushara & Marquette Counties, Wisconsin

Project Location And Lake Boundaries



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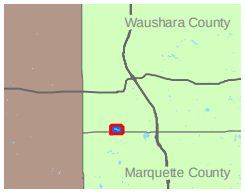
425
Feet

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Sources:
Orthophotography: NAIP, 2006
Aquatic Plants: Onterra, 2009

Map Date: October 2, 2009

File Name: Map2_Pleasant_Comm_Aug09.mxd



Extent of large map shown in red.

Legend

Public Access

Large Plant Communities

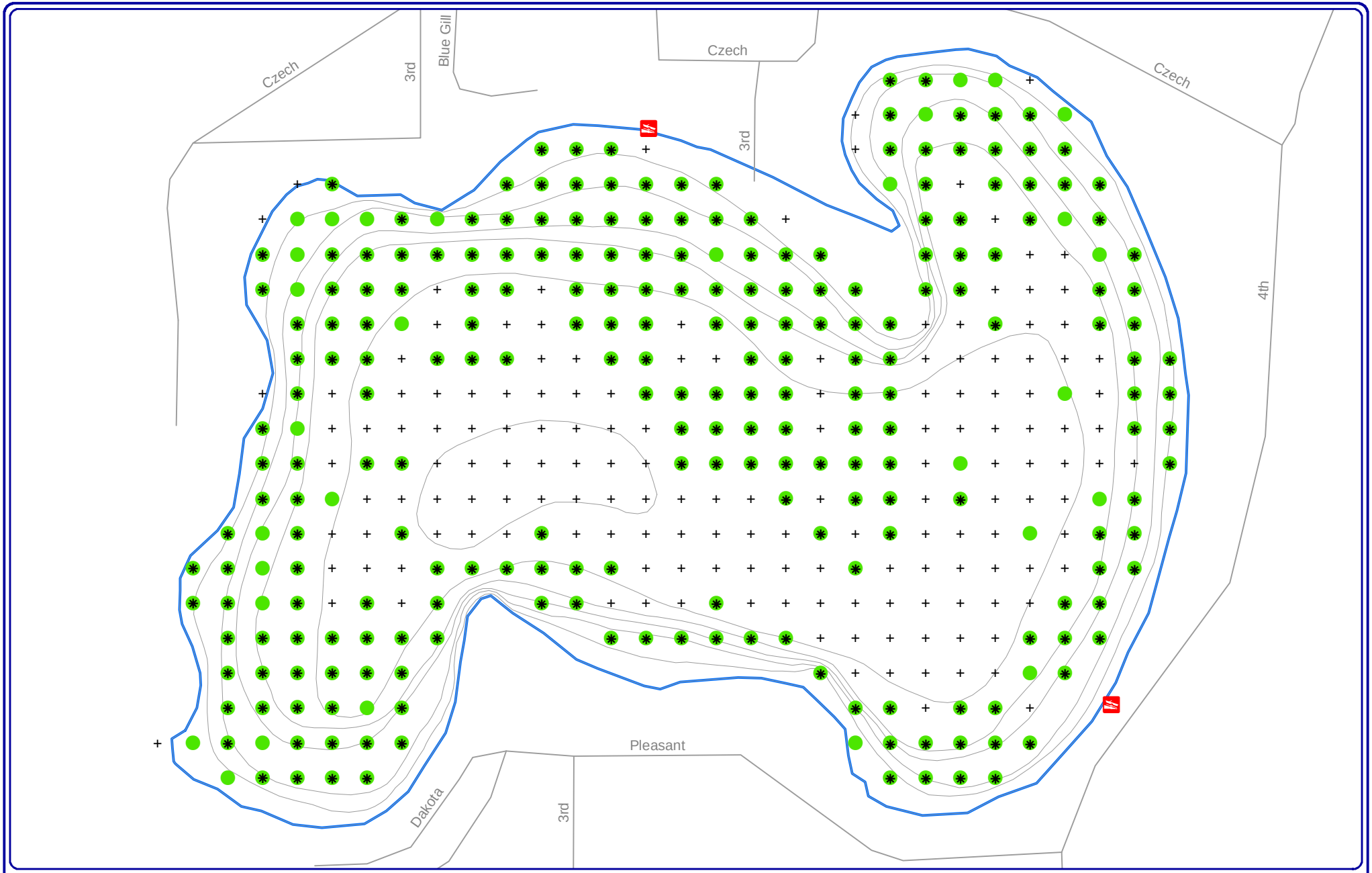
- Emergent
- Floating-leaf
- Mixed floating-leaf & emergent

Small Plant Communities

- Emergent
- Floating-leaf
- Mixed floating-leaf & emergent

Map 2
Pleasant Lake
Waushara & Marquette Counties, Wisconsin

Aquatic Plant Communities

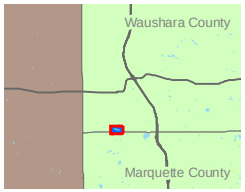


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Sources:
Roads and Hydro: WDNR
Orthophotography: NAIP, 2006
Aquatic Plants: Onterra, 2009
Map Date: December, 21 2009
File Name: Map3_Pleasant_Chara_PI.mxd



Extent of large map shown in red.

Legend

+ No Aquatic Plants
● Contains Aquatic Plants
✱ Contains Muskgrasses

Map 3
Pleasant Lake
Waushara & Marquette Counties, Wisconsin
2009 Point-intercept Survey Results

2010 Proposed Treatment Areas

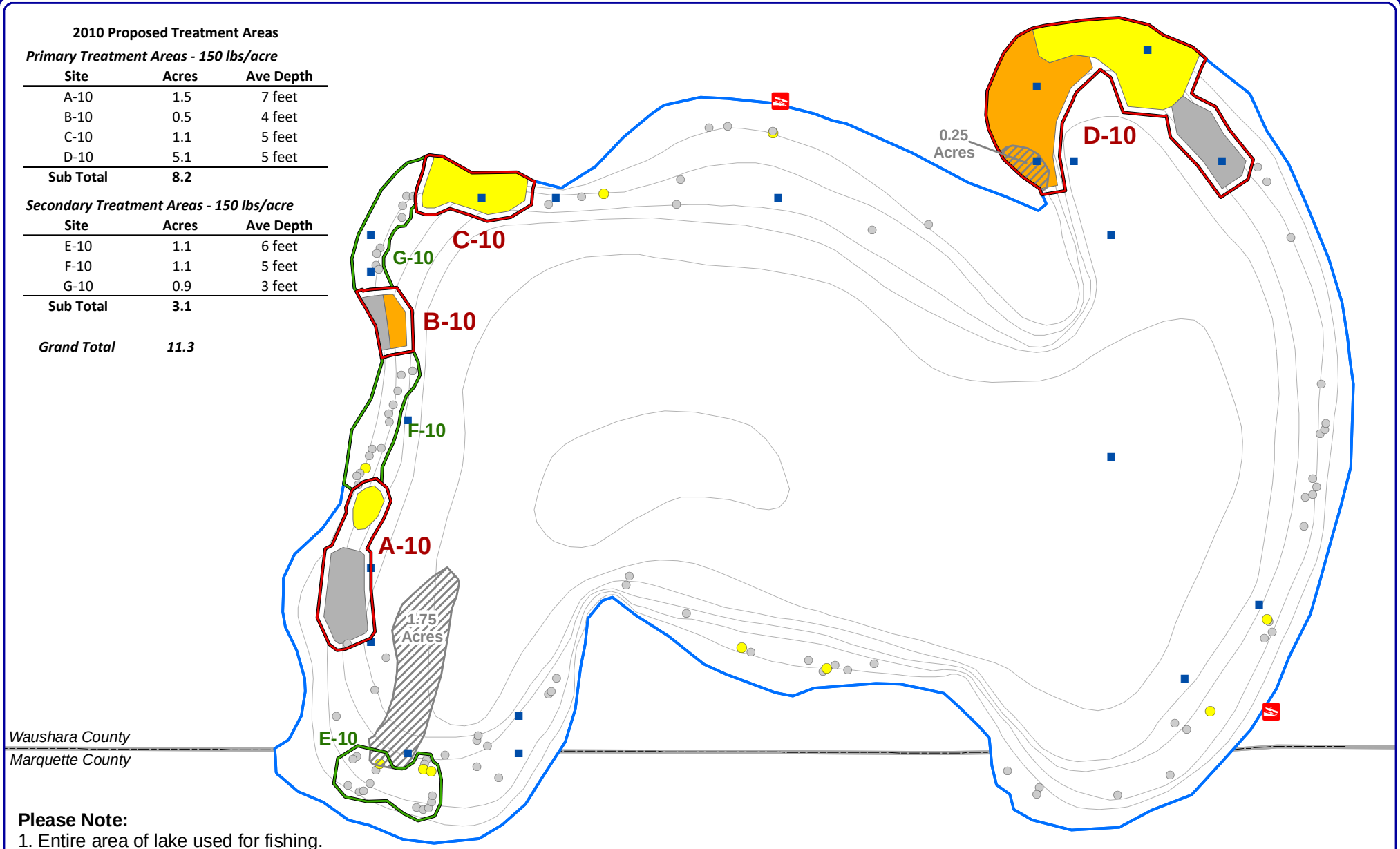
Primary Treatment Areas - 150 lbs/acre

Site	Acres	Ave Depth
A-10	1.5	7 feet
B-10	0.5	4 feet
C-10	1.1	5 feet
D-10	5.1	5 feet
Sub Total	**8.2**	

Secondary Treatment Areas - 150 lbs/acre

Site	Acres	Ave Depth
E-10	1.1	6 feet
F-10	1.1	5 feet
G-10	0.9	3 feet
Sub Total	**3.1**	

Grand Total ***11.3***



Please Note:

1. Entire area of lake used for fishing.
2. Proposed Treatment areas are used for all boating activities.

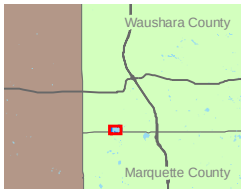
N W E S

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Feet

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Sources:
Roads and Hydro: WDNR
Aquatic Plants: Onterra, 2009
Map Date: December 23, 2009
File Name: Map4_Pleasant_T2010_EWM_Cond1.mxd



Extent of large map shown in red.

2008 Treatment Area *(~2.0 Acres)*

2010 Proposed Treatment Areas
Primary Treatment Area
Secondary Treatment Area

Point-intercept Survey Results (Aug 2009)
Contains Eurasian Water Milfoil

EWM Survey Results (Sept 2009)
Single or Few Plants
Clumps of Plants
Scattered
Dominant
Highly Dominant
Surface Matting *(none found)*

Map 4
Pleasant Lake
Waushara & Marquette Counties, Wisconsin

2009 EWM Survey Results and 2010 Propsed Treatment

Sampling Point	Latitude (decimal degrees)	Longitude (decimal degrees)	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock)	Sampled holding rake pole (P) or rake rope (R)	Comments	*Myriophyllum spicatum*	*Potamogeton crispus*	*Chara sp.*	*Potamogeton zosteriformis*	*Myriophyllum sibiricum*	*Potamogeton praelongus*	*Potamogeton strictifolius*	*Potamogeton gramineus*	*Vallisneria americana*	*Najas flexilis*	*Ceratophyllum demersum*	*Stuckenia pectinata*	*Potamogeton friesii*	*Heteranthera dubia*	*Potamogeton foliosus*	*Nymphaea odorata*	*Potamogeton hybrid sp*	*Potamogeton natans*
1	43.98233	-89.55856				Unreachable																		
2	43.98386	-89.55813	2	S	P				1				1					1						
3	43.98356	-89.55813	1	S	P				1															
4	43.98233	-89.55814	2	M	P					1			2							1		1		
5	43.98417	-89.55770	3	S	P				2															
6	43.98386	-89.55771	3	M	P				3															
7	43.98355	-89.55771	4	M	P				2									1						
8	43.98325	-89.55771	4	M	P				2					1										
9	43.98294	-89.55771	3	S	P				2															
10	43.98264	-89.55771	3	M	P				1										1					
11	43.98233	-89.55772	5	M	P				1	2									1					
12	43.98202	-89.55772	2	S	P								2		1	1		1	1			1		
13	43.98692	-89.55726				Unreachable																		
14	43.98661	-89.55726	3	M	P		1		1							1						1		
15	43.98631	-89.55726	3	M	P		1		1	1								1						
16	43.98539	-89.55727				Unreachable																		
17	43.98508	-89.55727	3	M	P				3															
18	43.98478	-89.55727	5	M	P				3															
19	43.98447	-89.55728	9	M	P				1															
20	43.98416	-89.55728	13	-	R					1	1	1			2				1				1	
21	43.98386	-89.55728	9	M	P		1			3										1				
22	43.98355	-89.55728	9	M	P					2										1				
23	43.98325	-89.55729	6	M	P		1		2	1														
24	43.98294	-89.55729	6	M	P				2					1		1								
25	43.98263	-89.55729	13	-	R				1	2	1							1						
26	43.98233	-89.55729	8	M	P						1													
27	43.98202	-89.55730	4	M	P				2															
28	43.98722	-89.55683				Unreachable																		
29	43.98692	-89.55683	4	M	P					1			3		1									
30	43.98661	-89.55684	8	M	P					3		1												
31	43.98631	-89.55684	7	M	P			1		2			1		1				1	1				
32	43.98600	-89.55684	9	M	P				3															
33	43.98569	-89.55684	6	M	P				2					1										
34	43.98539	-89.55685	6	M	P				2															
35	43.98508	-89.55685	13	-	R		1			1	1													
36	43.98477	-89.55685	13	-	R				1	1	1						1							
37	43.98447	-89.55685	15	-	R				2															
38	43.98416	-89.55686	17	-	R				3															
39	43.98386	-89.55686	18	-	R				1															
40	43.98355	-89.55686	17	-	R				2															
41	43.98324	-89.55686	15	-	R				3		1													
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44	43.98233	-89.55687	14	-	R		3		1															
45	43.98202	-89.55687	6	M	P				2	1			1			1								
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47	43.98692	-89.55641	7	M	P					3	1	1	1											
48	43.98661	-89.55641	16	-	R				2															
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50	43.98600	-89.55642	18	-	R				1															
51	43.98569	-89.55642	15	-	R				2															
52	43.98539	-89.55642				BOAT																		
53	43.98508	-89.55642	19	-	R	No Vegetation																		
54	43.98477	-89.55643	20	-	R																			
55	43.98447	-89.55643	21	-	R																1			
56	43.98416	-89.55643	20	-	R	No Vegetation																		
57	43.98385	-89.55643	20	-	R	No Vegetation																		
58	43.98355	-89.55644	20	-	R	No Vegetation																		
59	43.98324	-89.55644	19	-	R				2															
60	43.98294	-89.55644	18	-	R				1															
61	43.98263	-89.55644	15	-	R				3															
62	43.98232	-89.55644	8	M	P				1	2	1			1	1			1			1			
63	43.98202	-89.55645	4	S	P				1															
64	43.98691	-89.55599	5	M	P		1			3	1	1			1			1						
65	43.98661	-89.55599	16	-	R				1															
66	43.98630	-89.55599	19	-	R				2															
67	43.98600	-89.55599	19	-	R				1															
68	43.98569	-89.55600	20	-	R				1															
69	43.98538	-89.55600	20	-	R				1												1			
70	43.98508	-89.55600	21	-	R	No Vegetation																		
71	43.98477	-89.55600	21	-	R				1															
72	43.98447	-89.55601	22	-	R	No Vegetation																		
73	43.98416	-89.55601	22	-	R	No Vegetation																		
74	43.98385	-89.55601	21	-	R	No Vegetation																		
75	43.98355	-89.55601	21	-	R				2															
76	43.98324	-89.55601	20	-	R				2															
77	43.98293	-89.55602	17	-	R				3															
78	43.98263	-89.55602	9	M	P					2		1	1											

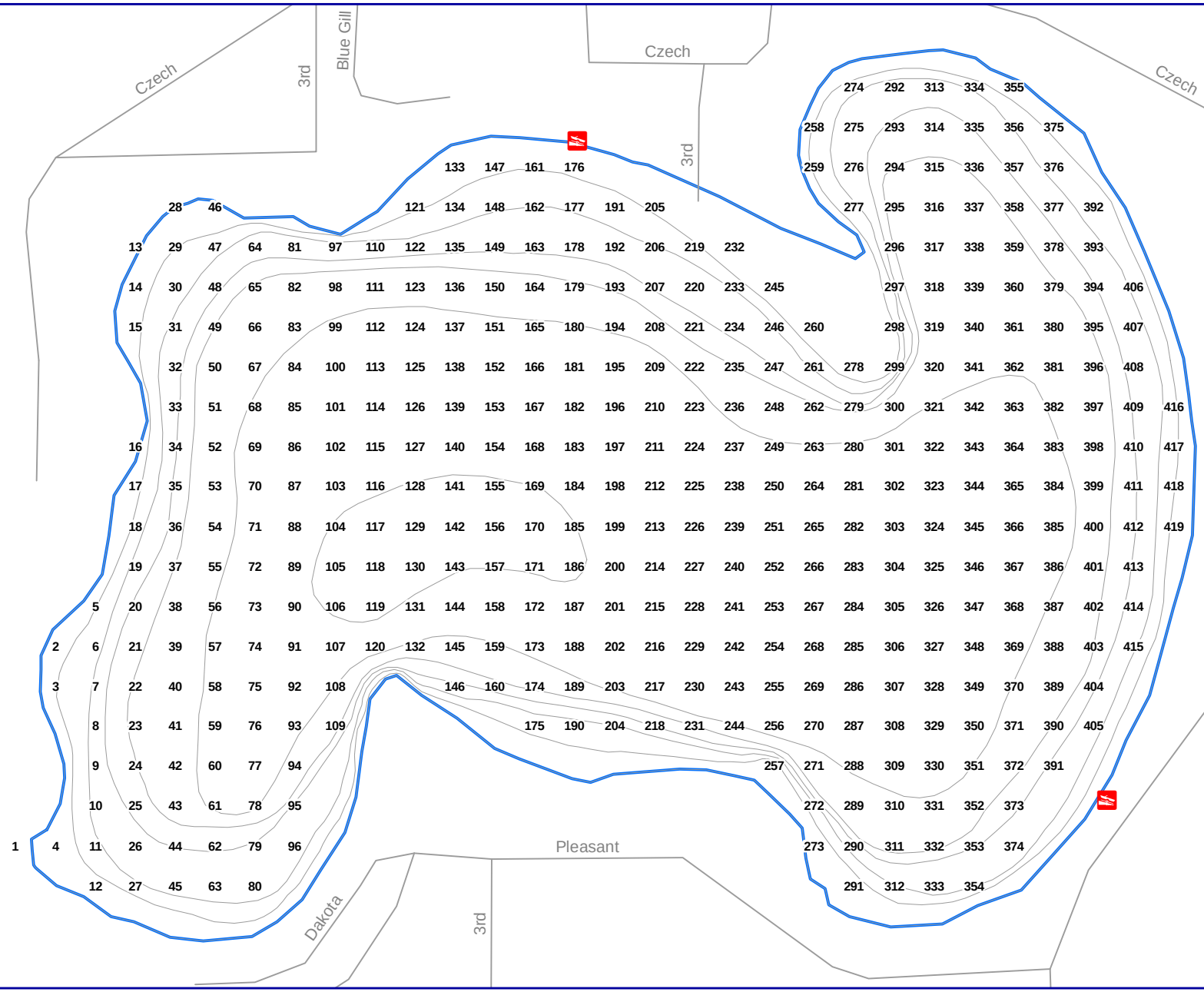
Sampling Point	Latitude (decimal degrees)	Longitude (decimal degrees)	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock)	Sampled holding rake pole (P) or rake rope (R)	Comments	*Myriophyllum spicatum*	*Potamogeton crispus*	*Chara sp.*	*Potamogeton zosteriformis*	*Myriophyllum sibiricum*	*Potamogeton praelongus*	*Potamogeton strictifolius*	*Potamogeton gramineus*	*Vallisneria americana*	*Najas flexilis*	*Ceratophyllum demersum*	*Stuckenia pectinata*	*Potamogeton friesii*	*Heteranthera dubia*	*Potamogeton foliosus*	*Nymphaea odorata*	*Potamogeton hybrid sp*	*Potamogeton natans*
79	43.98232	-89.55602	7	S	P				1															
80	43.98202	-89.55602	4	S	P				2			1												
81	43.98691	-89.55556	5	M	P				2															
82	43.98661	-89.55557	16	-	R				1		1													
83	43.98630	-89.55557	19	-	R				1															
84	43.98599	-89.55557	20	-	R												2							
85	43.98569	-89.55557	21	-	R	No Vegetation																		
86	43.98538	-89.55557	21	-	R	No Vegetation																		
87	43.98508	-89.55558	22	-	R	No Vegetation																		
88	43.98477	-89.55558	22	-	R				2															
89	43.98446	-89.55558	22	-	R	No Vegetation																		
90	43.98416	-89.55558	22	-	R				1															
91	43.98385	-89.55559	22	-	R	No Vegetation																		
92	43.98355	-89.55559	20	-	R	No Vegetation																		
93	43.98324	-89.55559	18	-	R				2															
94	43.98293	-89.55559	13	-	R				1		1		1											
95	43.98263	-89.55559	7	M	P		1		1	2	1	1												
96	43.98232	-89.55560	3	M	P		1		3															
97	43.98691	-89.55514	4	S	P		1													1				
98	43.98660	-89.55514	17	-	R				3															
99	43.98630	-89.55514	20	-	R	No Vegetation																		
100	43.98599	-89.55515	21	-	R	No Vegetation																		
101	43.98569	-89.55515	21	-	R				1															
102	43.98538	-89.55515	22	-	R	No Vegetation																		
103	43.98507	-89.55515	22	-	R	No Vegetation																		
104	43.98477	-89.55515	22	-	R	No Vegetation																		
105	43.98446	-89.55516	22	-	R	No Vegetation																		
106	43.98416	-89.55516	22	-	R	No Vegetation																		
107	43.98385	-89.55516	22	-	R				1															
108	43.98354	-89.55516	22	-	R				3															
109	43.98324	-89.55517	16	-	R				2															
110	43.98691	-89.55471	8	M	P				3															
111	43.98660	-89.55472	18	-	R				2		1													
112	43.98630	-89.55472	20	-	R				3															
113	43.98599	-89.55472	21	-	R				2															
114	43.98568	-89.55472	21	-	R				3															
115	43.98538	-89.55473	22	-	R																			
116	43.98507	-89.55473																						
117	43.98477	-89.55473																						
118	43.98446	-89.55473																						
119	43.98415	-89.55474	22	-	R	No Vegetation																		
120	43.98385	-89.55474	20	-	R				1															
121	43.98721	-89.55429	4	S	P				2															
122	43.98691	-89.55429	7	M	P				2		1													
123	43.98660	-89.55429	17	-	R				2		1						2							
124	43.98630	-89.55430	20	-	R	No Vegetation			2															
125	43.98599	-89.55430	21	-	R																			
126	43.98568	-89.55430	22	-	R	No Vegetation			1															
127	43.98538	-89.55430	22	-	R	Too Deep																		
128	43.98507	-89.55430				Too Deep																		
129	43.98476	-89.55431				Too Deep																		
130	43.98446	-89.55431				Too Deep																		
131	43.98415	-89.55431	22	-	R	No Vegetation																		
132	43.98385	-89.55431	9	R	P				1				1											
133	43.98752	-89.55386	2	S	P				1				1		1	2		1	1			1		
134	43.98721	-89.55386	4	M	P				1							1								
135	43.98691	-89.55387	7	M	P				2	1	1	1							1					
136	43.98660	-89.55387	17	-	R				3															
137	43.98629	-89.55387	20	-	R	No Vegetation																		
138	43.98599	-89.55387	21	-	R	No Vegetation																		
139	43.98568	-89.55388	22	-	R	No Vegetation																		
140	43.98538	-89.55388				Too Deep																		
141	43.98507	-89.55388				Too Deep																		
142	43.98476	-89.55388				Too Deep																		
143	43.98446	-89.55389				Too Deep																		
144	43.98415	-89.55389	22	-	R				1															
145	43.98384	-89.55389	17	-	R				2															
146	43.98354	-89.55389	5	S	P				2															
147	43.98752	-89.55344	2	S	P				1				1			1		1						
148	43.98721	-89.55344	4	S	P				2					1		1								
149	43.98690	-89.55344	8	S	P				1	1	1	1				1								
150	43.98660	-89.55345	16	-	R				2															
151	43.98629	-89.55345	20	-	R				1															
152	43.98599	-89.55345	21	-	R				2															
153	43.98568	-89.55345	22	-	R	No Vegetation																		
154	43.98537	-89.55345	22	-	R	No Vegetation																		
155	43.98507	-89.55346				Too Deep																		
156	43.98476	-89.55346				Too Deep																		

Sampling Point	Latitude (decimal degrees)	Longitude (decimal degrees)	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock)	Sampled holding rake pole (P) or rake rope (R)	Comments	*Myriophyllum spicatum*	*Potamogeton crispus*	*Chara sp.*	*Potamogeton zosteriformis*	*Myriophyllum sibiricum*	*Potamogeton praelongus*	*Potamogeton strictifolius*	*Potamogeton gramineus*	*Vallisneria americana*	*Najas flexilis*	*Ceratophyllum demersum*	*Stuckenia pectinata*	*Potamogeton friesii*	*Heteranthera dubia*	*Potamogeton foliosus*	*Nymphaea odorata*	*Potamogeton hybrid sp*	*Potamogeton natans*
157	43.98446	-89.55346				Too Deep																		
158	43.98415	-89.55346	22	-	R	No Vegetation																		
159	43.98384	-89.55347	19	-	R				1	1											1			
160	43.98354	-89.55347	14	-	R				2															
161	43.98751	-89.55301	3	S	P				2					1		1								
162	43.98721	-89.55302	4	S	P				2															
163	43.98690	-89.55302	7	S	P				2	1			2											
164	43.98660	-89.55302	16	-	R				3			1					1						1	
165	43.98629	-89.55302	19	-	R				3															
166	43.98598	-89.55303	21	-	R				3															
167	43.98568	-89.55303	21	-	R				2															
168	43.98537	-89.55303	22	-	R	No Vegetation																		
169	43.98507	-89.55303				Too Deep																		
170	43.98476	-89.55304				Too Deep																		
171	43.98445	-89.55304				Too Deep																		
172	43.98415	-89.55304	22	-	R	No Vegetation																		
173	43.98384	-89.55304	20	-	R				2															
174	43.98354	-89.55304	19	-	R	No Vegetation																		
175	43.98323	-89.55305	9	S	P				2				1	1				1						
176	43.98751	-89.55259	2	S	P	No Vegetation																		
177	43.98721	-89.55259	4	S	P				2															
178	43.98690	-89.55260	6	M	P		1		2					1		1								
179	43.98660	-89.55260	16	-	R				2															
180	43.98629	-89.55260	19	-	R				1															
181	43.98598	-89.55260	20	-	R				1															
182	43.98568	-89.55260	21	-	R				2															
183	43.98537	-89.55261	22	-	R				1															
184	43.98506	-89.55261	22	-	R	No Vegetation																		
185	43.98476	-89.55261	24	-	R	No Vegetation																		
186	43.98445	-89.55261	24	-	R	No Vegetation																		
187	43.98415	-89.55262	22	-	R	No Vegetation																		
188	43.98384	-89.55262	21	-	R	No Vegetation																		
189	43.98353	-89.55262	20	-	R	No Vegetation																		
190	43.98323	-89.55262	18	-	R				3															
191	43.98721	-89.55217	4	M	P				2															
192	43.98690	-89.55217	7	M	P				3					1										
193	43.98659	-89.55217	15	-	R				2															
194	43.98629	-89.55218	18	-	R				1															
195	43.98598	-89.55218	20	-	R	No Vegetation																		
196	43.98568	-89.55218	21	-	R	No Vegetation																		
197	43.98537	-89.55218	21	-	R				2															
198	43.98506	-89.55218	21	-	R				2															
199	43.98476	-89.55219	22	-	R				1															
200	43.98445	-89.55219	23			Too Deep																		
201	43.98414	-89.55219				Too Deep																		
202	43.98384	-89.55219	22	-	R	No Vegetation																		
203	43.98353	-89.55220	21	-	R	No Vegetation																		
204	43.98323	-89.55220	19	-	R				3															
205	43.98720	-89.55174	3	S	P				2															
206	43.98690	-89.55175	7	S	P				3					1										
207	43.98659	-89.55175	14	-	R						1	1					1							
208	43.98629	-89.55175	19	-	R				1															
209	43.98598	-89.55175	20	-	R				1															
210	43.98567	-89.55176	21	-	R	No Vegetation																		
211	43.98537	-89.55176	21	-	R				2															
212	43.98506	-89.55176	21	-	R				1															
213	43.98476	-89.55176	21	-	R				2															
214	43.98445	-89.55177	22	-	R	No Vegetation																		
215	43.98414	-89.55177	22	-	R	No Vegetation																		
216	43.98384	-89.55177	22	-	R	No Vegetation																		
217	43.98353	-89.55177	21	-	R				1															
218	43.98322	-89.55177	15	-	R				1															
219	43.98690	-89.55132	5	S	P				3					1										
220	43.98659	-89.55133	8	M	P				3															
221	43.98628	-89.55133	16	-	R				1															
222	43.98598	-89.55133	19	-	R				2															
223	43.98567	-89.55133	20	-	R				3															
224	43.98537	-89.55133	21	-	R				1															
225	43.98506	-89.55134	21	-	R				1															
226	43.98475	-89.55134	21	-	R				2															
227	43.98445	-89.55134	21	-	R	No Vegetation																		
228	43.98414	-89.55134	22	-	R	No Vegetation																		
229	43.98384	-89.55135	22	-	R	No Vegetation																		
230	43.98353	-89.55135	22	-	R	No Vegetation																		
231	43.98322	-89.55135	17	-	R				1					1										
232	43.98689	-89.55090	4	S	P	No Vegetation																		
233	43.98659	-89.55090	6	M	P				3					1										
234	43.98628	-89.55090	15	-	R				2															

Sampling Point	Latitude (decimal degrees)	Longitude (decimal degrees)	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock)	Sampled holding rake pole (P) or rake rope (R)	Comments	*Myriophyllum spicatum*	*Potamogeton crispus*	*Chara sp.*	*Potamogeton zosteriformis*	*Myriophyllum sibiricum*	*Potamogeton praelongus*	*Potamogeton strictifolius*	*Potamogeton gramineus*	*Vallisneria americana*	*Najas flexilis*	*Ceratophyllum demersum*	*Stuckenia pectinata*	*Potamogeton friesii*	*Heteranthera dubia*	*Potamogeton foliosus*	*Nymphaea odorata*	*Potamogeton hybrid sp*	*Potamogeton natans*
235	43.98598	-89.55091	19	-	R				2															
236	43.98567	-89.55091	19	-	R				2															
237	43.98536	-89.55091	21	-	R				2															
238	43.98506	-89.55091	21	-	R				2															
239	43.98475	-89.55092	21	-	R				3															
240	43.98445	-89.55092	21	-	R				3															
241	43.98414	-89.55092	22	-	R	No Vegetation																		
242	43.98383	-89.55092	22	-	R	No Vegetation																		
243	43.98353	-89.55092	22	-	R	No Vegetation																		
244	43.98322	-89.55093	14	-	R				1															
245	43.98659	-89.55048	4	S	P				2					1		1								
246	43.98628	-89.55048	9	M	P				1															
247	43.98597	-89.55048	18	-	R				2															
248	43.98567	-89.55048	20	-	R	No Vegetation																		
249	43.98536	-89.55049	21	-	R	No Vegetation																		
250	43.98506	-89.55049	21	-	R	No Vegetation																		
251	43.98475	-89.55049	21	-	R				2															
252	43.98444	-89.55049	21	-	R	No Vegetation																		
253	43.98414	-89.55050	21	-	R				1															
254	43.98383	-89.55050	21	-	R	No Vegetation																		
255	43.98353	-89.55050	22	-	R	No Vegetation																		
256	43.98322	-89.55050	20	-	R	No Vegetation																		
257	43.98291	-89.55051	8	M	P				2				1	1										
258	43.98781	-89.55004				Unreachable																		
259	43.98750	-89.55005				Unreachable																		
260	43.98628	-89.55006	4	S	P				1															
261	43.98597	-89.55006	17	-	R				3															
262	43.98567	-89.55006	20	-	R				2															
263	43.98536	-89.55006	21	-	R				1															
264	43.98505	-89.55007	21	-	R				1															
265	43.98475	-89.55007	21	-	R				2															
266	43.98444	-89.55007	21	-	R				2															
267	43.98414	-89.55007	22	-	R	No Vegetation																		
268	43.98383	-89.55007	22	-	R				1															
269	43.98352	-89.55008	21	-	R	No Vegetation																		
270	43.98322	-89.55008	20	-	R	No Vegetation																		
271	43.98291	-89.55008	18	-	R	No Vegetation																		
272	43.98261	-89.55008	14	-	R				3															
273	43.98230	-89.55009	3	S	P					1														
274	43.98811	-89.54962	3	S	P				1															
275	43.98781	-89.54962	5	M	P		1		1	1		1			1	1								1
276	43.98750	-89.54962	5	M	P				2			1			1									
277	43.98720	-89.54962	5	M	P		1					1		1	1	1					1			
278	43.98597	-89.54963	13	M	P				1					1										
279	43.98567	-89.54964	19	-	R				1															
280	43.98536	-89.54964	21	-	R				1															
281	43.98505	-89.54964	21	-	R				1															
282	43.98475	-89.54964	22	-	R				1															
283	43.98444	-89.54965	22	-	R				1				1											
284	43.98413	-89.54965	22	-	R				1															
285	43.98383	-89.54965	22	-	R	No Vegetation																		
286	43.98352	-89.54965	22	-	R	No Vegetation																		
287	43.98322	-89.54966	22	-	R	No Vegetation																		
288	43.98291	-89.54966	21	-	R	No Vegetation																		
289	43.98260	-89.54966	20	-	R				1															
290	43.98230	-89.54966	9	M	P				2															
291	43.98199	-89.54966	4	M	P				3															
292	43.98811	-89.54919	4	M	P				1	1		1	1		1	1		1	1	1				
293	43.98781	-89.54920	9	M	P					3		1			1		1			1				
294	43.98750	-89.54920	14	-	R				3		1													
295	43.98719	-89.54920	15	-	R		1		1															
296	43.98689	-89.54920	13	M	P				1															
297	43.98658	-89.54921	4	S	P				1	1			1					1		1				
298	43.98628	-89.54921	2	S	P				1															
299	43.98597	-89.54921	20	-	R																			
300	43.98566	-89.54921	21	-	R	No Vegetation																		
301	43.98536	-89.54921	22	-	R	No Vegetation																		
302	43.98505	-89.54922	22	-	R	No Vegetation																		
303	43.98475	-89.54922	22	-	R	No Vegetation																		
304	43.98444	-89.54922	22	-	R	No Vegetation																		
305	43.98413	-89.54922				Too Deep																		
306	43.98383	-89.54923	22	-	R	No Vegetation																		
307	43.98352	-89.54923	22	-	R	No Vegetation																		
308	43.98321	-89.54923	22	-	R	No Vegetation																		
309	43.98291	-89.54923	21	-	R	No Vegetation																		
310	43.98260	-89.54924	19	-	R	No Vegetation																		
311	43.98230	-89.54924	10	M	P				1											1				
312	43.98199	-89.54924	6	M	P				2															

Sampling Point	Latitude (decimal degrees)	Longitude (decimal degrees)	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock)	Sampled holding rake pole (P) or rake rope (R)	Comments	*Myriophyllum spicatum*	*Potamogeton crispus*	*Chara sp.*	*Potamogeton zosteriformis*	*Myriophyllum sibiricum*	*Potamogeton praelongus*	*Potamogeton strictifolius*	*Potamogeton gramineus*	*Vallisneria americana*	*Najas flexilis*	*Ceratophyllum demersum*	*Stuckenia pectinata*	*Potamogeton friesii*	*Heteranthera dubia*	*Potamogeton foliosus*	*Nymphaea odorata*	*Potamogeton hybrid sp*	*Potamogeton natans*
313	43.98811	-89.54877	5	M	P					3			1		1									
314	43.98780	-89.54877	10	M	P				1	1														
315	43.98750	-89.54877	15	-	R				1															
316	43.98719	-89.54878	17	-	R	No Vegetation																		
317	43.98689	-89.54878	18	-	R				1															
318	43.98658	-89.54878	18	-	R		1		1								2							
319	43.98627	-89.54878	21	-	R				2															
320	43.98597	-89.54879	22	-	R	No Vegetation																		
321	43.98566	-89.54879	22	-	R	No Vegetation																		
322	43.98536	-89.54879	22	-	R	No Vegetation																		
323	43.98505	-89.54879	22	-	R	No Vegetation																		
324	43.98474	-89.54880	22	-	R		1																	
325	43.98444	-89.54880	22	-	R				1															
326	43.98413	-89.54880	22	-	R	No Vegetation																		
327	43.98383	-89.54880				Too Deep																		
328	43.98352	-89.54880	22	-	R	NNo Vegetation																		
329	43.98321	-89.54881	22	-	R	No Vegetation																		
330	43.98291	-89.54881	21	-	R	No Vegetation																		
331	43.98260	-89.54881	19	-	R				1		1													
332	43.98229	-89.54881	9	M	P				2					1										
333	43.98199	-89.54882	6	M	P				3															
334	43.98811	-89.54835	3	M	P		1			2			1											
335	43.98780	-89.54835	7	M	P				1	1		1							1					
336	43.98750	-89.54835	13	M	P				1	1	1						1							
337	43.98719	-89.54835	12	-	R				1	2	1	1			1									
338	43.98688	-89.54836	18	-	R																			
339	43.98658	-89.54836	19	-	R				1															
340	43.98627	-89.54836	20	-	R	No Vegetation																		
341	43.98597	-89.54836	21	-	R				1															
342	43.98566	-89.54836	22	-	R	No Vegetation																		
343	43.98535	-89.54837	22	-	R	No Vegetation																		
344	43.98505	-89.54837	22	-	R	No Vegetation																		
345	43.98474	-89.54837	22	-	R	No Vegetation																		
346	43.98444	-89.54837	22	-	R	No Vegetation																		
347	43.98413	-89.54838	22	-	R	No Vegetation																		
348	43.98382	-89.54838	21	-	R	No Vegetation																		
349	43.98352	-89.54838	21	-	R	No Vegetation																		
350	43.98321	-89.54838	20	-	R	No Vegetation																		
351	43.98290	-89.54839	18	-	R	No Vegetation																		
352	43.98260	-89.54839	15	-	R				1		1													
353	43.98229	-89.54839	8	M	P				2			1			1								1	
354	43.98199	-89.54839	4	M	P				3					1										
355	43.98811	-89.54792																						
356	43.98780	-89.54792	3	M	P				3															
357	43.98749	-89.54793	5	M	P				3															
358	43.98719	-89.54793	9	M	P				1	2	1	1												
359	43.98688	-89.54793	15	-	R				2															
360	43.98658	-89.54793	18	-	R	No Vegetation																		
361	43.98627	-89.54794	19	-	R	No Vegetation																		
362	43.98596	-89.54794	20	-	R	No Vegetation																		
363	43.98566	-89.54794	21	-	R	No Vegetation																		
364	43.98535	-89.54794	21	-	R	No Vegetation																		
365	43.98505	-89.54795	22	-	R	No Vegetation																		
366	43.98474	-89.54795	22	-	R	No Vegetation																		
367	43.98443	-89.54795	22	-	R	No Vegetation																		
368	43.98413	-89.54795	22	-	R																1			
369	43.98382	-89.54795	21	-	R	No Vegetation																		
370	43.98352	-89.54796	20	-	R	No Vegetation																		
371	43.98321	-89.54796	18	-	R				2			1												
372	43.98290	-89.54796	16	-	R		1			2		1			1									
373	43.98260	-89.54796	9	M	P																			
374	43.98229	-89.54797	3	M	P				1															
375	43.98780	-89.54750	17	-	R												2							
376	43.98749	-89.54750	4	S	P				2															
377	43.98719	-89.54751	7	M	P		1		2					1										
378	43.98688	-89.54751	13	-	R					2									1					
379	43.98657	-89.54751				Too Deep																		
380	43.98627	-89.54751	18	-	R	No Vegetation																		
381	43.98596	-89.54751	20	-	R	No Vegetation																		
382	43.98566	-89.54752				Too Deep																		
383	43.98535	-89.54752	21	-	R												1							
384	43.98504	-89.54752	21	-	R	No Vegetation																		
385	43.98474	-89.54752	21	-	R	No Vegetation																		
386	43.98443	-89.54753	21	-	R	No Vegetation																		
387	43.98413	-89.54753				Too Deep																		
388	43.98382	-89.54753	19	-	R	No Vegetation																		
389	43.98351	-89.54753	17	-	R				1															
390	43.98321	-89.54754	13	M	P				2															

Sampling Point	Latitude (decimal degrees)	Longitude (decimal degrees)	Depth (ft)	Dominant sediment type (M=muck, S=Sand, R=Rock)	Sampled holding rake pole (P) or rake rope (R)	Comments	*Myriophyllum spicatum*	*Potamogeton crispus*	*Chara sp.*	*Potamogeton zosteriformis*	*Myriophyllum sibiricum*	*Potamogeton praelongus*	*Potamogeton strictifolius*	*Potamogeton gramineus*	*Vallisneria americana*	*Najas flexilis*	*Ceratophyllum demersum*	*Stuckenia pectinata*	*Potamogeton friesii*	*Heteranthera dubia*	*Potamogeton foliosus*	*Nymphaea odorata*	*Potamogeton hybrid sp*	*Potamogeton natans*
391	43.98290	-89.54754	5	M	P				2			1												
392	43.98719	-89.54708	3	M	P				2															
393	43.98688	-89.54708	5	M	P				3						1									
394	43.98657	-89.54709	9	M	P							2												
395	43.98627	-89.54709	15	-	R				2															
396	43.98596	-89.54709	15	-	R				1	1	2													
397	43.98565	-89.54709	17	-	R	No Vegetation																		
398	43.98535	-89.54710	20	-	R	No Vegetation																		
399	43.98504	-89.54710	19	-	R	No Vegetation																		
400	43.98474	-89.54710	18	-	R	No Vegetation																		
401	43.98443	-89.54710	18	-	R												1							
402	43.98412	-89.54710	18	-	R				2															
403	43.98382	-89.54711	14	-	R				2					1			1							
404	43.98351	-89.54711	7	M	P		1		1	1			1		2									
405	43.98321	-89.54711	5	M	P				1	1		1	3		1		1							
406	43.98657	-89.54666	5	M	P				2															
407	43.98627	-89.54666	8	M	P				2					1	1									
408	43.98596	-89.54667	10	M	P				2															
409	43.98565	-89.54667	10	M	P				1															
410	43.98535	-89.54667	12	M	P				1															
411	43.98504	-89.54667	11	M	P				2															
412	43.98473	-89.54668	13	-	R	No Vegetation																		
413	43.98443	-89.54668	10	M	P				1															
414	43.98412	-89.54668	5	M	P				2				1	1	1									
415	43.98382	-89.54668	5	M	P				1				1	1	1									
416	43.98565	-89.54624	4	S	P				3															
417	43.98535	-89.54625	4	M	P				1															
418	43.98504	-89.54625	4	S	P				2															
419	43.98473	-89.54625	4	M	P				2															



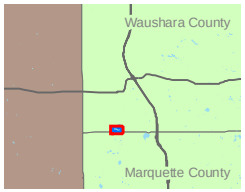
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Sources:
Roads and Hydro: WDNR

Map Date: December, 21 2009
File Name: AppA_Pleasant_Pl.mxd



Extent of large map shown in red.

Legend

\# Sample Location

Public Boat Landing

Appendix A

Pleasant Lake

Waushara & Marquette Counties, Wisconsin

2009 Point-intercept Survey Locations