P O R T A G E   C O U N T Y

EURASIAN WATER MILFOIL ASSESSMENT

2003 - 2004 Studies

Adult Weevil Found on Eurasian Water Milfoil Stem Sample

Prepared for:
Land Conservation Division of Portage County Planning & Zoning Department

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See Appendices for how YOU can help stop the spread of invasives or help your milfoil weevils!

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Portage County
Eurasian Water Milfoil Assessment

I. INTRODUCTION

Eurasian water milfoil (EWM) (Myriophyllum spicatum) is an exotic aquatic plant that has been gaining notoriety across the United States for its extremely aggressive invasive nature. Native to the Eurasian continent, it has been inadvertently introduced to water bodies across the U.S. by boaters, recreationalists and various aquatic industries. Once introduced, EWM, a champion of reproductive ingenuity, spreads rapidly via stolons or fragmentation. The submersed aquatic plant goes through two flowering periods each summer, after which, it fragments into many pieces. Each fragment may sprout roots and can remain afloat and stay viable for several weeks until it drifts to a suitable site, where it can become another plant. A perennial, the plant may wait out the winter under the ice, intact, and will be growing and well established by April or May, much sooner than native aquatics. It will grow rapidly, reach the water surface and then spread into a dense, tangled mat, shading out the sunlight the other plants need. This dense mat also increases the dissolved oxygen fluxuations, carbon dioxide fluxuations, pH fluxuations and the temperature stratification of the water, and it inhibits water circulation. The EWM aggressively out-competes the native aquatic plants, which results in a rapid decrease in the diversity of the lake's plant community. This in turn decreases the diversity of the insect and fish populations. Dense growth of EWM can impede predator-prey relationships between fish, stunting the growth of the larger fishes as it reduces their ability to see prey. The tangled mats at the water surface can become dense enough to strand boaters, become a safety hazard for swimmers, and create a stagnant breeding ground for mosquitoes. (Jester 1998)

EWM Reports in Portage Co.

Confirmed - Present:
1. Lake Emily
2. Lake Jonas
3. McDill Pond
4. Lake Pacawa
5. Springville Pond
6. Thomas Lake

Confirmed - Not Present:
(should be watched)
1. Bear Lake

Unconfirmed:
1. Jordan Pond

The cumulative effect of EWM impacts creates a chain reaction of changes in to the lake's ecology, decreasing the recreational value, sporting value and aesthetic value of the water body, which may in turn result in decreased property values (Jester 1998). A study in Minnesota found water clarity directly affects lakefront property values, and a study in Maine found that a noticeable gain in water quality could bring about $25 million in additional spending into the state. (Meersman 2003 and "The Economics")

Therefore, there is a strategic, monetary benefit to understanding a lake or pond's ecosystem and preventing and/or controlling an EWM infestation. Various types of treatments are available, depending on the extent and density of the infestation, including trained manual removal, bottom barriers, mechanical removal/harvesting, winter water level drawdowns, herbicides and biological controls. Choosing the best treatment option is also dependant on the individual qualities of the particular water body, economic feasibility and the restrictions/allowances of local and state ordinances.

Making the connection…

When new cases of EWM are reported, there is currently no well-defined response program. Sometimes the Wisconsin Department of Natural Resources (WDNR) has the personnel and budget to conduct an assessment, sometimes not. Sometimes there is an active lake association to implement a control plan, sometimes not. Some connection between the local level and state level is needed.

In the summer of 2003, EWM was recorded at 8 of the 29 Portage County lakes that were part of a study being conducted by Portage County and the University of Wisconsin-Stevens Point. It was determined that additional information and management plans for EWM were needed for those lakes. The Portage County EWM Study was initiated by the Portage County Land Conservation Division (LCD) of the Planning and Zoning Department to collect that information.

The Portage County EWM Studies did not seek to take on the task of EWM control at the county level, but rather to investigate the problem, devise well-informed recommendations tailored to each lake, and then to provide the information to the appropriate lake management units and collaborate with them on implementation details. This approach of information gathering, dissemination and networking seems to be the best role the county can play in EWM control.

What's been done…

In October of 2003, field mapping of EWM was completed for four lakes using GPS equipment. Treatment recommendations and suggestions for additional investigation and mapping were given in the 2003 EWM Assessment Report. In 2004, those recommendations and suggestions were pursued. Some treatment recommendations given in the 2003 report changed slightly due to the findings of the 2004 studies. Complete summary of study findings and treatment recommendations are given in this report for the six lakes studied to date. Please note that EWM was just reported on Jordan Pond and Lake Jonas in 2004 and those lakes have not been investigated yet. Mapping for those water bodies is planned for spring 2005.

Protect your favorite lake…

The recommendations for each lake include many tools put together to make a comprehensive plan for future management. Public education, annual monitoring and creating "Clean Boats" habits are a large part of these plans. There is too much for a county or any one governmental unit to do alone. Any citizen can learn about exotic species, help control the spread of those species, express their interest in control to local government units and be an advocate for their favorite lake.

"Volunteers Prevent Exotic Invader From Entering Crescent Lake"

In their first summer of operation, volunteer boat inspectors with the Crescent Lake Association stopped four boats with EWM, curly pondweed and zebra mussels from entering their lake. Not only did they protect their lake, they also taught numerous boaters how to check their boats for "hitch hiking" invasives. (WAL 2004)

II. METHODS

This project was initiated and facilitated by Steve Bradley, the County Conservationist of Portage County. (See Appendix C for contact information.) All fieldwork was performed by Amy Thorstenson, Golden Sands Resource Conservation & Development (RC&D), with the help of various field assistants. Project coordination and report preparation was also completed by Amy Thorstenson. (See Appendix C for contact information.)

All surveys were planned with the technical guidance of WDNR personnel. Multiple personnel were contacted regarding various issues, but the main contact person was the WDNR regional Aquatic Plant Specialist, Deborah Konkel. All treatment recommendations given for each lake were developed with, reviewed by and approved by Deborah Konkel (WDNR). (See Appendix C for contact information.) Survey plans and treatment recommendations were also developed with the technical guidance of Nancy Turyk, Water Resources Scientist with the Center for Watershed Sciences and Education at the University of Wisconsin-Stevens Point.

<u>EWM Mapping Surveys</u>:

EWM surveys on Bear Lake, McDill Pond, Lake Pacawa, Springville Pond and Thomas Lake were conducted from a canoe. Lake Emily EWM surveys were conducted from a pontoon boat. In the cases of Lake Pacawa and Springville Pond, where the waterbody is shallow enough for EWM to grow at any given point, observers paddled slowly, navigating back and forth across the waterbody until the entire waterbody had been visually searched. On Bear Lake, Lake Emily and Thomas Lake, the depth at the centers of these lakes precludes EWM from growing anywhere but around the periphery of the lakes. In this situation, observers circled the lakes slowly while visually searching for EWM.

Wherever EWM was found, GPS coordinates were recorded to sub-meter accuracy with a Trimble Pro XR. If it was a single plant or a very small colony of plants, a point feature was used to log the location. If the EWM colony was large enough to be recorded accurately as an area feature, the outline of the colony was traced, or corner points were recorded, to map the area feature. The mapping features were then overlain on aerial photographs to create GIS maps of EWM locations. If depth contours were available, contour lines were also overlain onto the aerial photographs. Please note that in the case of Bear Lake, no EWM was located during field exercises, therefore no GIS maps were created.

Voucher specimens of EWM and northern water milfoil (*Myriophyllum sibiricum*) were collected randomly, bagged in water and kept refrigerated. These were later pressed, mounted and the species identification verified by Dr. Robert Freckman, professor emeritus, University of Wisconsin - Stevens Point. The mounted specimens will be retained at the Robert W. Freckman Herbarium on campus.

In the case of McDill Pond, with its shallow maximum depth of 15 feet, EWM is capable of growing most anywhere in the pond and is already widespread. The nutrient rich pond also has dense growth of many native and non-native plant species, including another exotic invasive species, curly pondweed (*Potamogeton crispus*). To combat this problem, mechanical harvesting has already been in practice for several years.

With these factors in mind, the goal of the survey on McDill Pond was not to map individual EWM growths, but rather to gather data that could be compared with pre-harvesting data to identify shifts in plant population dominance. Therefore, the transect method was used to survey for frequency and dominance of all plant species.

Transects on McDill Pond were delineated with GIS before performing the field work. The transects were randomly located, perpendicular to shore, every 1500 feet along the shoreline. The transects were located in the field using a Trimble Pro XR GPS unit. Personnel then sampled from a point randomly chosen along the transect within each depth zone (0-1.5 feet, 1.5-5 feet, 5-10 feet and 10-20 feet). Sampling was performed by dropping a long-handled, steel, thatching rake straight down to the lake bed, then pulling it straight back up and recording the presence and relative density of each plant species present on the rake. At each sample point, the rake was dropped four times, one time within each quarter of a 6-foot diameter quadrant. For each sample point, relative density of each species was rated from 1 to 5. A rating of 1, 2, 3 or 4 indicated the species was present on 1, 2, 3 or 4 rake samples. A rating of 5 was given if the species was *abundantly* present on all four rake samples.

Plant species observed to be present but not sampled were recorded, to compile a more complete list of species present in McDill Pond. Voucher specimens of all plants observed, sampled and not sampled, were collected, bagged in water and kept refrigerated. These were later pressed, mounted and the species identification declared and/or verified by Dr. Robert Freckman, professor emeritus, University of Wisconsin - Stevens Point. The mounted specimens will be retained at the Robert W. Freckman Herbarium on the UW-Stevens Point campus.

<u>Weevil Surveys</u>:

Milfoil weevil survey methodology was modeled after the 1996-97 study completed by Laura Jester, in cooperation with the DNR, as detailed in her 1998 report *"The Geographic Distribution of the Aquatic Milfoil Weevil (Euhrychiopsis lecontei) and Factors Influencing its Density in Wisconsin Lakes"*.

Four representative EWM beds were selected for each of the lakes to be surveyed for weevils (Lake Emily, Lake Pacawa, Springville Pond and Thomas Lake). In Springville Pond, where four individual beds were not available, the largest bed was divided into two equal halves. (In Thomas Lake, where EWM grows in a complete ring around the lake, samples were randomly collected all the way around the lake, from all depth zones. Samples from the west half of the lake were kept separate from those from the east half, for comparison purposes.)

Because the weevil lives within the top 20 inches of the stems, only samples 20 inches or more in length were retained for examination. The Jester report stated that 120 samples had been collected for each lake, but in conversations with Jester, she stated that the study had found statistical confidence at about half that number. (Jester 2003, *pers. comm.*)

Initially, the attempt was to collect samples from each bed along three transects extending perpendicular to shore, by snorkeling alongside the canoe and grabbing one plant stem at five roughly equidistant points along the transect, for a total of 60 stems per lake. (4 beds x 3 transects x 5 sample points) Reality proved that snorkeling through thick EWM beds is very difficult. Staying on a perfectly straight transect line at the same time seemed impossible. Thus, the secondary method given in the Jester report (reaching for stems from the canoe) quickly became the preferred method. Additionally, it was decided that maintaining strict transects was not necessary for the purposes of this study, and stem samples were collected by meandering around in the EWM beds and collecting samples from all areas of the bed and across all depths within the bed. Field personnel were conscientious to refrain from visually scanning the stems before picking them, which would have introduced sampling bias. Where EWM was not close to the surface, a long-handled, steel, thatching rake was dropped overboard to snag some stems. The first intact, 20-inch long stem to be randomly selected and untangled from the rake was retained as the sample stem.

Water depth range (deepest and shallowest points) within each sample bed was recorded. Water temperature, dissolved oxygen and secchi depth data were collected from the deepest point of each waterbody and the depth of that sample point was recorded. Water temperature and dissolved oxygen were recorded using a YSI®55 digital meter and secchi depth was recorded using a standard secchi disk attached to a nylon cord.

Stem samples were stored with water in labeled plastic bags, chilled on ice in a cooler while in the field and later kept refrigerated at approximately 3-4°C until they were examined. Any samples that could not be processed within eight days of collection were preserved with ethyl alcohol to retain the integrity of the sample. Samples were examined under magnification by floating them in shallow water in a clear, glass pan over a light table. All weevils of all life stages found within the stems or clinging to the outsides were preserved in a labeled glass vial. Weevils found in the stem were carefully extracted with dissecting equipment so they could still be identifiable. All weevil specimens were mailed to Laura Jester, of Jester Consulting in Eden Prairie, Minnesota, for species identification confirmation.

<u>Background Data Collection</u>:

Background lake data was gathered for each lake from multiple sources, including records maintained by WDNR, the UW-Stevens Point Robert W. Freckman Herbarium and preliminary research reports from the University of Wisconsin-Stevens Point and Portage County. Please note that the UWSP and Portage County report cited *(Portage County Lake Study-Preliminary Results 2003)* was indeed a preliminary report, and some of the preliminary data used in this report may differ slightly with what is presented in the Portage County Lake Study <u>final</u> report, which is to be released in early 2005.

III. COUNTY–WIDE RECOMMENDATIONS

a. Exotic Species Signage at All Landings

Under Wisconsin Statutes, Chapter 30.715, it is illegal to transport boats or equipment that have aquatic plants attached. (Wisconsin Legislature: Infobases) To increase boater awareness, signage should be in place at every public boat landing warning boaters to clean off their boats to the prevent transfer of exotic species from lake to lake. This is important because a single boater transporting a single piece of EWM can be responsible for introducing the exotic plant to a previously uninfested lake. **If signs are missing or damaged, contact the WDNR to have the sign replaced.**

"Help prevent the spread…" signage at Bear Lake public boat landing.

For lakes that are currently not infested with any exotic species, there are "Help Prevent the Spread…" signs available, which instruct boaters to clean equipment before entering that lake. For lakes already infested by one or more exotic species, there are "Exotic Species Advisory" signs, informing of the presence of each exotic species known to be in that lake. (See Appendix A for "Clean Boats, Clean Waters" tips and guidelines.)

"Exotic Species Advisory" sign at McDill Pond public boat landing.

b. Encourage Shoreland Buffers

State code (NR115) and Portage County ordinance 7.7.5 prohibit the removal of trees and shrubbery within 35 feet of the shoreline (with the exception of up to 30 feet within any 100 feet of the shoreline length permitted for clearing as a "view corridor"). While this provides some natural vegetation along the shoreline, the code and ordinance do not mention mowing of grasses and native, non-woody vegetation. A true shoreland buffer zone includes this vital understory that provides food and cover for many wildlife species, including the native milfoil weevil, *Euhrychiopsis lecontei*. (See Appendix B for tips on providing weevil habitat.) Buffer zones that include un-mowed grasses also protect the health of the lake by filtering out sediments, fertilizers and other contaminants from storm water before it trickles into the lake.

A beautiful buffer.

Currently, NR115 is undergoing revisions to prohibit the removal of *all* vegetation within 50 feet of the shoreline. In anticipation of these revisions, and in support of the health of Portage County's lakes and rivers, county policies and education efforts should strive to encourage the use of shoreland buffers on public and private lands.

Some county-level support for shoreland buffers is already in place. Technical assistance with shoreland restoration projects is available from the Portage County LCD. Additionally, restorations within certain watersheds are eligible for cost-sharing programs. Contact the LCD for more information at (715) 346-1334.

c. Trained Volunteer Watercraft Inspectors

Clean Boats, Clean Waters

Kits available for check-out from Portage Co. LCD or Golden Sands RC&D

Because the public plays such a key role in spreading aquatic invasive species, information about invasive species *must* get into the hands of every boater. Under the new Clean Boat, Clean Waters Program, a network of volunteers is being trained and organized by the Wisconsin Lakes Partnership (WDNR, UW-Extension and Wisconsin Association of Lakes). Workshops will train citizens in identifying aquatic invasive species, how to properly purge and clean a boat and how to teach this information to boaters. Once trained, volunteers can spend time at public boat landings distributing informational pamphlets and showing boaters the steps for inspecting and cleaning their boats. These volunteers can also inspect the area near the boat landing (a hot spot for new infestations) for EWM and other invasive species and report new infestations. Information about upcoming training workshops or assistance starting a volunteer watercraft inspection program is available from the Volunteer Monitoring Coordinator at (715) 346-3366. (See Appendix C for more contact information.)

Portage County and Golden Sands RC&D are supportive of the Clean Boats, Clean Waters program. **Clean Boats kits are available for check-out** from the Land Conservation Division or Golden Sands RC&D for any group who needs an extra kit during their watercraft inspection day.

d. Public Awareness of Current Infestations

The public at large should be informed of the waterbodies in Portage County containing EWM and how to report new infestations. Lakefront property owners, Portage County lake associations, lake protection groups and Town boards around the eight subject lakes are key groups who should be educated about EWM problems, trained in EWM identification and encouraged to participate in the Clean Boats, Clean Waters Program.

e. Local Contact Point = Portage County Land Conservation Division

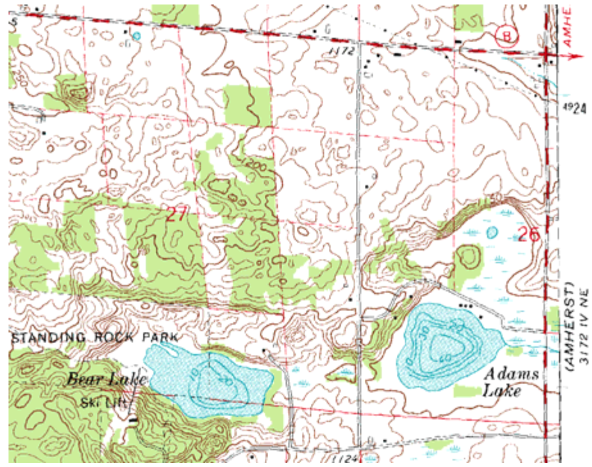
The information disseminated to the public should have **local contact information** with it. Although the WDNR has knowledgeable personnel available to help the public with aquatic plant issues, the average citizen often does not know about these services or has difficulty finding out which office to call. A designated contact point at a familiar, nearby location may be helpful for citizens to easily and quickly report any potential new EWM sightings at previously uninfested lakes. Also, a local contact point would make it easier for citizens to bring pieces of the plant to the contact point for species identification confirmation. The contact point, if unable to confirm the specie's identity, will know how to properly preserve the specimen and send it to appropriate WDNR personnel for confirmation. The contact point will also know how to facilitate the follow-up efforts for treatment.

The Portage County Land Conservation Division (LCD) has agreed to serve as the local contact point for EWM reports. The LCD is located in the Planning and Zoning Department office of the Portage County Courthouse Annex Building at 1462 Strongs Avenue, Stevens Point, WI 54481, (715) 346-1334.

IV. BEAR LAKE

a. Lake Background

Located approximately one mile south of County Highway B in the Town of Arnott, Bear Lake is a small seepage lake with a surface area of 28 acres and a maximum depth of 28 feet. The water in Bear Lake comes from groundwater, runoff and precipitation. Water leaves the lake via evaporation and seepage to groundwater. Because Bear Lake's water comes from multiple sources, one must think of its watershed in terms of a surface watershed and a groundwater shed. (See Appendix C for definitions of terms.) In the case of Bear Lake, the surface watershed is dominated by forest cover, and the groundwater shed is dominated by both forest cover and non-irrigated cropland. [University of Wisconsin-Stevens Point (UWSP) and Portage County 2003, Preliminary Results] There is a non-trailerable public boat landing on Bear Lake.



Bear Lake on USGS topographic map.

Bear Lake boat landing.

Total phosphorus levels of 30 ppb or higher categorizes a lake as eutrophic, resulting in more aquatic plant growth, which makes the lake more productive for fish and wildlife than a mesotrophic or oligotrophic lake, but less desirable for swimming. Bear Lake is a eutrophic lake, with total phosphorus levels historically averaging approximately 32 parts per billion (ppb) and average phosphorus levels for the year 2002 of approximately 36 ppb. (UWSP and Portage County 2003, Preliminary Results)

Water clarity in Bear Lake is considered fair when compared with similar lakes in the region. Average historic Secchi depth (a measure of water clarity) was best in June (13 feet) and poorest in September (6 ½ feet). Fluctuations in water clarity are normal, due to increases and decreases of algae population and sedimentation. (UWSP and Portage County 2003, Preliminary Results)

b. History of Aquatic Plant Control in Bear Lake

No records of previous aquatic plant treatments were found to report for this assessment. Table 1 lists aquatic vegetation species documented in Bear Lake.

Table 1 - List of Documented Aquatic Vegetation
(Submergent and Floating Leaf Aquatics Only)

	Herbarium Records for Bear Lake *	
	Scientific Name	Common Name
1	*Brasenia shreberi*	Watershield
2	*Ceratophylum demersum*	Coontail
3	*Elodea Canadensis*	Waterweed
4	*Lemna turionifera*	Perennial duckweed
5	*Megalodonta beckii*	Water beggar-ticks
6	*Myriophyllum sibiricum*	Northern water milfoil
7	*Myriophyllum spicatum* (?) (e)	Eurasian water milfoil
8	*Najas flexilis*	Slender naiad
9	*Nuphar variegata*	Bullhead pond lily
10	*Nymphea odorata*	White water lily
11	*Polygonum amphibium*	Amphibious smartweed
12	*Potamogeton amplifolius*	Large leaf pondweed
13	*Potamogeton crispus* (e)	Curly leaf pondweed
14	*Potamogeton gramineus*	Variable pondweed
15	*Potamogeton illinoensis*	Illinois pondweed
17	*Potamogeton natans*	Floating leaf pondweed
18	*Potamogeton praelongus*	White stem pondweed
19	*Utricularia gibba*	Creeping bladderwort
20	*Utricularia intermedia*	Flat leaved bladderwort
21	*Utricularia minor*	Small bladderwort
22	*Utricularia vulgaris*	Common bladderwort

* Robert W. Freckman Herbarium records through November 2003, University of Wisconsin-Stevens Point. (Note: These herbarium records are historical documentation of what has been identified to date at Bear Lake. *This is not an exclusive list.* Further, it cannot be stated with certainty that because a species has not been recorded at that lake recently that the species is no longer present in that lake. However, it has been well documented that as exotic invasives infest a lake, native vegetation is progressively less able to compete and the number of species (diversity) in the lake declines. Anecdotally, this is what has been seen at lakes in Portage County where EWM is present, however it would require quantitative vegetation surveys to confirm this.)

(e) Exotic, invasive

(?) Eurasian Water Milfoil (*Milfolium spicatum)* was sighted washed-up at the boat landing during 2003 plant surveys, and was collected for a voucher specimen to be retained at the Robert W. Freckman Herbarium on the University of Stevens Point campus. However, no other EWM (washed-up, rooted or floating) could be located within the lake.

c. Mapping Results

Field mapping efforts for this assessment on October 8, 2003 could not locate EWM, either rooted, floating or washed-up. Therefore, **no EWM map was produced** for Bear Lake. It is possible that the EWM collected was a lone piece, removed from a boat before being launched, however, this is hopeful speculation, and Bear Lake should be monitored frequently to catch any EWM infestations early. Until an infestation site can be located and confirmed, management must still focus on the prevention phase.

d. Recommended Management Plan for Eurasian Water Monitoring:

Prevention and Annual Monitoring

1. **Maintain Invasive Species Information Sign**

The best way to control EWM is to prevent it from entering the water body in the first place. The main method of spread is by hitch hiking from lake to lake on boats, trailers and recreational equipment. Under Wisconsin Statutes, Chapter 30.715, it is illegal to place a boat, trailer or equipment that have aquatic plants attached into a navigable waterway. (Wisconsin Legislature: Infobases). Prominent signage can help remind boaters to check their boats and trailers for "hitch hiking" plants.

Bear Lake public boat landing - Sign is posted in a visible location.

Currently, a "Help Prevent the Spread…" sign, designed for uninfected lakes, is posted at the Bear Lake boat landing. If EWM is found in the lake in the future, this signage should then be changed to an "Exotic Species Advisory" sign, to warn of the presence of EWM.

If this sign is missing or damaged the WDNR should be notified.

2. **Annual Surveying**

WHO???

Survey volunteers have not yet been identified and will be sought in 2005.

Annual surveying should be done to search for potential EWM outbreaks. Volunteers for surveying have not yet been identified and will be sought in 2005. Potential candidates would be anyone who regularly boats on Bear Lake and would be willing to watch for EWM and report it.

a. Notify Contact Point

If even one live EWM plant is found, rooted or floating, the *local contact point* should be notified immediately. If possible, a sample of the plant should be collected, kept in chilled water and delivered to the local contact point for species identification confirmation. The local contact point should then notify WDNR personnel to facilitate evaluation and implementation of treatment options.

b. Implement Best Treatment Option

Treatment options should be implemented by trained volunteers or professionals, at the direction of WDNR personnel. If a floating or washed-up plant was found, the plant should be removed and disposed of and the source infestation (rooted, live EWM plants) searched for. If no source is found, no further treatment is necessary, but if a source can be located, treatment should be implemented as soon as possible. Individual plants or small colonies can be cut at the sediment line or hand pulled, roots and all. (Hand removal of exotic species does not require a permit from the WDNR.) If hand pulling is done, the sediment may need to be loosened with a pitchfork to make total removal of the roots possible. If cutting is done, it is best to time this early in the year, when the plant is expending its winter reserves sprouting new growth. Monthly follow-up cuttings must then be done to continue draining the plants of energy.

c. Dispose of Plants Removed

ALL PLANT PARTS cut or pulled must be removed from the water and destroyed or disposed of.

d. Follow-up Monitoring

Monthly follow-up monitoring must be done through the remainder of the growing season to check for re-sprouts. Again, ALL PLANT PARTS must be removed and destroyed or disposed of. Annual monitoring should be continued, since *EWM eradication is never permanent*.

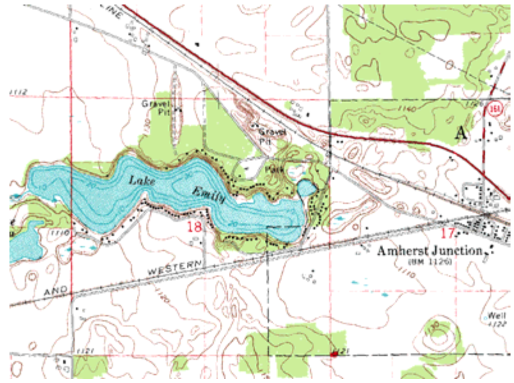
3. **Trained Volunteer Watercraft Inspectors**

Because aquatic invasive species spread primarily by hitch hiking from lake to lake on boats and boating equipment, information about invasive species must get into the hands of every boater. The presence of trained volunteer watercraft inspectors, especially on major boating weekends, would be helpful to educate boaters about the invasive nature of exotic species and the importance of checking boats and trailers for “hitch hikers”.

Residents of Bear Lake, as well as other conservation groups in Portage County, are encouraged to **protect Bear Lake** by participating in the volunteer watercraft inspector training workshops and the support network offered by the Clean Boats, Clean Water Program through the Wisconsin Lakes Partnership. More information about this program is given in Section III.c.

V. LAKE EMILY

a. Lake Background



Lake Emily on USGS topographic map.

Located approximately $^{1}/_{5}$ mile south of State Highway 10 in the Town of Amherst, Lake Emily is a medium-sized seepage lake with a surface area of 95.5 acres and a maximum depth of 35 feet. The water in Lake Emily comes from groundwater, runoff, precipitation and one intermittent inlet from Mud Lake at the west end. Water leaves the lake via evaporation and seepage to groundwater. Because Lake Emily's water comes from multiple sources, one must think of its watershed in terms of its surface watershed and its groundwater shed. (See Appendix C for definitions of terms.) In the case of Lake Emily, the surface watershed and groundwater shed are both dominated by non-irrigated agriculture. Although residential land use is a small percentage of land area in these watersheds, most of these properties are concentrated directly around the lake shoreline, which heightens their potential to impact the health of the lake. Residential land use has increased significantly since 1948. (UWSP and Portage County 2003, Preliminary Results) This is a heavily recreated lake with high resident usage and a county campground, park, beach and two trailerable boat landings (one maintained by the county, one maintained by the township).

Total phosphorus levels of 30 ppb or higher categorizes a lake as eutrophic, resulting in more aquatic plant growth, which makes the lake more productive for fish and wildlife than a mesotrophic or oligotrophic lake, but less desirable for swimming. Lake Emily is historically a mesotrophic lake, with Total Phosphorus Levels historically averaging approximately 26 parts per billion (ppb), but average phosphorus levels in 2002 were approximately 33 ppb, which is 3 ppb above the eutrophic level. (UWSP and Portage County 2003, Preliminary Results)

Water clarity in Lake Emily is considered fair when compared with similar lakes in the region. Average historic Secchi depth (a measure of water clarity) was best in May (17 feet) and poorest in July (8 feet). Fluctuations in water clarity are normal, due to increases and decreases of algae population and sedimentation. Average secchi depth readings for 2002 indicated poorer water clarity in late summer than the historic average. (UWSP and Portage County 2003, Preliminary Results)

Lake Emily's East boat landing.

b. History of Aquatic Plant Control in Lake Emily

No records of previous aquatic plant treatments were found to report for this assessment. WDNR records show EWM was first reported in this lake in 1993. (WDNR website) Table 2 lists aquatic vegetation species documented in Lake Emily.

Table 2 - List of Documented Aquatic Vegetation
(Submergent and Floating Leaf Aquatics Only)

	Herbarium Records for Lake Emily *	
	Scientific Name	Common Name
1	*Brasenia shreberi*	Watersheild
2	*Ceratophylum demersum*	Coontail
3	*Elodea Canadensis*	Waterweed
4	*Lemna minor*	Small duckweed
5	*Lemna turionifera*	Perennial duckweed
6	*Megalodonta beckii*	Water beggar-ticks
7	*Myriophyllum sibiricum*	Northern water milfoil
8	*Myriophyllum spicatum* (e)	Eurasian water milfoil
9	*Najas flexilis*	Slender naiad
10	*Nuphar variegata*	Bullhead pond lily
11	*Nymphea odorata*	White water lily
12	*Potamogeton friesii*	Fries's pondweed
13	*Potamogeton gramineus*	Variable pondweed
14	*Potamogeton illinoensis*	Illinois pondweed
15	*Potamogeton natans*	Floating leaf pondweed
16	*Vallisneria americana*	Water celery

* Robert W. Freckman Herbarium records through November 2003, University of Wisconsin-Stevens Point. (Note: These herbarium records are historical documentation of what has been identified to date at Lake Emily. *This is not an exclusive list.* Further, it cannot be stated with certainty that because a species has not been recorded at that lake recently that the species is no longer present in that lake. However, it has been well documented that as exotic invasives infest a lake, native vegetation is progressively less able to compete and the number of species (diversity) in the lake declines. Anecdotally, this is what has been seen by researchers at lakes in Portage County where EWM is present, however it would require quantitative vegetation surveys to confirm this.)

(e) Exotic invasive

c. Mapping Results

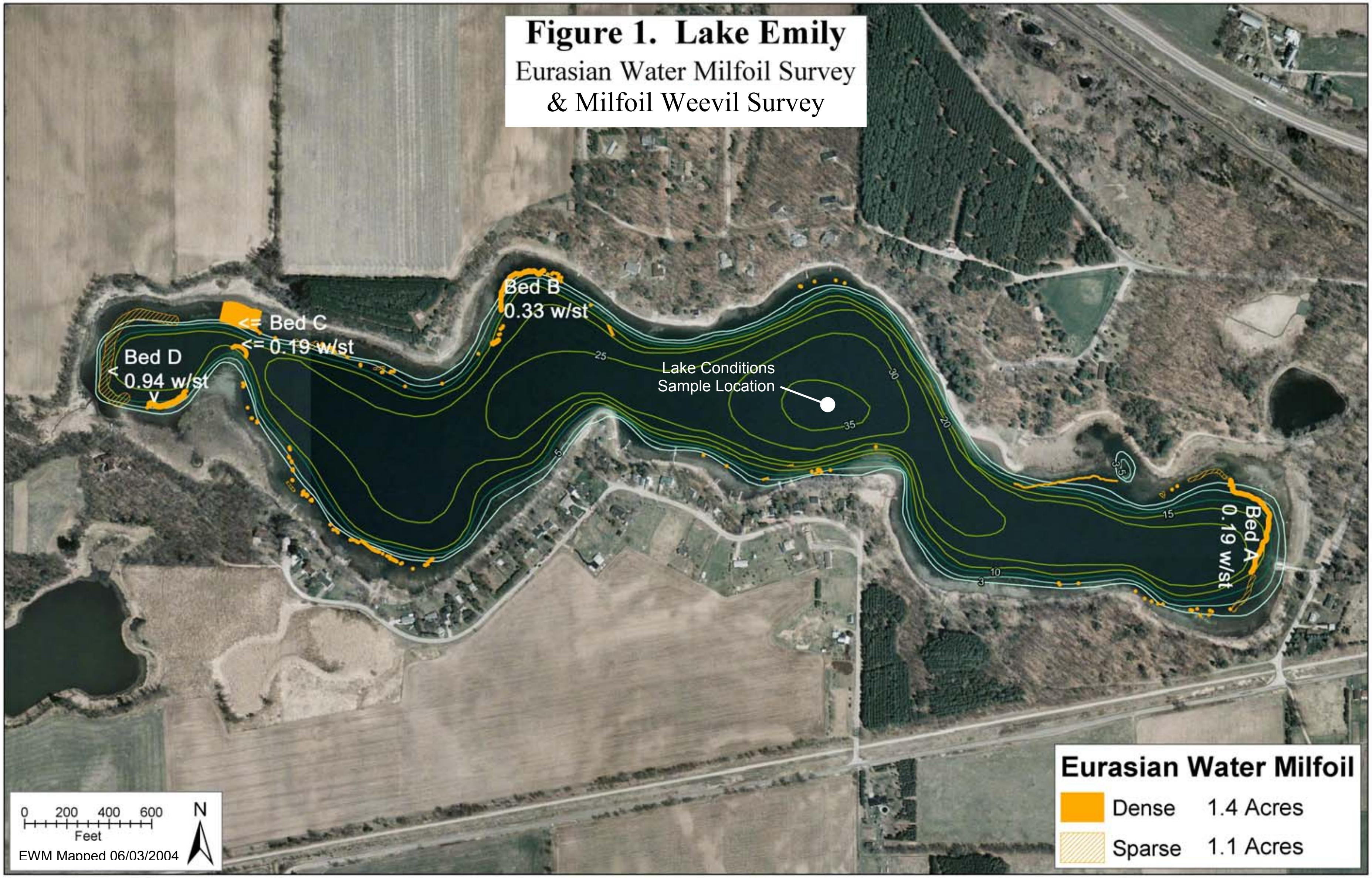
Multiple areas of sparse to dense EWM growth were mapped during 06/03/2004 field activities. Dense EWM growth totaled 1.4 acres and sparse growth totaled 1.1 acres. (See Figure 1.)

Although mapping plans originally called for the mapping of Mud Lake, a small lake connected to Lake Emily by a creek, this was determined to be unnecessary. Mud Lake is surrounded by private property, which prohibits public access and minimizes the chances that it is a source of EWM to Lake Emily. It is also unlikely that EWM is spreading *from* Lake Emily *to* Mud Lake, since it would have to travel upstream to do so.

d. Weevil Population Density Survey Results

The primary recommendation for Lake Emily suggested in the 2003 EWM Assessment Report was to investigate the potential for using biological control. It was suggested that, if biological control proved a viable option under the conditions present at Lake Emily, then this might provide a natural, long-term solution.

Population density surveys were performed in August 2004 to determine the existing natural population of the aquatic milfoil weevil, *Euhrychiopsis lecontei*. EWM stem samples were collected from Lake Emily on August 5th, 2004 and examined in the laboratory on August 19th–20th, 2004. Extracted weevil specimens were placed in labeled sample vials, preserved in 95% ethyl alcohol and sent to Laura Jester of Jester Consulting, Eden Prairie, MN, for species identification confirmation. See Figure 1 for sample bed locations and Table 3 for summarized results.



Beds A, B, C and D surveyed for milfoil weevils (*Eurychiopsis lecontei*) on 08/05/04. Stem samples collected from sample beds were examined in laboratory on 08/19/04 – 08/20/04. Values on map represent average number of weevils per stem for each bed. Average weevil density overall for Lake Emily was found to be **0.60 weevils per stem**.

Table 3. Weevil Population Density Survey – Results Summary

Lab Date (2004)	Bed No.*	Depth Range (ft)	Tot # Stem Samples	% Samples marl**-covered	Ave # Broken Tips	Ave # of Apical Tips	% Stems w/ Weevil Damage	Ave # Eggs per Stem	Ave # Larvae per Stem	Ave # Pupae per Stem	Ave # Adults per Stem	Ave Weevils per Stem (All Life Stages)
8/18, 19	**A**	4 - 11	16	19%	0.19	2.63	19%	0.00	0.06	0.13	0.00	**0.19**
8/18, 20	**B**	8 – 13	15	13%	0.40	2.80	87%	0.00	0.27	0.07	0.00	**0.33**
8/19, 20	**C**	1 - 12	16	44%	0.75	1.88	31%	0.00	0.19	0.00	0.00	**0.19**
8/19/04	**D**	2 - 13	16	56%	0.19	2.31	44%	0.19	0.50	0.13	0.13	**0.94**
Whole Lake Results		1 - 13	63	33%	0.40	2.40	43%	0.05	0.38	0.13	0.05	**0.60**

*See Figure 1 for EWM sample bed locations.
**Slime coating on samples may have been a combination of marl and algae.

Survey Notes:

Sample Date: 8/5/2004

Weather Conditions: Sunny Breezy, 70°F

Lake Conditions: Secchi Depth = 11 ft
Temperature = 24.4°C
Dissolved Oxygen = 14.0 mg/l
(Secchi, Temp and D.O. sampled at water depth of 35 ft. See Figure 1 for sample location.)

Land Cover @ Shore: Bed A = Park (mowed to shoreline)
Bed B = Residential (most mowed to shoreline), Natural (forest and wetlands)
Bed C = Residential (most mowed to shoreline), Natural (forest and wetlands)
Bed D = Natural (forest and wetlands)

Sample Preservation: Samples were kept in water in labeled plastic bags at 3-4°C until time of examination. Any samples not examined within eight days of collection were preserved with ethyl alcohol. Due to a shortage of available ethyl alcohol, only approximately 30 ml of 95% ethyl alcohol could be added to the sample bags (containing apx. 100-130 ml of lake water). All samples appeared to be in good condition at the time of examination.

Other notes: A leaf deformity, fused lower leaflets, was noted on a few Lake Emily samples. Beds A and C are in main boat traffic thoroughfares. Efforts were made to avoid sampling in severely disturbed sections of these beds, but boat disturbance is likely affecting weevil success in these areas.

Average (*E. lecontei*) milfoil weevil density for Lake Emily was found to be 0.60 weevils per stem, which appears to be a near average natural density. Of the 31 Wisconsin lakes studied by Laura Jester from 1996 to 1997, the mean natural weevil density was 0.65 weevils per stem. (Jester 1998)

Figure 1 shows EWM sample bed locations and average weevil densities for those beds. There was notable contrast in weevil densities between sample beds. Beds B and D had considerably healthier weevil densities, at 0.33 and 0.94 weevils per stem, respectively. Of the 31 Wisconsin lakes studied by Laura Jester, less than a third had natural weevil densities equal to or greater than 0.9 weevils per stem. (Jester 1998) Past studies have indicated that densities greater than 2 weevils per stem are associated with EWM declines, but recent evidence indicates that the density of weevils required to impact EWM is in some cases less than 2 weevils per stem and is highly lake specific. In fact, researchers now suggest that, while densities at or greater than 1 weevil per stem is preferable to achieve EWM *decline*, control may occur at levels around 0.5 weevils per stem or lower. (Newman 2004, *pers. comm.*) This may be good news for lakes with low natural weevil densities, and it may also be possible for some lakes to increase weevil populations over time.

Factors found to positively impact weevils are bed locations that are near shore and growing in shallow water, near a higher percentage of natural shoreline, or have a higher number of growing tips per plant (bushier plants). (Jester, et al. 1999) In the case of Lake Emily, sample beds A and C were both found to have a relatively low weevil density of 0.19 weevils per stem. These beds are in high boat-traffic areas and EWM plants were noted to commonly have chopped and mangled tips within the main thoroughfare. These plants were considered to be inappropriate for stem samples, so samples were collected away from the most disturbed sections of the thoroughfare, but weevil densities were still very low in these sample beds. Weevils lay their eggs in the growing tips of the plants, and the larvae feed on the top one-foot or so of the plant stem, so it seems logical that beds where boats are chopping tips or creating a lot of current would have reduced weevil reproduction success.

Bed D shows, by far, the best weevil populations of the four beds sampled (0.94 weevils per stem). This bed is in relatively shallow, calm, low-traffic water, near to shore, and the shoreline has a high percentage of natural vegetation. Weevils overwinter in the mud and leaf litter along shore and, therefore, fare best with a higher percentage of natural shoreline that is not mowed, raked, rip-rapped, sand or sea-walls. (Jester et al. 1999) Of the factors that appear to be affecting weevil populations on Lake Emily, percent of natural shoreline and boat traffic are the two that are within human control.

e. Recommended Management Plan for Eurasian Water Milfoil:

Combination Treatments – Two Options

Note:
Friends of Lake Emily, Inc. has chosen to pursue Option 1, reserving Option 2 as a treatment option for the future.

At the present extent of the EWM infestation in Lake Emily, the chance for total eradication of the weed is fleeting. An aggressive attack, implemented as soon as possible, might achieve this. If efforts of this magnitude are unattainable, then other things should be done to attempt to achieve control before EWM spreads out of control.

Whether pursuing eradication or control, one must be aware that neither scenario is permanent. Even if EWM is eradicated, it just takes one boat to bring the weed in again and start a new infestation. Likewise, if control in achieved, conditions may arise which throw the balance off, permitting EWM to spread faster than it can be controlled. In short, lake planners must think about EWM management in the **short term** and the **long term**. In the long term, enhancement of weevil winter habitat to build the population over time appears to be the best option at Lake Emily. In the short term, two options hold potential, but regardless of the option pursued, *the supplementary measures discussed in Sections V.e.2, 3, 4 and 5 are ESSENTIAL to the success of those efforts*!

1. **Option 1 = Push for Eradication (Herbicide Treatments)**

   Chemical treatment requires a permit from the WDNR.

   If a push for eradication is pursued, it will begin with chemical treatment of all the EWM beds and MUST include aggressive hand-pulling of the individual EWM plants peppered around the lake. Herbicide treatment of these individual plants would be cost prohibitive and an excessive use of chemicals. (See Section V.e.2 for details on hand-pulling recommendations.) Chemical treatment using a selective herbicide would serve as an initial "attack" on the EWM. If this "attack" is to be pursued, it should be done so aggressively. The first treatment should take place in spring, when EWM is most susceptible. Hand-pulling of individual plants should follow 30 days after herbicide treatments. Follow-up monitoring in August may determine herbicide re-treatment to be necessary in fall of 2005. *Herbicide treatment should be contracted with service providers who provide precise dosing, accuracy of delivery and follow-up monitoring services*.

   For this effort to be successful, there MUST also be follow-up evaluation of results of the 2005 eradication efforts and decision of what methods to pursue in 2006, 2007 and beyond. Those follow-up methods may include another year of herbicides, use of plant barriers and/or more hand-pulling. Consult with Deb Konkel, WDNR Aquatic Plants Specialist, to decide how to proceed in 2006. (See Appendix C for contact information.)

   No matter the amount of effort and money spent in 2005, eradication will NOT be achieved without a commitment to implement treatment efforts in 2006, 2007 and beyond.

Option 2 = Invest in Control

If the commitment level necessary for eradication is not feasible, the available money and effort might be better spent investing in long-term control. This may be best achieved with some initial expense and effort to boost the natural milfoil weevil populations at Lake Emily.

While milfoil weevils do hold potential to control EWM, it should be understood that that potential varies from lake to lake and, therefore, there is risk of it not working well on Lake Emily. Also, natural, biological control works in a naturally dynamic way. As the weevil's habitat (EWM) expands, the weevils will multiply to occupy that habitat and eventually impact the habitat, but this does not happen overnight. Once the weevils are numerous enough to impact EWM health, the EWM population will decline and so will the weevils. Thus, it should be understood that biological control will mean natural fluctuations in the amount of EWM seen from year to year.

The natural weevil populations appear to be struggling in high-traffic areas (Beds A and C), but doing reasonably well in quieter, more suitable habitats (Beds B and D). A few things can be done to boost weevil populations and control the spread of EWM while the weevils are "catching up":

- ✓ Purchase weevils to add to Beds B and D may help boost numbers in these areas, which can then spread out to other areas. (Approval from the DNR will be required.)

- ✓ Control of Beds A and C in 2005. These two beds are in high boat-traffic areas, which presents two problems: Motors will chop EWM and spread bits around the lake, and traffic will impede weevil success in those beds. Beds A and C should be controlled using plant barriers or herbicide treatments. It is likely that weevils displaced by those treatments will move to other milfoil beds.

- ✓ Hand-pulling of individual growths to keep EWM from spreading faster than the weevils can keep up. (See Section V.e.2)

- ✓ Provide weevil habitat. ***<= ESSENTIAL !!!*** (See Section V.e.3)

2. **Hand-pulling Individual Growths – *Summer 2005***

Whether Option 1 or Option 2 is being pursued, hand-pulling of the individual growths will greatly increase the success of either treatment plan. A resident of Lake Emily who has experimented with hand-pulling EWM stated that the soft marl sediment makes removal of the plant, roots and all, quite easy. Organized efforts, whether wading, snorkeling or diving, will be a *significant* part in EWM control on this lake. (The deeper growths will necessitate the help of divers, and a significant number of hours will be needed.)

Exotic species can be cut or pulled by hand without a permit from the WDNR. Volunteers/professionals engaged in this activity should be trained in the proper identification and removal of EWM. EWM can be cut at the sediment line or (preferably) hand-pulled, roots and all. If hand-pulling is done, the sediment may need to be loosened with a pitch fork to make total removal of the roots possible. Follow-up monitoring must be done to check for re-sprouts. ALL PLANT PARTS must be removed and destroyed or disposed of. (Any piece of EWM stem, two inches or longer, can sprout into a new plant, so removal of any loose, floating EWM stems is important!)

3. **Provide Weevil Habitat – *Beginning Immediately!***

Whether Option 1 or Option 2 is being pursued, providing weevil winter habitat may increase chances for long-term control. Under Option 1, if eradication is achieved, there will always be a chance for re-infestation in the future and having good habitat for weevils will provide future options. Under Option 2, the investment in buying weevils can be maximized by providing good winter habitat.

Natural (un-raked, un-mowed) vegetation along shore is essential because weevils spend their winters hibernating in the mud, leaf litter and vegetation debris on shore. Weevils do not survive in areas that are mowed, raked, rip-rapped or bare sand. (Disturbances such as these also *encourage* the establishment of exotic species.) Because weevils are weak fliers, the day they emerge from the water to fly to shore and hibernate, they are at the mercy of the wind. The more shoreline that is in natural condition the better the weevils' chances are of landing in suitable habitat.

To help the weevils survive and do the job we are asking of them, parks departments and private landowners can:

- ✓ <u>Leave as much un-mowed land as possible within 35' of shore</u>. (More is better!) At a minimum, don't mow or rake before Memorial Day or after Labor Day to give the weevils time to leave or find hibernation habitats.

- ✓ <u>Minimize the area</u> maintained in beach, mowed paths, rip-rap, or otherwise disturbed/manipulated land.

- ✓ <u>Restore disturbed/manipulated areas</u>.
  For cost-sharing or technical assistance on restorations, contact the Portage Co. Land Conservation Dept.

- ✓ <u>Minimize fertilizer use</u>.
  Storm water from fertilized properties can speed EWM growth!

  (Also see Appendix B for more tips on providing weevil habitat.)

4. **Trained Volunteer Monitoring Program – *Spring 2005***

Whether Option 1 or Option 2 is being pursued, a trained volunteer monitoring crew who can correctly identify EWM and map new EWM beds on an annual or biannual basis will be essential to the management the EWM on Lake Emily. Annual monitoring may help reduce future expenses by identifying problems early or reducing the amount of information a consultant would need to collect. Your WDNR Aquatic Plants Specialist can arrange this training. (See Appendix C for contact information.)

Landowners can learn how to keep their docks EWM-free!

Additionally, all landowners can learn how to keep their dock areas "EWM-free", thereby helping to control the weed's spread. Once trained to identify and control EWM, landowners can watch for EWM that washes up on shore and dispose of those plants before it takes hold and starts a new bed. Landowners can also be trained how to pull individual EWM plants found in the shallows around their property to prevent a new bed from developing. (Pulling individual, spotty growths should not negatively impact natural weevil populations and may help keep EWM from spreading faster than the control treatments can work.) Again, landowners should be *trained* for this, so they are not pulling beneficial, native plants.

5. **Boating Lanes – *Spring 2005***

Whether Option 1 or Option 2 is being pursued, minimizing the boat traffic through Beds A and C will increase the success of either treatment plan. Boat traffic through these beds chops up the stems and assists the spread of EWM. Traffic also impedes the establishment of milfoil weevils. "Boating lanes" or "No-boating" areas should be established to steer traffic around these two beds. If it is not possible to get *around* these beds, boating lanes would confine traffic to a smaller area *through* the beds. (Placement of bouys requires WDNR permit approval. Local permits may also be required.)

Optionally, "No-boating" areas may also established around other EWM beds where stems are within reach of boat props or wash. Weevil densities are only known in four EWM beds, and it is possible that other beds on Lake Emily are also affected by boat traffic and the weevils in those beds may be struggling too.

6. **Create Aquatic Plant Management Plan**

EWM eradication should be considered to be just one part of a larger goal of total lake health. It is recommended that the 2004 survey data be used to create a comprehensive aquatic plant management plan for Lake Emily. The Portage County Lake Study and other projects have already gathered a great deal of data needed to create a well-balanced lake management plan.

7. **Maintain Exotic Species Advisory Signs**

Under Wisconsin Statutes, Chapter 30.715, it is illegal to place a boat, trailer or equipment that have aquatic plants attached into a navigable waterway.

(Wisconsin Legislature: Infobases). "Exotic Species Advisory" signs placed at boat landings can be a reminder to boaters to check for hitch hiking plants.

The signs, as originally posted at the east boat landing on Lake Emily, were not highly visible at a point where boaters would be tending to their equipment and likely to take the time to look for "hitch-hiking" plants. The signs have since been moved and are now more noticeable. Also, the south boat landing was previously not posted, but signs were posted at this landing in summer of 2004.

Prominent signage should be maintained in good condition at <u>both</u> boat landings to prevent boaters from bringing additional exotic species to Lake Emily or transferring EWM to other lakes.

If the signs are damaged or missing the WDNR should be notified.

View as launching at the East boat landing. Sign is now more visible than it was as originally posted.

Close-up of posted signage.

8. **Volunteer Watercraft Inspection Program**

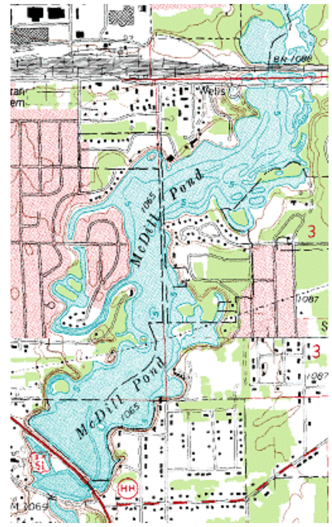
Because aquatic invasive species spread primarily by hitch hiking from lake to lake on boats and boating equipment, information about invasive species must get into the hands of every boater. The presence of trained volunteer watercraft inspectors, especially on major boating weekends, would be helpful to educate boaters about the invasive nature of exotic species and the importance of checking boats and trailers for "hitch hikers".

Lake Emily has a high recreational value and is held in high regard by the area citizens and the Friends of Lake Emily protection group. This group, as well as other conservation groups in Portage County, should be encouraged to participate in the volunteer watercraft inspector training workshops and the support network offered by the Clean Boats, Clean Water Program through the Wisconsin Lakes Partnership. More information about this program is given in Section III.c. See Appendix B for program contacts.

VI. McDILL POND

a. Lake Background

Straddling the Village of Whiting and City of Stevens Point border, McDill Pond is a large impoundment of the Plover River, with a surface area of 261 acres and a maximum depth of 8 feet. The water of McDill Pond mostly comes from the Plover River, with other contributions coming from runoff, groundwater, and precipitation. Much of the water exits the pond at the dam and some water moves to the groundwater. Because the majority of McDill Pond's water comes from the Plover River, one must think of the pond's watershed and the river's watershed as being one in the same. The Plover River's surface watershed has the most impact on the water quality of the river and the pond. (See Appendix C for definitions of terms.) The dominant landuse in that watershed is fairly evenly spread between forest (34%), agriculture (23%), wetland (20%) and grassland (18%). (UWSP and Portage County 2003, Preliminary Results)



McDill Pond on USGS topographic map.


McDill Pond's northern boat landing.

Perhaps of greater importance in the case of McDill Pond is the amount of development surrounding the pond. Land use within 1000 feet of the shoreline, which was dominated by open field and forest in 1960, is now 0% forest or open field and is 100% residential, streets, parks and commercial land uses. (UWSP and Portage County 2003, Preliminary Results) This is a highly recreated waterbody with dense residential land, four public parks and two trailerable boat landings.

McDill Pond historically has been a mesotrophic lake. Total phosphorus levels historically average approximately 21 parts per billion (ppb) but average phosphorus levels for the year 2002 were approximately 28.5 ppb, which is just under the eutrophic level of 30 ppb. (UWSP and Portage County 2003, Preliminary Results)

Water clarity in McDill Pond is considered good when compared with similar ponds in the region. Secchi depth (a measure of water clarity) in 2002 was best in September (6 feet) and poorest in July (5 feet). Fluctuations in water clarity are normal, due to increases and decreases of algae population and sedimentation. (UWSP and Portage County 2003, Preliminary Results)

b. History of Aquatic Plant Control in McDill Pond

Nuisance aquatic plant control and heavy sedimentation has been an ongoing problem in McDill Pond. It's very nature as an impoundment of the Plover River makes it a settling area for sediment and nutrients being carried by the river, including phosphorus, the nutrient most responsible for excessive plant and algae growth. In the 1950's, a small aquatic plant harvester was operated by the Stevens Point Sportsman Club. (McDill Inland Lake Protection District 1995) From 1959 to 1962, the pond was drained, and several disjointed improvement efforts were made by waterfront property owners, developers and the Village of Whiting. Plant material was collected and burned, channels were straightened and deepened and mucky, sediment-filled areas were scraped. The nuisance plant problem was greatly reduced by these efforts, but by 1966 weed growth was again approaching nuisance levels. (McDill Lake District Technical Committee 1978)

Herbicide use for weed control began in 1967. The list of chemicals (active ingredients) used included Arsenic, Diquat, Endothall and Silvex. (City of Stevens Point and McDill Pond Association 1992) The herbicides were first used in selected areas, then in increasingly larger areas until 1982, when annual plant harvesting was resumed with the goal of reducing available phosphorus in the pond by removing excess plant matter (McDill Inland Lake Protection and Rehabilitation District 1995, Shaw and Mealy 1983). Another less extensive drawdown, or drainage, was done in 1991 to allow for maintenance of the sediment-trapping areas at the pond's headwaters, but intense recreational pressures prevented a prolonged drawdown like that of the 1960's. (City of Stevens Point and McDill Pond Association 1992)

Because the Aquatic Plant Management Plan written for McDill Pond in 1992 found that most of the available control options (drawdowns, herbicides, manual control) were impractical or carried significant drawbacks, mechanical harvesting was determined to be the most practical, responsible and efficient method of weed control for McDill Pond. In addition to recommending this as the best control method for all uses of the pond, the plan also recommended a campaign for responsible riparian land practices to reduce nutrient inputs to McDill Pond and its watershed. (City of Stevens Point and McDill Pond Association 1992)

While the current management plan laid good groundwork, it is now over a decade old. Infestations can increase, decrease or appear in new locations around a water body. The 1996 Aquatic Plant Harvesting Summary showed that 21% of the plant matter removed was milfoil, but 61% was curly leaf pondweed (*Potamogeton crispus*, another invasive exotic specie). (McDill Inland Lake Protection and Rehabilitation District 1996) Anecdotal evidence suggests that this ratio has now changed, with EWM greatly out-competing curly leaf pondweed. With new survey data available, it may be helpful to review and update the management plan. Table 4 lists all aquatic vegetation species documented in McDill Pond.

[Note: A recent dredging operation, *unrelated to aquatic plant control*, was implemented in June-July of 2002 by the McDill Pond Inland Lake Protection & Rehabilitation District. Approximately 147,000 cubic yards of sand was removed from the upper end of the pond to create a sediment trap where the Plover River empties into the pond. (McDill Pond News)]

Table 4 - List of Documented Aquatic Vegetation
(Submergent and Floating Leaf Aquatics Only)
* Most abundant species noted with asterisk *

	Documented Aquatic Vegetation for McDill Pond			
	Scientific Name	**Common Name**	**Historical Records (1)**	**2004 Surveys (2)**
1	*Ceratophylum demersum* (n)	Coontail	X *	X *
2	*Chara vulgaris*	Muskgrass	X	X
3	*Elodea Canadensis* (n)	Waterweed	X *	X *
4	*Lemna minor*	Small duckweed	X	X
5	*Lemna trisulca*	Star duckweed	X	
6	*Lemna turionifera*	Perennial duckweed	X	
7	*Myriophyllum spp*. (e)	Milfoil species **	X *	X *
8	*Najas flexilis*	Slender naiad		X
9	*Nuphar variegata*	Bullhead pond lily	X	X
10	*Nymphea odorata*	White water lily	X	X
11	*Potamogeton amplifolius*	Large leaf pondweed	X	
12	*Potamogeton crispus* (e)	Curly leaf pondweed	X *	X *
13	*Potamogeton foliosus*	Leafy pondweed	X	X
14	*Potamogeton natans*	Floating leaf pondweed	X	
15	*Potamogeton nodosus*	Long leaf pondweed	X	
16	*Potamogeton pectinatus*	Sago pondweed	X *	X
17	*Potamogeton praelongus*	White stem pondweed	X	X
18	*Potamogeton pusillus*	Small pondweed		X
19	*Potamogeton richardsonii*	Clasping leaf pondweed	X	
20	*Potamogeton robbinsii*	Robbin's pondweed	X	
21	*Potamogeton zosteriformis*	Flat-stem pondweed		X
22	*Ranunculus aquatilis*	White water crowfoot	X	X
23	*Spirodela polyrhiza*	Large duckweed		X
24	*Utricularia sp.*	Bladderwort	X	
25	*Valisneria Americana*	Wild celery	X *	
26	*Wolfia spp.*	Water meal		X
27	*Wolffia borealis*	Northern water-meal	X	
28	*Wolffia columbiana*	Common water-meal	X	
29	*Zannichellia palustris*	Horned pondweed		X
30	*Zosterella dubia*	Water stargrass	X	

(1) Reported in 1983 plant surveys (Shaw and Mealy 1983), WDNR records, Robert W. Freckman Herbarium (University of Wisconsin-Stevens Point) records and available reports through November 2003, [Note: These herbarium records are historical documentation of what has been identified to date at McDill Pond. *This is not an exclusive list.* Further, it cannot be stated with certainty that because a species has not been recorded at that lake recently that the species is no longer present in that lake. However, it has been well documented that as exotic invasives infest a lake, native vegetation is progressively less able to compete and the number of species (diversity) in the lake declines.]

(2) Recorded during 2004 plant surveys. (5/26-6/8/04)

* Reported to be a dominant species during plant surveys

** Refers to both Eurasian (*M. spicatum*) and Northern (*M. sibiricum*) milfoils. 1983 report did not distinguish species (Mealy and Shaw 1983), 1992 report listed only Northern milfoil (City of Stevens Point and McDill Pond Association 1992). The 2004 surveys attempted to distinguish between Eurasian and Northern milfoils, but apparent hybridization between the species made that difficult, therefore the milfoils were lumped together for statistical evaluation.

(e) Exotic, invasive

(n) Native, can be invasive

c. Vegetation Survey Results

Because McDill Pond has a long history of nuisance plant treatments, EWM surveys would have been exhausting and pointless. However, with historical plant surveys available, new plant surveys could provide updated data to compare to historical data, perhaps giving some insight about changes in the pond and guiding future management choices.

Plant surveys were conducted on McDill Pond on 5/26, 5/28, 6/1, 6/2 and 6/8/04. See Section II for methods used. All species appearing at sample points were recorded. Any additional species noticed between sample points were noted, but not tallied for statistical evaluation. All plants noted during 2004 field surveys are reported in Table 4. Survey transects are shown on Figure 3. Spreadsheets showing survey rankings for all species recorded at sample points are presented in Appendix E. Voucher specimens were collected during sampling, pressed, labeled and will be retained in the Robert W. Freckman Herbarium on the University of Wisconsin-Stevens Point campus.

Attempts were made during the 2004 plant surveys to distinguish between the exotic Eurasian Water Milfoil (*Myriophyllum spicatum*) and the native Northern Milfoil (*Myriophyllum sibiricum*). However, this proved to be quite difficult at times, and it appears there may be some hybridizing between the two species. The 1983 survey (Shaw and Mealy 1983) did not attempt to distinguish species type, and the 1992 report (City of Stevens Point and McDill Pond Association 1992) listed only *Myriophyllum exalbescens* (the formerly used name for *Myriophyllum sibiricum*). Due to these factors, the 2004 data collected for Northern and Eurasian milfoil were combined together for statistical evaluation.

Overall, four plants were found to have the highest relative density on McDill Pond: milfoils (species combined, see above paragraph), elodea (*Elodea Canadensis*), curly pondweed (*Potamogeton crispus*) and coontail (*Ceratophyllum demersum*), in that order. Looking specifically at depth zones, milfoils rate the highest density across all depth zones, with elodea rating second in depth zones 0-1.5 feet and 1.5-5 feet and curly pondweed rating second in the 5-10 feet depth zone. (No plants were found in the 10-20 feet depth zone.)

A total of 30 submergent or floating aquatic species have been documented at McDill Pond to date. The pond has a good diversity of aquatic plant species. Twelve species listed on Table 4 were historically present but not seen during the 2004 surveys. Six species also were seen during the 2004 surveys that were previously not recorded. The fact that these species were recorded during one survey and not in others does not *necessarily* mean the species have disappeared from or are new to the pond. However, in comparing new data to historical data, small duckweed (*Lemna minor*) is recorded in the 2004 surveys as a dominant species in Zone 1, which may indicate an increase in nutrient enrichment. Muskgrass (*Chara vulgaris*), a species indicative of disturbance, was found to be a dominant species in Zone 2 during the 2004 surveys. The Floristic Quality Index also indicates that disturbance on McDill Pond has increased since 1983.

Another notable change appears to be the absence of wild celery during the 2004 surveys. (See Table 5.) It was not recorded at sample points, nor as an observed species elsewhere. The 1983 surveys had found it to be a dominant species in Zones 1 and 2. Since mechanical harvesting usually encourages wild celery growth, the cause of this decline is not understood. White water crowfoot (*Ranunculus aquatilis*) was mapped in dense beds in Zone 1 during the 1983 surveys but was only trivially present during the 2004 surveys.

Referring to back to Table 4, also absent during the 2004 surveys was Robbin's pondweed (*Potamogeton Robbinsii*), which was listed as "common" in the 1992 report by the City of Stevens Point and the McDill Pond Association. A markedly decreased abundance of these two native species may indicate that the natives are indeed being out-competed by invasive species, both exotic and native, as has been documented elsewhere.

Table 5. Current and Historic Vegetation Dominance Comparison

		Species Recorded as Dominant or Abundant	
Zone*	**Description**	**1983[(1)(2)]**	**2004**
1	Headwaters region. Sediment and nutrient build-up, dredged occasionally. Not mech. harvested.	V. Americana, P. crispus, P. pectinatus, E. canadensis	E. Canadensis, C. demersum, Myriophyllum spp., P. crispus, Lemna minor
2	Shallow. Lots of backwater areas. Dense zone of vegetation. Extensive mechanical harvesting.	P. crispus, C. demersum	E. Canadensis, Myriophyllum spp., P. crispus, C. demersum, Chara sp.
3	Dense vegetation more isolated, limited to edges. Some mechanical harvesting.	Myriophyllum sp. and P. crispus, succeeded by C. demersum and V. Americana	Myriophyllum spp., P. crispus, C. demersum, E. Canadensis

* See Figure 3 for Zone locations.

(1) (Shaw and Mealy 1983)

(2) No survey date could be found in the 1983 Shaw and Mealy report. Because curly pondweed (*Potamogeton crispus*) dominance cycles throughout the summer and varies with water temperature, without knowing the date of the 1983 surveys, direct comparison of curly pondweed dominance between the 1983 and 2004 studies may be invalid.

Disturbances like drawdowns, dredging and harvesting can reduce some native species and, therefore, open up areas to invasion by invasive species, both exotic and native. As these tools are necessary to manage the sediment- and nutrient-rich McDill Pond, it may be helpful to look for ways to use these tools to achieve management goals while also protecting the species diversity of the pond. Protecting the non-invasive, native vegetation may give those species a chance to better compete with the invasive species, thereby offering some *natural* control of those invasive species and possibly reducing the degree of mechanical control needed.

"Targeted" Harvesting…

One way mechanical harvesting has been used to successfully control invasive species is with "targeted" harvesting, as on Lake Pewaukee. Lake Pewaukee, like McDill Pond, is a nutrient rich, soft sediment impoundment that has its own long history with nuisance weed control. In recent years, the Lake Pewaukee Sanitary District opted to steer completely away from yearly use of herbicides and use a harvesting-only approach, which targets heavily on the nuisance species (mainly EWM). Their harvesters begin operation very early in the spring when EWM is already going strong, but when the less-bothersome, native species are still dormant. Harvesters target the beds of EWM, cutting as close to the bottom as they can. This will deplete the EWM of its stored energy and set the plants back, while doing little, if any, damage to the still-dormant natives. In summer, once the natives come up, the harvesters just cut the tops of EWM beds, to impact the EWM but avoid impacting the native species significantly. An additional summer task is raking and pickup of loose EWM stems that collect along the shoreline. The sanitary district feels this has been very helpful in two ways; it reduces the amount of rotting plant material contributing nutrients to the sediments, and it reduces the amount of reproduction via stem fragments. Windward areas of the lake have benefited most from this practice, seeing very little new establishment of EWM beds, but even leeward areas have seen a significant reduction in new EWM growths.

In fall, when native species go dormant again, the harvesters on Lake Pewaukee resume the deep cutting of EWM. This strategy is also helping in two ways; it deprives the plant the opportunity to store energy for the winter, and it removes the plant before it can autofragment to produce new shoots. After the implementation of these aggressive fall cuttings, harvesting of previously troublesome, shallow bays has been unnecessary until late in the season, presumably because EWM growths struggled to recover for most of the season.

The targeted harvesting and shoreline pickup strategies have, after several years, succeeded in diminishing the EWM populations *and* in allowing the native species to compete again, restoring plant diversity in Lake Pewaukee. With these changes, an increased diversity of invertebrate populations and better balance of fish populations have been observed. This improved control of nuisance species was achieved in spite of steady, high phosphorus levels.

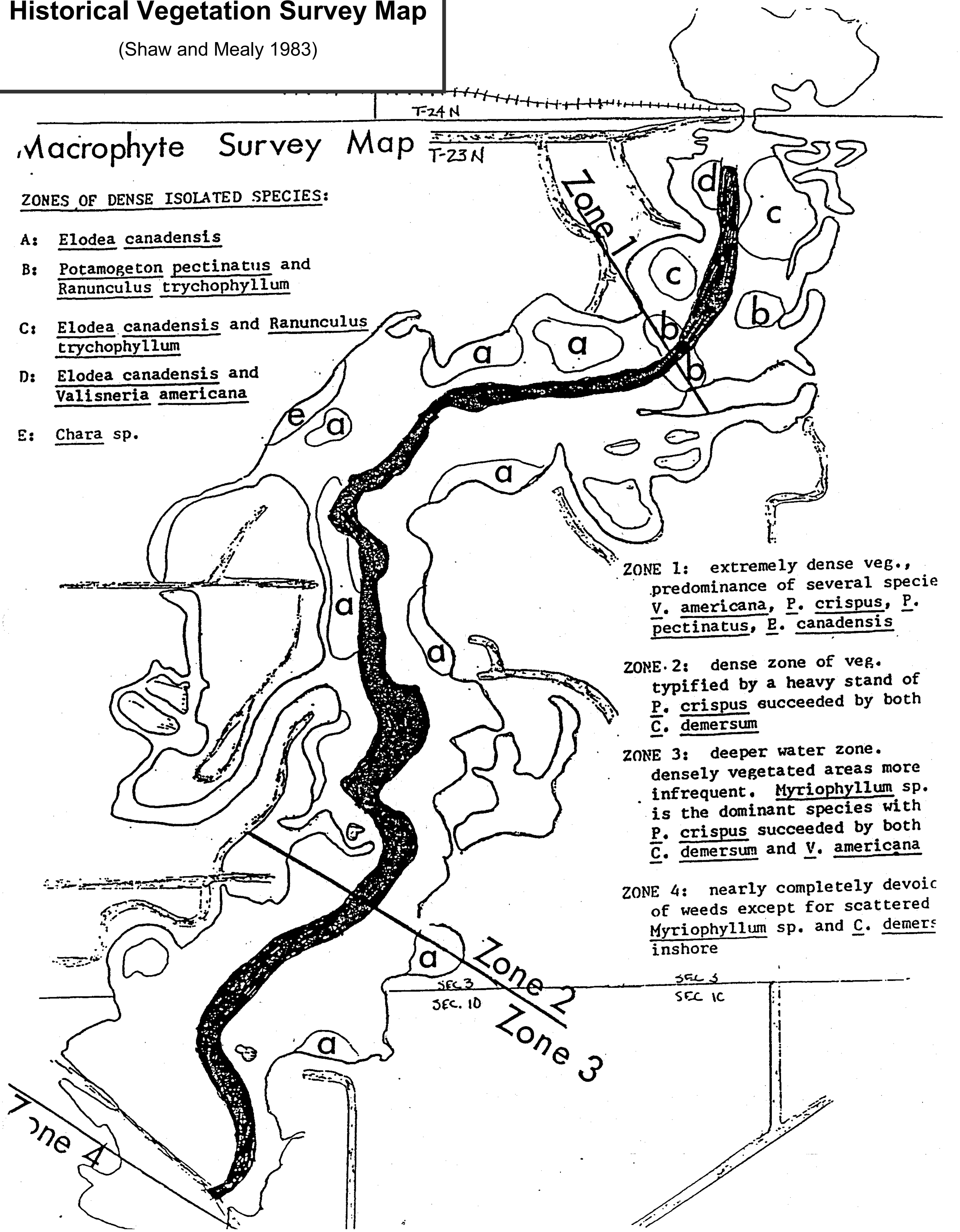
McDill Pond has problems with multiple species, but this targeted harvesting strategy may still be useful. Curly pondweed, coontail and elodea, like EWM, are cold-tolerant species and are actively growing in early spring and late fall. Therefore, it is possible that all four of these problem species could be better controlled by heavy, targeted harvesting in spring and fall.

Additionally, because three of those four problem species reproduce mainly from stem fragments, routine pickup of the loose stems produced by mechanical harvesting may help to control establishment of new growths and reduce the rotting plant material contributing to already high nutrient levels. If needed, pickup efforts could reasonably be limited to downstream and leeward shores where fragments most commonly tend to collect.

Figure 2. McDill Pond
Survey Transects

Figure 3.
Historical Vegetation Survey Map

(Shaw and Mealy 1983)



d. General Recommendations:

<u>*"Targeted" Harvesting & Shoreline Pickup*</u>

1. **"Targeted" Harvesting and Shoreline Pickup**

For McDill Pond, mechanical harvesting is the most appropriate method for yearly control of EWM and the other problem species. This control method, does however have two inherent drawbacks: It can adversely impact non-invasive native species, decreasing their ability to compete and thereby reducing diversity, and it creates loose stem fragments, which can assist the spread of nuisance species and contribute nutrients to the sediments. "Targeted" harvesting and shoreline pickup may help reduce the effects of these two drawbacks. An additional benefit may be the reduction in the amount of harvesting needed over time, which has been seen on Lake Pewaukee.

"Targeted" harvesting has been used on Lake Pewaukee to successfully control EWM. McDill Pond has problems with multiple species, but this strategy may still be useful. Curly pondweed, coontail and elodea, like EWM, are cold-tolerant species and are actively growing in early spring and late fall. Therefore, it is possible that all four of these problem species could be controlled by heavy, targeted harvesting in spring and fall. (See more detailed description of this method in Section VI.c.) Another critical season for targeting curly pondweed is in late June, when it goes to seed, dies off and releases its phosphorus content back into the water, which feeds the mid-summer algae blooms. Targeted harvesting of curly pondweed beds in late June may help reduce the reproduction of curly pondweed *and* reduce the severity of the mid-summer algae blooms.

Additionally, because three of those four problem species reproduce mainly from stem fragments, routine pickup of the loose stems produced by mechanical harvesting may help to control establishment of those species in new areas and reduce the amount of rotting plant material contributing nutrients to the already nutrient-rich sediment.

Try a
"Test-Bay"
to evaluate the benefits of the targeted harvesting method.

If a cost-benefit analysis is necessary, a targeted harvesting plan could be implemented in one "<u>Test-Bay</u>", over a couple growing seasons, and pickup efforts could reasonably be limited to downstream and leeward shores where fragments most likely tend to collect. The Test-Bay could then be evaluated for reductions in nuisance species, cost of control methods, etc… before determining whether to implement the strategy pond-wide.

2. **Evaluate Management Plan**

The analysis of the new vegetation survey data that is presented in this report is fairly simple. More in-depth examination of the data by managers of McDill Pond may help to fine-tune and update the existing management plan.

3. **Evaluate Success of Public Education Efforts**

While evaluating the management plan and exploring all future options, the successes or failures of the campaign for responsible riparian land practices should also be evaluated and fine-tuned.

4. **Maintain Exotic Species Advisory Signs**

Under Wisconsin Statutes, Chapter 30.715, it is illegal to place a boat, trailer or equipment that have aquatic plants attached into a navigable waterway. (Wisconsin Legislature: Infobases). "Exotic Species Advisory" signs placed at boat landings can be a reminder to boaters to check for hitch hiking plants.

In 2003, there was no sign at the north boat landing, and the sign at McDill Pond's south boat landing only warned of EWM. The WDNR was notified and both items have been addresses. Now that signs are present and up to date at <u>both</u> boat landings, they should be maintained in good condition at visible locations to prevent boaters from bringing *additional* exotic species to McDill Pond or transferring EWM and curly pondweed to other lakes.

If the signs are damaged or missing the WDNR should be notified.

Highly visible signage at McDill Pond's south boat landing. Curly pondweed stickers were added in May of 2004.
A sign is now also present at the north boat landing

5. **Volunteer Watercraft Inspection Program**

Because aquatic invasive species spread primarily by hitch hiking from lake to lake on boats and boating equipment, information about invasive species must get into the hands of every boater. The presence of trained volunteer watercraft inspectors, especially on major boating weekends, would be helpful to educate boaters about the invasive nature of exotic species and the importance of checking boats and trailers for "hitch hikers".

McDill Pond has a high recreational value to the surrounding communities and has an active protection organization, the McDill Pond Association. This group, as well as other conservation groups in Portage County, are encouraged to participate in the volunteer watercraft inspector training workshops and the support network offered by the Clean Boats, Clean Water Program through the Wisconsin Lakes Partnership. More information about this program is given in Section III.c.

VII. LAKE PACAWA

a. Lake Background

Located approximately 200 feet west of U.S. Highway 39 and 1,600 feet south of the County Highway B and US 39 interchange in the Village of Plover, Lake Pacawa is a small man-made lake with a surface area of 12 acres. (*"EWM in WI as of 2002"*) The lake was a borrow-pit for highway improvement projects that eventually filled with groundwater. Lake Pacawa is a heavily recreated lake surrounded by public beaches, a park, a boat landing and two ball diamonds. A Korean War Memorial is located on the island in the center of Lake Pacawa, accessible by a concrete causeway. The lake also plays host to a Village of Plover annual summertime celebration, called Lake Pacawa Days, as well as other events and festivals.

Lake Pacawa on USGS topographic map. (Numbered 1078)

Because of the lake's small size and man-made origin, it has not been included in many lake studies performed on Portage County lakes. Watershed information, lake depth contour maps or maximum depth records were not available to include in this assessment.


Lake Pacawa with Korean War Memorial on island.

Lake Pacawa is a hard water lake and appears to have excellent clarity. Secchi depth (a measure of water clarity) was 9 feet on August 5th, 2004, when measured during weevil surveys. See Section VII.d.) No other secchi depth records were found to report in this assessment. Phosphorus levels were also not available to report. More thorough sampling and testing would be necessary to truly evaluate the overall health of Lake Pacawa.

b. History of Aquatic Plant Control in Lake Pacawa

According to WDNR records, a herbicide treatment with Aquathol for "nuisance" plant growth was done in July of 1986 to clear the beaches and boating lanes. Table 5 lists aquatic vegetation species documented in Lake Pacawa.

Table 6. List of Documented Aquatic Vegetation
(Submergent and Floating Leaf Aquatics Only)

	Herbarium Records for Lake Pacawa *	
	Scientific Name	Common Name
1	*Myriophyllum spicatum* (e)	Eurasian water milfoil
2	*Potamogeton pectinatus*	Sago pondweed

* Specimens were randomly collected during 10/22/03 field mapping activities and later preserved and submitted for record to the Robert W. Freckman Herbarium at University of Wisconsin-Stevens Point. Only one previous collection record (sago pondweed, coll'd in 1975) could be found for Lake Pacawa. Fieldwork on 10/22/03 was not focused on identifying all plant species in the lake, therefore, this plant list is NOT an exclusive list. Because little historical plant data is available, it cannot be said whether plant diversity in Lake Pacawa has been adversely affected by the presence of EWM. However, it has been well documented that as invasive species infest a lake, native vegetation is progressively less able to compete and the number of species (diversity) in the lake declines.

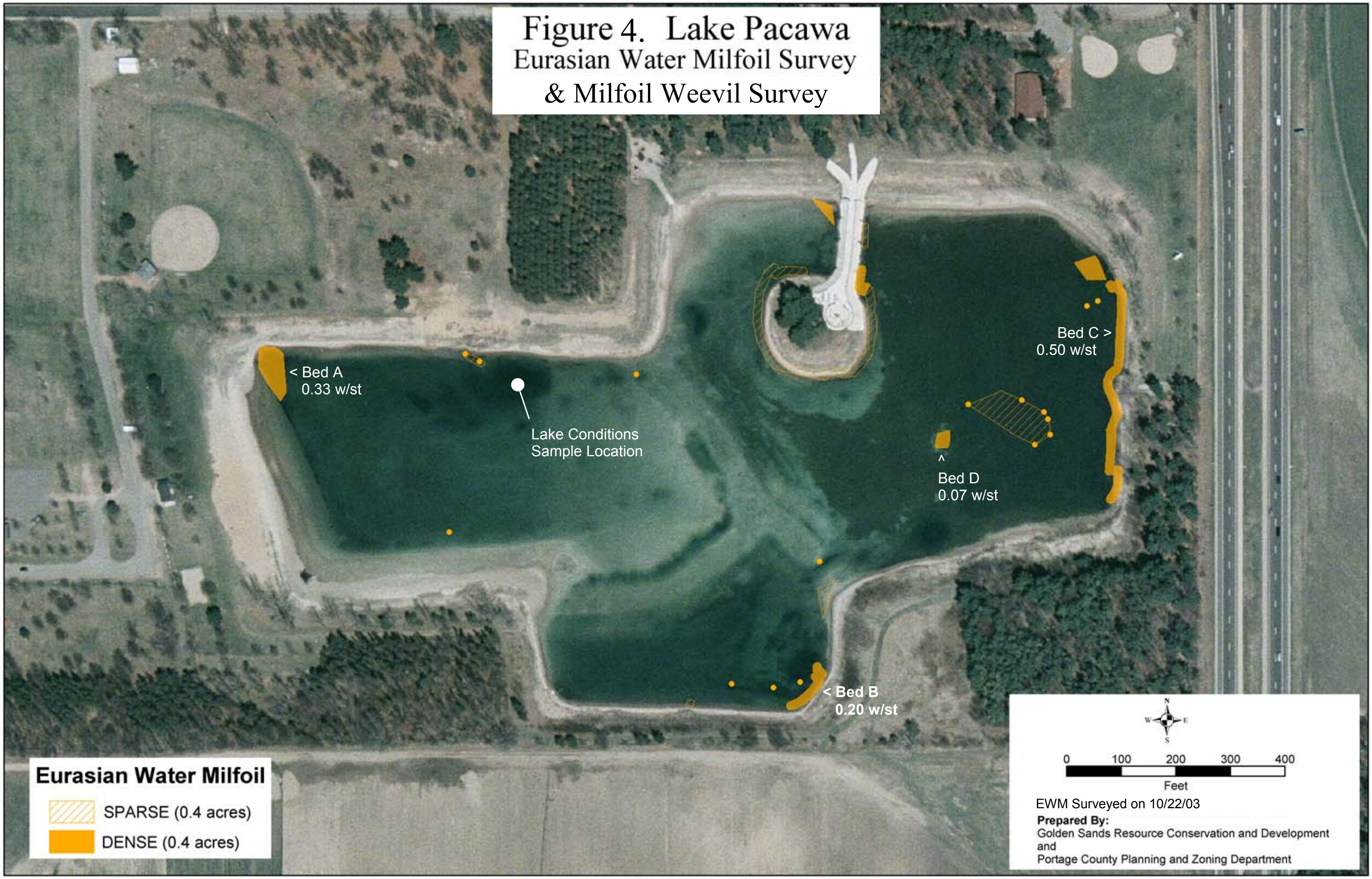
(e) Exotic invasive

c. Mapping Results

A dense EWM growth in Lake Pacawa.

Multiple areas of sparse to dense EWM growth were mapped during 10/22/03 field activities. Dense EWM growth totaled 0.4 acres and sparse growth totaled 0.4 acres. (See Figure 4.) EWM specimens were randomly collected to examine for evidence of the presence of the aquatic weevil, *Euhrychiopsis lecontei*. *E. lecontei* is a naturally occurring weevil, usually found where native milfoils occur, and can keep milfoil populations in check. The weevil can effectively impact the health of the milfoil plants by removing vascular tissue and destroying apical growing tips. (Jester 1998) Although no evidence of weevils could be found from the samples collected, a more thorough survey would be required to conclusively determine the presence or absence of *E. lecontei*.

While the largest beds of dense EWM growth observed on 10/22/03 and 8/5/04 were unsightly, Lake Pacawa does not appear to be "weed-choked", even 17 years after the only herbicide treatment performed there. It is possible that something in Lake Pacawa may be naturally inhibiting the spread of EWM.



Beds A, B, C and D surveyed for milfoil weevils (*Eurychiopsis lecontei*) on 08/05/04. Stem samples collected from sample beds were examined in laboratory on 08/13/04. Values on map represent average number of weevils per stem for each bed. Average weevil density overall for Lake Pacawa was found to be **0.28 weevils per stem.**

d. Weevil Population Density Survey Results:

In the 2003 EWM Assessment Report, one option suggested for Lake Pacawa was to investigate the potential for using biological control. It was suggested that if biological control proved a viable option under the conditions present at Lake Pacawa, this could provide a natural, long-term solution.

Population density surveys were performed in August 2004 to determine the existing natural population of the aquatic milfoil weevil *Euhrychiopsis lecontei*. EWM stem samples were collected from Lake Pacawa on August 5th, 2004 and examined in the laboratory on August 13th, 2004. Extracted weevil specimens were preserved in 95% ethyl alcohol and sent to Laura Jester of Jester Consulting, Eden Prairie, MN for species identification confirmation. See Figure 4 for sample locations and Table 7 for summarized results.

Table 7. Weevil Population Density Survey – Results Summary

Lab Date (2004)	Bed No.*	Depth Range (ft)	Tot # Stem Samples	% Samples Algae-covered	Ave # Broken Tips	Ave # of Apical Tips	% Stems w/ Weevil Damage	Ave # Eggs per Stem	Ave # Larvae per Stem	Ave # Pupae per Stem	Ave # Adults per Stem	Ave Weevils per Stem (All Life Stages)
8/13	**A**	3 – 6	15	0%	1.20	5.00	27%	0.00	0.33	0.00	0.00	**0.33**
8/13	**B**	6 – 7	15	0%	0.53	3.20	20%	0.00	0.13	0.07	0.00	**0.20**
8/13,8/17	**C**	2½ - 6	16	6%	0.56	2.13	19%	0.00	0.50	0.00	0.00	**0.50**
8/13	**D**	7 – 7½	15	0%	1.53	2.87	20%	0.07	0.00	0.00	0.00	**0.07**
Whole-Lake Results		2½ - 7½	61	2%	1.00	3.30	21%	0.02	0.25	0.02	0.0	**0.28**

*See Figure 4 for EWM sample bed locations.

Survey Notes:

Sample Date: 8/5/2004

Weather Conditions: Sunny, Breezy, 70°F

Lake Conditions: Secchi Depth = 9 ft
Temperature = 24.1°C
Dissolved Oxygen = 17.7 mg/l
(Secchi, Temp and D.O. sampled at water depth of 12 ft. See Figure 3 for sample location.)

Land Cover @ Shore: Bed A = Beach (sand), Park (mostly mowed close to shoreline)
Bed B = Natural, but heavily disturbed area nearby (litter/trampled/campfire scar)
Bed C = Park (mowed close to shoreline), Natural
Bed D = Middle of water, some distance from shore. Shore to far south and east is natural, to far north is park (mowed close to shoreline).

Sample Preservation: Samples were kept in water in labeled plastic bags at 3-4°C until time of examination. Any samples not examined within eight days of collection were preserved with ethyl alcohol. Due to a shortage of available ethyl alcohol, only approximately 30 ml of 95% ethyl alcohol could be added to the sample bags (containing apx. 100-130 ml of lake water). All samples appeared to be in good condition at the time of examination.

Average (*E. lecontei*) milfoil weevil density for Lake Pacawa was found to be 0.28 weevils per stem, which seems at first glance to be a low natural density. Of the 31 Wisconsin lakes studied by Laura Jester from 1996 to 1997, natural weevil densities varied greatly, (0.0 to 2.5 weevils per stem) with a mean of 0.65 weevils per stem.

(Jester 1998) Past studies have indicated that densities greater than 2 weevils per stem are associated with EWM declines, but recent evidence indicates that the density of weevils required to impact EWM is sometimes less than 2 weevils per stem and is highly lake specific. (Jester, et al. 1999) In fact, researchers now suggest that, while densities at or greater than 1 weevil per stem is preferable to achieve EWM *decline*, *control* may occur at levels around 0.5 weevils per stem or lower. (Newman 2004, *pers. comm.*)

Understanding these issues, discussion about the differences in weevil densities between the sample beds may be important. Figure 4 shows EWM sample bed locations and average weevil densities for those beds. There was notable contrast in weevil densities between sample beds. Factors found to positively impact weevils are a higher percentage of natural shoreline, bed locations that are near shore and growing in shallow water, and a higher number of growing tips per plant (bushier plants). (Jester, et al. 1999)

Beds A, B and C all had low to moderate population densities (0.33, 0.20 and 0.50 weevils per stem, respectively), but Bed D had non-detectable levels (0.00 weevils per stem). Bed D may be at a disadvantage due to distance from shore and depth of water, factors which cannot be changed. Beds A and C are possibly being impacted by the high percentage of beach and/or mowed parkland at shore and Bed B is possibly being impacted by the concentration of human activity on that shore (trampling, campfires, litter). These human-induced factors can be ameliorated, to at least some degree, by changes in park maintenance. Weevils overwinter in the mud and leaf litter along shore and, therefore, survive best with a higher percentage of natural shoreline that is not mowed, raked, rip-rapped, sand or sea-walls. (Jester et al. 1999)

By changing mowing practices and reducing concentrated public use of shorelines near EWM beds, weevil densities in Beds A, B and C may have a better survival rate, allowing the population to build-up and eventually populate Bed D more heavily. In essence, though Lake Pacawa currently has a low average weevil density across the lake, there may be opportunities to improve that population.

e. Recommended Management Plan for Eurasian Water Milfoil:

<u>*Biological Control*</u>

The EWM infestation in Lake Pacawa is too big for hand-cutting/pulling and too small for mechanical harvesting. Chemical controls may possibly be capable of eradicating EWM growths but must be repeated for several years to be effective, and it can be a costly and controversial treatment method. Plant barriers may provide an effective, chemical-free treatment option, but are also costly to install and maintain from year-to-year.

If financial support for herbicide treatment or plant barriers is unattainable, it may be possible to use the native aquatic milfoil weevil, *E. lecontei*, as a natural biological control of EWM. Successful biological control would *control* EWM, not *eradicate* it, but biological control would be a long-term, natural control method.

Please note that, as stated multiple times in this report, the number of weevils needed to control EWM varies from lake to lake, and there is *no guarantee* that Lake Pacawa can support high enough populations of weevils to control EWM.

1. **Provide Weevil Habitat – *Beginning Immediately***

   A native population of milfoil weevils already exists at Lake Pacawa, though currently at low levels. That population could possibly be naturally boosted by providing more habitat for winter hibernation. Weevils overwinter in the mud and vegetation debris along shore and, therefore, fare best with a higher percentage of natural shoreline that is not mowed, raked, rip-rapped, sand or sea-walls. (Jester et al. 1999) Also, because milfoil weevils are weak fliers, the day the weevils emerge from the lake to fly to shore they are at the mercy of the wind. The more natural shoreline available, the better their chances of landing on suitable habitat. To easily and affordably help the weevils survive and better control EWM, park managers at Lake Pacawa can:

   - ✓ Leave as much un-mowed land as possible within 35' of shore. (More is better!) Refrain from mowing or raking before Memorial Day and after Labor Day to give the weevils a chance to leave and find their winter habitat.

   - ✓ Minimize the area maintained in beach, mowed paths, rip-rap, or otherwise disturbed/manipulated land.

   - ✓ Restore disturbed/manipulated areas. (For technical assistance, Portage County Land Conservation Department.)

   - ✓ Minimize fertilizer use. (Runoff from fertilized properties can speed EWM growth!)

     (Also see Appendix B for more tips on providing weevil habitat.)

2. **Augment Natural Population (Optional) – *Summer 2005***

   Stocking weevils requires approval from the WDNR.

   The natural milfoil weevil population could be boosted further by stocking. Stocking may be accomplished by buying weevils from a supplier or by collecting weevils from Lake Pacawa and rearing them in tanks. Either method requires an investment in time and money, and the results cannot be guaranteed. For best results:

   - ✓ A solid commitment to providing overwintering habitat may help increase the chances for success.

   - ✓ Arrangements for follow-up surveys should be performed to assess the results of stocking, which may guide future plans to continue or discontinue stocking.

3. **Trained Volunteer Monitoring Program - *Annual***

EWM control is never permanent. It will be critical to identify the problem early if the biological control begins to fail. A volunteer monitoring crew, trained to identify EWM and weevil-damaged stems, may help track progress or identify problems. It should be understood that biological control is dynamic and that natural fluctuations between EWM and milfoil weevil populations will occur. However, if concerns arise about the continuing effectiveness of biological control of EWM, the WDNR Aquatic Plant Specialist should be consulted. (See Appendix C for contact information.)

4. **Maintain Exotic Species Advisory Sign**

As recommended in the 2003 EWM Assessment report, exotic species advisory signs have now been posted at the boat landing informing boaters of the presence of EWM in Lake Pacawa. Under Wisconsin Statutes, Chapter 30.715, it is illegal to transport boats or equipment that have aquatic plants attached. (Wisconsin Legislature: Infobases) When EWM is present in a water body, there is always a risk of boaters inadvertently transporting pieces of EWM and infesting another lake. “Exotic Species Advisory” signs placed at boat landings can be a reminder to boaters to check for “hitch-hikers”.

Although Lake Pacawa does not allow motorized watercraft, and motors are the most likely place to snag EWM, pieces of EWM plants can also get snagged on other equipment. With many “EWM-free” lakes in Portage County, this prominent signage at Lake Pacawa is important and should be maintained in good condition.

If the sign is damaged or missing the WDNR should be notified.

5. **Volunteer Watercraft Inspection Program**

Because aquatic invasive species spread primarily by hitch hiking from lake to lake on boats and boating equipment, information about invasive species must get into the hands of every boater. The presence of trained volunteer watercraft inspectors, especially on major boating weekends, would be helpful to educate boaters about the invasive nature of exotic species and the importance of checking boats and trailers for “hitch hikers”. These trained volunteers are often also the first to identify new exotic species infestations through their inspections of the water around the boat landing area.

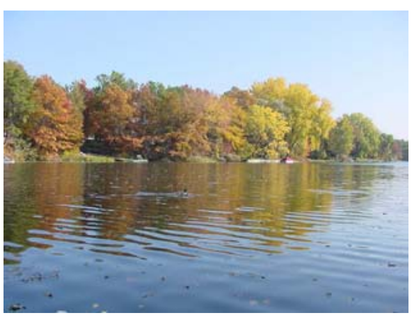
Lake Pacawa has a very high recreational value to the Lions Club, Village of Plover and surrounding communities. These groups, as well as other conservation groups in Portage County, are encouraged to participate in the volunteer watercraft inspector training workshops and the support network offered by the Clean Boats, Clean Waters Program through the Wisconsin Lakes Partnership. More information about this program is given in Section III.c.

VIII. SPRINGVILLE POND

a. Lake Background

Springville Pond on USGS topographic map.

Located on the east side of Business 51 in the Village of Plover, Springville Pond is a small impoundment of the Little Plover River, a Class I trout stream. Total surface area of the pond is 18 acres and maximum depth is 12 feet. The water of Springville Pond mostly comes from the Little Plover River, with other contributions coming from runoff, groundwater, and precipitation. Much of the water exits the pond at the dam and some water seeps back to the groundwater. (UWSP and Portage County 2003, Preliminary Results) Because the majority of Springville Pond's water comes from the Little Plover River, the pond's watershed and the river's watershed are one in the same, with 90-95% of the water coming from groundwater (Weeks et al. 1965). The Springville Pond/Little Plover River watershed lies within the porous, sandy groundwater recharge area for some of the Village of Plover's municipal wells, and groundwater studies and protection efforts have been ongoing for decades. Extensive efforts have been made by many agencies to increase public education regarding groundwater protection.


Fall colors on Springville Pond.

The three dominant land uses (nearly equal) within the surface watershed are forest, agriculture and residential. Perhaps of greater importance in the case of Springville Pond is the amount of development surrounding the pond. Land use within 1000 feet of the shoreline, which was dominated by open field and forest in 1960, is now primarily residential, parks, streets and commercial land uses. (UWSP and Portage County 2003, Preliminary Results) This is a modestly recreated pond lake with low-impact resident usage (non-motorized watercraft) and one small public park. In the past, one trailerable boat landing existed at the public park, which was removed in recent years. Currently, there is a grassy landing for non-motorized, hand-carry watercrafts.

A lake is categorized as "eutrophic" when total phosphorus levels are 30 ppb or higher, which results in more aquatic plant growth. Springville Pond is a eutrophic lake, with total phosphorus levels in 2002 around 34 ppb, although this level is much better than the state average for impoundments (70 ppb). (UWSP et al. 2003)

Water clarity in Springville Pond is considered good when compared with similar ponds in the region. Secchi depth (a measure of water clarity) in 2002 was best in August (8 feet) and poorest in September (5 feet). Fluctuations in water clarity are normal, due to increases and decreases of algae population and sedimentation. (UWSP and Portage County 2003, Preliminary Results)

b. History of Aquatic Plant Control in Springville Pond

Nuisance weed treatment and heavy sedimentation has been an ongoing problem in Springville Pond. Its very nature as an impoundment of the Little Plover River makes it the settling area for sediment and nutrients being carried by the river, including phosphorus, the nutrient most responsible for excessive plant and algae growth. WDNR Aquatic Plant Management Treatment Records show herbicide treatments for nuisance aquatic plant growth were used in the pond in 1967, 1991, 1992, 1993, 1994 and 1999. The list of chemicals used included Cutrine Plus, Diquat, Aquathol, Aquathol K, 2, 4-D and X77 surfactant. Sediment dredging was done in 1983, 1985 and 1991. Drawdowns were done in 1985, 1988, 1991, 1996 and 1999. Mechanical harvesting was done in 1987. Planting of native aquatic vegetation was done in 1992 and 1993. (Lampert-Lee & Associates 1997 and WDNR records) Table 8 lists aquatic vegetation species documented in Springville Pond.

(Note: A drawdown *unrelated to plant control* was done in 2003 for dam repairs. According to personnel at the Village of Plover, no dredging or plant control work was done during this drawdown.)

The Little Plover River and Springville Pond Watershed Management Plan, written by Lampert-Lee & Associates in 1997, stated that while chemical treatments may have been the most effective method used in Springville Pond (no quantitative study was done to confirm this), but that the use of chemical treatments has drawbacks, such as toxicity to animals, excessive plant decay causing oxygen depletion, residual by-products and unintended drift. The plan suggested that good environmental practices in the watershed may help to reduce the nutrient loading that boosts nuisance plant growth, thereby reducing the need for chemical treatments. Also, the plan recommended against dredging, since exotics usually have an advantage over native species at repopulating bare substrates.

The watershed management plan and WDNR records show that herbicide treatments usually focused on the eastern third of the pond, which is shallowest and accumulates the most sediment and nutrients. A heavy population of EWM and an isolated bed of curly leaf pondweed (*Potamogeton crispus*, also an exotic invasive plant) persists there. Herbicide treatments also focused on one large, dense patch in the deeper water of the western end, which has been persistent throughout treatment efforts and was present in October 2003.

Table 8. List of Documented Aquatic Vegetation
(Submergent and Floating-Leaf Aquatics Only)

	Herbarium Records for Springville Pond *	
	Scientific Name	Common Name
1	*Elodea Canadensis*	Waterweed
2	*Lemna minor*	Small duckweed
3	*Myriophyllum sibiricum*	Northern water milfoil
4	*Myriophyllum spicatum* (e)	Eurasian water milfoil
5	*Potamogeton crispus* (e)	Curly leaf pondweed
6	*Potamogeton pectinatus*	Sago pondweed
7	*Zannichellia palustris*	Horned pondweed

* Robert W. Freckman Herbarium records through November 2003, University of Wisconsin-Stevens Point. (Note: These herbarium records are historical documentation of what has been identified to date at Springville Pond. *This is not an exclusive list.* Further, it cannot be stated with certainty that because a species has not been recorded at that lake recently that the species is no longer present in that lake. However, it has been well documented that as exotic invasives infest a lake, native vegetation is progressively less able to compete and the number of species (diversity) in the lake declines. Anecdotally, this is what has been seen at lakes in Portage County where EWM is present, however it would require quantitative vegetation surveys to confirm this.)

(e) Exotic invasive

c. Mapping Results


A dense EWM growth in Springville Pond.

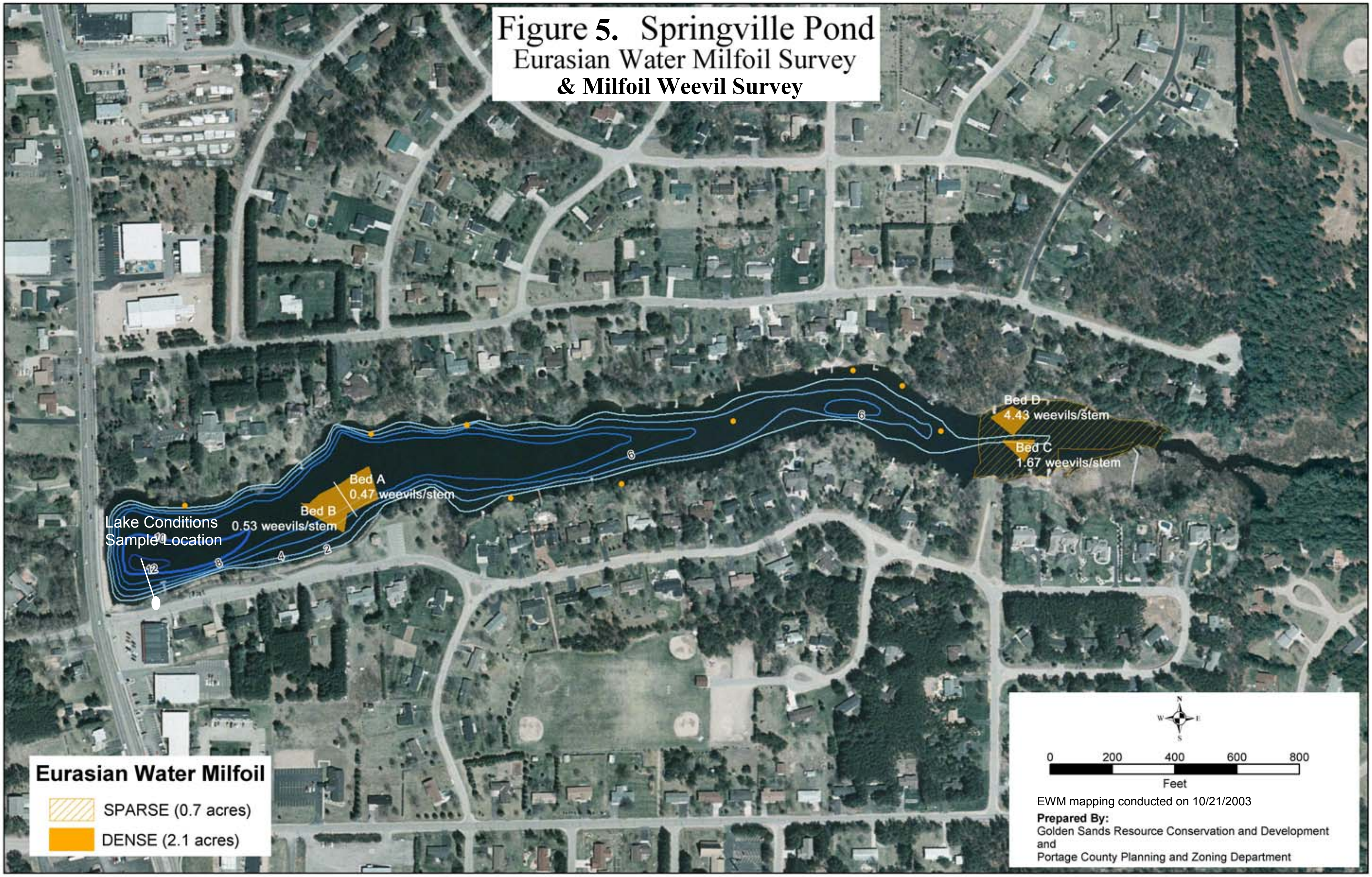
Multiple areas of sparse to dense EWM growth were mapped during October 2003 field activities. Dense EWM growths totaled 2.1 acres and sparse growths totaled 0.7 acres. (See Figure 5.) The growths mapped were comparable in size and location to growths seen approximately six years prior.

EWM specimens were randomly collected to examine for evidence of the presence of the aquatic milfoil weevil, *Euhrychiopsis lecontei*. *E. lecontei* is a naturally occurring weevil usually found where native milfoils occur and can keep milfoil populations in check. The weevil can effectively impact the health of the milfoil plants by removing vascular tissue and destroying apical growing tips. (Jester 1998) Examination of the EWM samples collected at Springville Pond found an *E. lecontei* pupae. Species identification was confirmed by Laura Jester, of Jester Consulting in Eden Prairie, Minnesota, confirming the presence of the aquatic weevil in Springville Pond. This is the first record of *E. lecontei* identified in Springville Pond, therefore the specimen was preserved, labeled and submitted to the UW-Stevens Point as a voucher specimen. It will be retained with the *E. lecontei* voucher specimens collected during Laura Jester's *E. lecontei* research in 1996-97.

d. Weevil Population Density Survey Results

In the 2003 EWM Assessment Report, the primary recommendation suggested for Springville Pond was to investigate the potential for using biological control. It was suggested that if biological control proved a viable option under the conditions present at Springville Pond, this could provide a natural, long-term solution.

Weevil population density surveys were performed in August 2004 to determine the existing natural population of the aquatic milfoil weevil, *Euhrychiopsis lecontei*. EWM stem samples were collected from Springville Pond on August 4th and 5th, 2004 and examined in the laboratory on August 9-12, 2004. Extracted weevil specimens were preserved in 95% ethyl alcohol and sent to Laura Jester of Jester Consulting, Eden Prairie, MN, for species identification confirmation. See Figure 5 for sample locations and Table 9 for summarized results.



Bed A, B, C and D surveyed for milfoil weevils (*Eurychiopsis lecontei*) on 08/04 – 08/05/04. Stem samples collected from sample beds were examined in laboratory on 08/09 – 08/12/04. Values on map represent average number of weevils per stem for each bed. Average weevil density overall for Springville Pond was found to be **1.65 weevils per stem.**

Table 9. Weevil Population Density Survey – Results Summary

Lab Date (2004)	Bed No.*	Depth Range (ft)	Tot # Stem Samples	% Samples Algae-covered	Ave # Broken Tips	Ave # of Apical Tips	% Stems w/ Weevil Damage	Ave # Eggs per Stem	Ave # Larvae per Stem	Ave # Pupae per Stem	Ave # Adults per Stem	Ave Weevils per Stem (All Life Stages)
8/10, 8/11	**A**	6 - 10	19	58%	1.68	2.79	58%	0.00	0.47	0.00	0.00	**0.47**
8/9, 8/10	**B**	8 - 10½	15	20%	1.27	2.00	47%	0.00	0.33	0.07	0.13	**0.53**
8/12	**C**	2½ - 3½	15	27%	0.87	2.73	80%	0.27	1.27	0.07	0.07	**1.67**
8/11, 8/12	**D**	2 - 2½	14	14%	1.21	4.43	93%	1.07	3.29	0.00	0.07	**4.43**
Whole Pond Results		2 - 10½	63	32%	1.3	3.0	70%	0.30	1.25	0.03	0.06	**1.65**

*See Figure 5 for EWM sample bed locations.

<u>Survey Notes:</u>

Sample Date: 8/4 – 8/5/2004

Weather Conditions: Sunny Breezy, 65 – 70°F

Lake Conditions: Secchi Depth = 9 ft
Temperature = 21.4°C
Dissolved Oxygen = 18.0 mg/l
(Secchi, Temp and D.O. sampled at water depth of 10 ft. See Figure 4 for sample location.)

Land Cover @ Shore: Bed A = Park (mowed to shoreline**), Residential (most mowed to shoreline)
Bed B = Park (mowed to shoreline**), Residential (most mowed to shoreline)
Bed C = Residential (some mowed, but more natural along shoreline)
Bed D = Residential (some mowed, but more natural along shoreline)

Sample Preservation: Samples were kept in water in labeled plastic bags at 3-4°C until time of examination. All Springville Pond samples were examine within eight days of collection, therefore, they did not require preservation with ethyl alcohol.

Other notes: Somewhat common leaf deformity = fused lower leaflets.

**Park maintenance at Springville Pond had traditionally mowed the entire park to the shore's edge. The park was recently terraced to reduce erosion and storm water runoff into the pond. During the summer of 2004, the mowing program reduced the extent of the mowed area and frequency of mowing times, which will significantly improve the amount of available winter weevil habitat at the park.

Average (*E. lecontei*) milfoil weevil density for Springville Pond was found to be 1.65 weevils per stem, which seems to be a healthy natural density. Of the 31 Wisconsin lakes studied by Laura Jester from 1996 to 1997, only four had natural weevil densities over 1.5 weevils per stem. (Jester 1998) Past studies have indicated that densities greater than 2 weevils per stem are associated with EWM declines, but recent evidence indicates that the density of weevils required to impact EWM may be less than 2 weevils per stem and is highly lake specific. In fact, researchers now suggest that, while densities at or greater than 1 weevil per stem is preferable to achieve EWM *decline*, *control* may occur at levels around 0.5 weevils per stem or lower. (Newman 2004, *pers. comm.*) Factors found to favor weevil population increases are; bed locations that are near shore and growing in shallow water, a higher percentage of natural shoreline, and a higher number of growing tips per plant (bushier plants). (Jester, et al. 1999)

Figure 5 shows EWM sample bed locations and average weevil densities for those beds. There was notable contrast in weevil densities between sample beds. Beds A and B were distinctly lower in weevil densities than Beds C and D at the far eastern end of the pond. One reason for this may be the greater depth and distance to shore of Beds A and B. A second factor could be the type of land cover found around Beds A and B. The shore in this area is park or residential land that was mostly mowed to the shoreline, with some rip-rap, although recent changes to park management have greatly increased the amount of natural shoreline available there. Weevils overwinter in the mud and leaf litter along shore and, therefore, survive best with a higher percentage of natural shoreline that is not mowed, raked, rip-rapped, sand or sea-walls. (Jester et al. 1999) Beds C and D may be better weevil habitat because they possess all three of these factors – they are nearer to shore, in shallower water and have more shoreline maintained with more natural vegetation along the shoreline. Of these factors, the one within human control is percent of natural shoreline.

On September 8th, 2004, a site visit to Springville Pond discovered that in Beds A and B weevil-damaged stems were observed, and EWM in Beds C and D had severely declined. When stem samples were collected from Beds C and D on August 5th, the EWM had been densely populating the area and stems were trailing along the water's surface, creating a thick canopy for the filamentous algae to cling to. The result was an unattractive, dense mat of weeds and algae on the water surface. Between the August 5th and September 8th visits, something had severely stressed the EWM, much of it died, and the algae mat broke apart and drifted away leaving behind a patch of clear water with just a few, sickly EWM stems remaining. (Note that the sparse EWM surrounding Beds C and D was still present, but weevil-damaged stems were observed.)

It cannot be said for certain whether the weevils were responsible for this sharp EWM decline, but few other naturally occurring factors could have stressed the EWM so severely and so quickly. If the weevils were indeed responsible for the EWM decline, this is a very good sign for Springville Pond.

e. Recommended Management Plan for Eurasian Water Milfoil:

Maximize Biological Control and Evaluate Management Plan

The use of chemical treatments has drawbacks, such as requiring repeated treatments, toxicity to animals, excessive plant decay causing oxygen depletion, residual by-products and unintended drift. Chemical use has been unsuccessful in eradicating EWM and has become increasingly controversial with residents and area citizens. Biological control, however, would be a long-term, non-toxic control method.

1. **Maximize Biological Control – *Beginning Immediately***

Springville Pond already has a healthy population of milfoil weevils, but some steps can be taken to try to boost the weevil population and maximize the control potential the weevils hold. Of the factors suspected to be impacting weevil success in Beds A and B, the one factor within human control is the percent of natural shoreline, a necessity for successful weevil hibernation. Some of the shoreline around Springville Pond is in somewhat natural condition, but could be improved. Other areas are greatly manipulated (mowed lawn, rip-rap, sea-walls, sandy beach) and are not good weevil habitat. Because weevils are weak fliers, the day they emerge from the water to fly to shore and hibernate, they are at the mercy of the wind. The more shoreline that is in natural condition the better the weevils' chances are of landing on suitable habitat. Recent changes in park maintenance at Springville Pond are likely to provide much more habitat this winter than previously and are a step in the right direction.

To help the weevils survive and do the job we are asking of them, the parks department and private landowners can:

- ✓ Leave as much un-mowed land as possible within 35' of shore. (More is better!) At a minimum, refrain from mowing or raking before Memorial Day and after Labor Day to give weevils a chance to leave and find winter habitats.

- ✓ Minimize the area maintained as beach, mowed paths, rip-rap or otherwise disturbed/manipulated land.

- ✓ Restore disturbed/manipulated areas.
  Contact the Portage County Land Conservation Department for help with involved restorations.

- ✓ Minimize fertilizer use.
  Runoff from fertilized properties can speed EWM growth!

  (Also see Appendix B for more tips on providing weevil habitat.)

2. **No Additional Control Treatments**

No additional control methods (cutting, pulling or chemical) should be utilized extensively in the pond. Extensive use of chemicals may set back the existing weevil population and extensive cutting/pulling would reduce the number of EWM growing tips, which would hamper weevil reproduction success.

a. **Exception: Personal Control Around Docks**

The exception to the above guideline would be in areas around docks where recreational usage is most affected. In these limited areas, hand-cutting/pulling, chemical treatments or the use of plant barriers (a fabric placed on top of the sediment, marked with buoys to prevent navigational hazards), would benefit recreational usage without significantly impeding weevil success. *(Chemical treatments or use of plant barriers require a permit from the WDNR.)*

b. **Optional Treatment: Drawdowns**

Water level drawdown is an optional tool for control of EWM in shallow areas, which has been effective in the past and should not significantly impact the milfoil weevils. Drawdowns require a *Waterway & Wetland Permit Application Form 3500* and a great deal of assistance from the WDNR. Timing and extent of drawdown is critical to accommodate the needs of the amphibians, fish and other wildlife residents.

3. **Trained Volunteer Monitoring Program -- *ESSENTIAL!!!* --**

EWM control is never permanent. Biological control is naturally dynamic and some fluctuation in EWM growths should be expected, but it will be critical to identify severe increases early if the biological control alone is not enough, and additional control methods (such as drawdown) are needed. A trained volunteer monitoring crew who can correctly identify EWM and map new EWM beds on an annual or biannual basis will be essential to the year to year management the EWM on Springville Pond. Your WDNR Aquatic Plants Specialist can arrange this training. (See Appendix B for contact information.)

Landowners can learn how to keep their docks EWM-free!

Additionally, landowners should be trained to identify EWM and learn how it is spread. Landowners can watch for EWM that washes up on shore and dispose of those plants before they take hold and start a new bed. Landowners can also pull individual EWM plants found in the shallows to prevent a new bed from developing. (Pulling individual, spotty growths should not impact weevil populations, and may help keep EWM from spreading faster than the weevils can work.) Again, landowners should be *trained* for this, so they are not pulling beneficial, native plants.

4. **Post Exotic Species Advisory Signage**

Under Wisconsin Statutes, Chapter 30.715, it is illegal to place a boat, trailer or equipment that have aquatic plants attached into a navigable waterway. (Wisconsin Legislature: Infobases). "Exotic Species Advisory" signs placed at boat landings can be a reminder to boaters to check for hitch hiking plants.

Although only non-motorized, hand-carry watercrafts are allowed on Springville Pond, these crafts are capable of introducing additional exotic species into the pond or transferring EWM or curly pondweed from the pond to other lakes. There were no signs posted during the August and September of 2004 visits to the pond, but the appropriate WDNR contacts have been notified of this need.

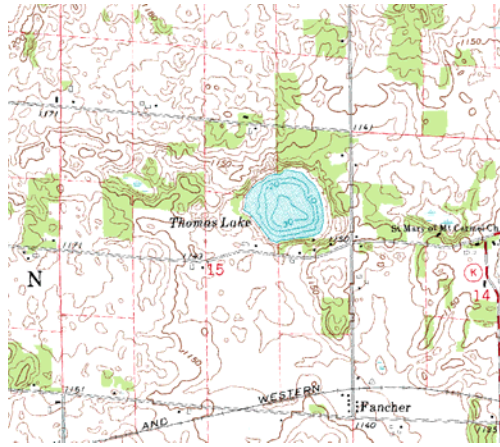
Once signs are posted, if they become damaged or stolen, the WDNR should be notified.

5. **Evaluate Management Plan**

EWM control should be considered to be just one part of a larger goal of total lake health. The Little Plover River and Springville Pond Watershed Management Plan covers many areas for comprehensive water quality improvement. This management plan should be reviewed with the new survey data to update and fine-tune the recommendations. Continued conservation, restoration and public education efforts should show slow but steady results.

IX. THOMAS LAKE

a. Lake Background



Thomas Lake on USGS topographic map.

Located approximately three miles west of Amherst Junction in the Town of Stockton, Thomas Lake is a small seepage lake with a surface area of 32 acres and a maximum depth of 28 feet. The water in Thomas Lake comes from groundwater, runoff and precipitation. Water leaves the lake via evaporation and seepage to groundwater. Because Thomas Lake's water comes from multiple sources, one must think of its watershed in terms of a surface watershed and a groundwater shed. (See Appendix C for definition of terms.) In the case of Thomas Lake, the surface watershed and groundwater shed were historically dominated by non-irrigated agriculture, which has been on the decline since 1948 land use surveys. Currently, the surface watershed is dominated by forest cover, and the groundwater shed is dominated by shrub cover. Residential land use has increased steadily in both watersheds, but remains a lesser component. (UWSP and Portage County 2003, Preliminary Results)

Thomas Lake with mats of aquatic vegetation visible at water surface.

A lake is categorized as "eutrophic" when total phosphorus levels are 30 ppb or higher, which results in more aquatic plant growth. Thomas Lake is a eutrophic lake, with total phosphorus levels historically around 34 ppb. (UWSP et al. 2003)

Water clarity in Thomas Lake is considered good when compared with similar lakes in the region. Average historic Secchi depth (a measure of water clarity) was best in July (14 feet) and poorest in September (6 feet). Fluctuations in water clarity are normal, due to increases and decreases of algae population and sedimentation. Average secchi depth readings for 2002 indicated better water clarity in late summer than the historic average. (UWSP and Portage County 2003, Preliminary Results)

b. History of Aquatic Plant Control in Thomas Lake

No records of previous aquatic plant treatments were found to report for this assessment. Table 10 lists aquatic vegetation species documented in Thomas Lake.

Table 10 - List of Documented Aquatic Vegetation
(Submergent and Floating Leaf Aquatics Only)

	Herbarium Records for Thomas Lake *	
	Scientific Name	Common Name
1	*Ceratophylum demersum*	Coontail
2	*Elodea canadensis*	Waterweed
3	*Elodea nuttallii*	Slender waterweed
4	*Myriophyllum sibiricum*	Northern water milfoil
5	*Myriophyllum spicatum* (e)	Eurasian water milfoil
6	*Najas flexilis*	Slender naiad
7	*Nuphar variegata*	Bullhead pond lily
8	*Nymphea odorata*	White water lily
9	*Polygonum amphibium*	Amphibious smartweed
10	*Potamogeton amplifolius*	Large leaf pondweed
11	*Potamogeton foliosus*	Leafy pondweed
12	*Potamogeton gramineus*	Variable pondweed
13	*Potamogeton illinoensis*	Illinois pondweed
14	*Potamogeton pectinatus*	Sago pondweed
15	*Potamogeton robbinsii*	Robbin's pondweed
17	*Spirodela polyrhiza*	Large duckweed
18	*Zosterella dubia*	Water stargrass

* Robert W. Freckman Herbarium records through November 2003, University of Wisconsin-Stevens Point. (Note: These herbarium records are historical documentation of what has been identified to date at Thomas Lake. *This is not an exclusive list.* Further, it cannot be stated with certainty that because a species has not been recorded at that lake recently that the species is no longer present in that lake. However, it has been well documented that as exotic invasives infest a lake, native vegetation is progressively less able to compete and the number of species (diversity) in the lake declines. Anecdotally, this is what has been seen at lakes in Portage County where EWM is present, however it would require quantitative vegetation surveys to confirm this.)

(e) Exotic invasive

c. Mapping Results

EWM was not identified in Thomas Lake until recent years, but with high phosphorus levels in this eutrophic lake, the exotic plant spread rapidly. EWM has become a dense mass of weeds surrounding the entire periphery of the lake. In those areas, EWM has become so thick at the surface that canoeing is difficult and boating is nearly impossible. The troublesome weed is only

Dense mats of EWM visible at water surface, entire circumference of lake.

precluded from growing in the center of the lake by the water depth.

A closer view of dense EWM growth in Thomas Lake.

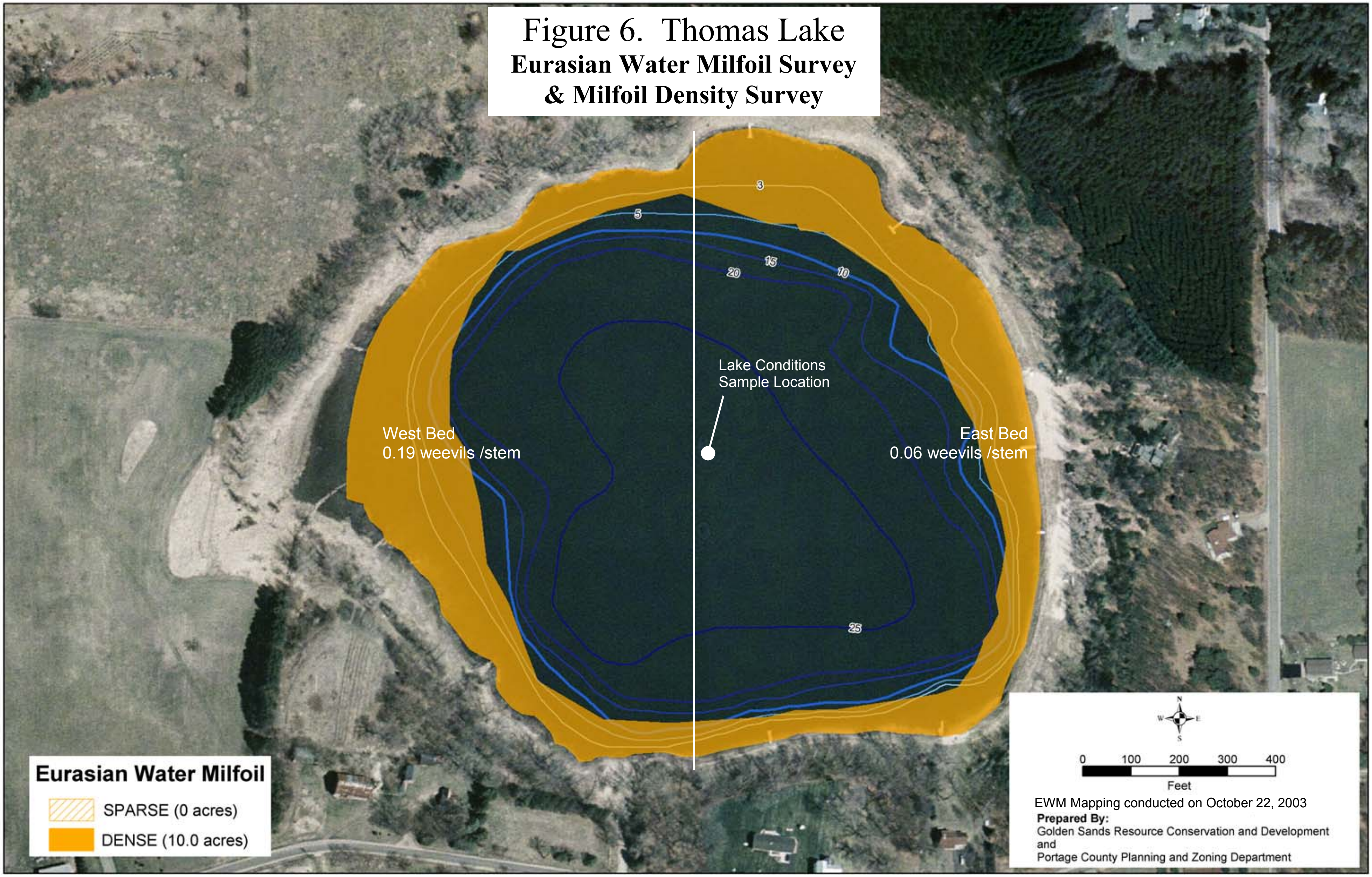
Field mapping on October 22, 2003 found the EWM growth to be mostly limited to a depth or 10 or 12 feet or less. The total surface area of the infestation is approximately 10.0 acres. (See Figure 6.) An infestation of this size cannot be eradicated by methods currently available, however *control* may be possible.

Several random samples of EWM were collected during 2003 field mapping exercises and later examined for evidence of the presence of the native aquatic milfoil weevil, *Euhrychiopsis lecontei*. Although no evidence of weevils could be found from these samples, it was believed that a more thorough survey would be required to conclusively determine the presence or absence of milfoil weevils.

d. Weevil Density Survey Results

The EWM infestation in Thomas Lake is beyond what chemical or manual control methods can likely handle. Mechanical harvesting would be a continual and costly effort, likened to mowing a lawn – it needs to be done over and over to keep up with growth. In the 2003 EWM Assessment Report, the primary recommendation for Thomas Lake was to investigate the potential for using biological control. It was suggested that if biological control proved a viable option under the conditions present at Thomas Lake, then this may provide a natural, long-term solution.

Population density surveys were performed in 2004 to determine the existing natural population of the aquatic milfoil weevil, *Euhrychiopsis lecontei*. EWM stem samples were collected from Thomas Lake on August 5th, 2004 and examined in the laboratory on August 13th, 17th and 18th, 2004. Extracted weevil specimens were preserved in labeled glass vials with 95% ethyl alcohol and sent to Laura Jester of Jester Consulting, Eden Prairie, MN, for species identification confirmation. See Figure 6 for sample bed locations and Table 11 for summarized results.



East and West Beds surveyed for milfoil weevils (*Eurychiopsis lecontei*) on 08/05/04. Stem samples collected from sample beds were examined in laboratory on 08/13, 8/17 and 8/18/04. Values on map represent average number of weevils per stem for each bed. Average weevil density overall for Thomas Lake was found to be **0.13 weevils per stem.**

Table 11. Weevil Population Density Survey – Results Summary

Lab Date (2004)	Bed No.*	Depth Range (ft)	Tot # Stem Samples	% Samples Algae-covered	Ave # Broken Tips	Ave # of Apical Tips	% Stems w/ Weevil Damage	Ave # Eggs per Stem	Ave # Larvae per Stem	Ave # Pupae per Stem	Ave # Adults per Stem	Ave Weevils per Stem (All Life Stages)
8/13, 8/17	**West**	0-12	36	31%	0.14	3.86	25%	0.00	0.17	0.00	0.03	**0.19**
8/17, 8/18	**East**	0-12	31	48%	0.23	1.87	10%	0.03	0.00	0.03	0.00	**0.06**
Whole Lake Results		0-12	67	38%	0.20	2.90	16%	0.01	0.09	0.01	0.01	**0.13**

*See Figure 6 for EWM sample bed locations.

Survey Notes:

Sample Date: 8/5/2004

Weather Conditions: Sunny Breezy, 70°F

Lake Conditions: Secchi Depth = 15 ft
Temperature = 25.2°C
Dissolved Oxygen = 13.8 mg/l
(Secchi, Temp and D.O. sampled at water depth of 23 ft. See Figure 5 for sample location.)

Land Cover @ Shore: West Bed = Natural shoreline (wetland edges and trees/shrubs beyond).
East Bed = Residential (some mowed to shore, some maintained in sand/beach)

Sample Preservation: Samples were kept in water in labeled plastic bags at 3-4°C. Any samples not examined within eight days of collection were preserved with ethyl alcohol. Due to a shortage of available ethyl alcohol, only approximately 30 ml of 95% ethyl alcohol could be added to the sample bags (containing apx. 100-130 ml of lake water). All samples appeared to be in good condition at the time of examination.

Other notes: A very common leaf deformity (fused lower leaflets) was seen in the Thomas Lake stem samples. It is unknown whether this deformity may affect weevil success. Also, hardening of nodes and easy breakage of stems – stems beginning auto-fragmentation naturally, or early auto-fragmentation due to refrigeration? This was not seen in other samples, which were refrigerated under same conditions.

Common leaf deformity observed in Thomas Lake stem samples.

Average (*E. lecontei*) milfoil weevil density for Thomas Lake was found to be 0.13 weevils per stem, which seems to be a low natural density. Of the 31 Wisconsin lakes studied by Laura Jester from 1996 to 1997, the mean natural weevil density was 0.65 weevils per stem. (Jester 1998)

Current research suggests that EWM control may occur at densities around 0.5 weevils per stem or lower, but that this cannot be predicted from lake to lake because of lake-specific conditions. (Newman 2004, *pers. comm.*) A factor found to negatively impact weevil populations is a high density of predator fish, such as sunfish. (Newman 2003) It is unlikely that fish predation is a significant limiting factor in Thomas Lake, since fish survey data collected for the Portage County Lake Study shows normal, balanced fish communities. (Turyk 2004, *pers. comm.*) Factors found to positively impact weevils are bed locations that are near shore and growing in shallow water, a higher percentage of natural shoreline, and a higher number of growing tips per plant (bushier plants). (Jester, et al. 1999)

Average weevil density in the West bed was found to be 0.19 weevils per stem, and average density in the East bed was notably lower (0.06 weevils per stem). (See Figure 6.) One possible cause for this difference between weevil counts is the high amount of natural, vegetated shoreline on the West shore, whereas the East shoreline has more mowed lawns and bare, sandy beach areas. Weevils overwinter in the mud and leaf litter along shore and, therefore, survive best with a higher percentage of natural shoreline that is not mowed, raked, rip-rap, sand or sea-walls. (Jester, et al. 1999) If investments will be made in weevil stocking it will be critical to preserve the natural shoreline on the West half of the lake and to increase the amount of natural vegetation on the East half.

e. Recommended Management Plan for Eurasian Water Milfoil:

Biological Control

Biological control of EWM may be possible if the population density of milfoil weevils can be increased. The EWM infestation developed so fast, that the weevil populations are likely having a hard time expanding fast enough to "catch up". Although research on biological control of EWM using milfoil weevils has shown mixed results, Thomas Lake has numerous conditions that positively correlate with successful biological control: natural shoreline on over half the lake, EWM beds near shore, and EWM populations have already reached maximum distributions. (Jester, et al. 1999)

Investing in biological control would be an investment in a long-term, natural control method. Most control methods provide only temporary reductions in EWM populations. It should be understood, however, that biological control is dynamic and that natural fluctuations between EWM and milfoil weevil populations will occur.

1. **Biological Control**

   Biological control requires approval from the WDNR.

   a. **Weevil Stocking – *Summer 2005***

      Purchase Weevils for Stocking

      Weevils can be purchased for stocking from EnviroScience, Inc. in Ohio (1-800-940-4025). EnviroScience, Inc. recommends that a stocking trial should consist of a minimum of 4000 weevils released together at one location. Follow-up surveys are required by the company to evaluate the success of the trial.

      OR

Propagate From Local or Nearby Stock

Thomas Lake, or other lakes nearby that have milfoil weevils, may be able to provide local or nearby propagation stock that would be better acclimated to local lake conditions than stock purchased from out of state. This option may be pursued if there exists the technical and financial support to produce high enough numbers of weevils. EnvironScience, Inc. suggests a stocking trial should consist of a minimum of 4000 weevils released together at one location. Follow-up surveys would be necessary to evaluate the success of the trial.

b. **Preservation and Restoration of Natural Shoreline – *Beginning Immediately!***

Milfoil weevils require natural shoreline with leaf litter and vegetation debris to over-winter. Because weevils are weak fliers, the day they emerge from the water to fly to shore and hibernate, they are at the mercy of the wind. The more shoreline that is in natural condition the better the weevils' chances are of landing in suitable habitat. Thomas Lake currently has a good deal of natural shoreline on the West shore, but needs more natural shoreline on the East shore. If money is being invested in weevil stocking, *preservation and restoration of the natural shoreline is strongly recommended*.

See Appendix B for more tips on providing weevil habitat. (For cost-sharing or technical assistance with shoreline restorations, contact the Portage County Land Conservation Department at 346-1334.)

c. **Follow-up Monitoring – *Late Summer 2005***

Biological control may take multiple tries over several seasons for the weevils to become established. Only by monitoring the progress with quantitative sampling can it be determined whether the biological control is succeeding or failing. This may help guide decisions to continue or discontinue the stocking program in 2006 and beyond.

If weevils are purchased from EnviroScience, Inc., monitoring is required by the company. If weevils are propagated from local stock, monitoring is *strongly* recommended.

2. **Optional: Mechanical Harvesting of Fish Lanes**

Mechanical harvesting requires a permit from the WDNR.

Mechanical harvesting would be a strategic tool for improving the success of the biological control. Heavy pan fish predation on the weevils would greatly impact the weevil population. Mechanical harvesting can be used to create "fish lanes", or travel lanes, for larger predator fish species to use when patrolling for smaller prey fish, thereby reducing the population of the smaller-sized pan fish feeding on weevils. The fish lanes should be created in multiple locations around the lake, extending perpendicularly from shore out to the open water.

Thomas Lake currently appears to have a balanced fish community, so fish lanes may or may not be a critical element to the success of weevil stocking. However, some of these fish lanes could be strategically located at docks to double as boating lanes for residents to access the open water. The WDNR can assist with recommendations for the best spacing or frequency of these fish/boating lanes.

To reduce costs of mechanical harvesting, it may be possible to contract the shared use of the McDill Pond harvester. This water body also has EWM, therefore there would not be a risk of spreading the plant to an uninfested water body. Lake Helen has a harvester but does not have EWM, therefore sharing a harvester with Lake Helen is NOT recommended.

3. **Trained Volunteer Monitoring Crew**

EWM control is never permanent. It will be critical to identify the problem early if the biological control begins to fail. A trained volunteer monitoring crew may help identify problems with EWM control, or other emerging water quality problems, by surveying the lake annually. It should be understood that biological control is dynamic and that natural fluctuations between EWM and milfoil weevil populations will occur. However, if concerns arise about the continuing effectiveness of biological control of EWM, the WDNR Aquatic Plant Specialist should be consulted. (See Appendix C for contact information.)

4. **Maintain Exotic Species Advisory Signs**

Under Wisconsin Statutes, Chapter 30.715, it is illegal to place a boat, trailer or equipment that have aquatic plants attached into a navigable waterway. (Wisconsin Legislature: Infobases). "Exotic Species Advisory" signs placed at boat landings can be a reminder to boaters to check for hitch hiking plants.

A well-placed and highly visible sign is currently in place at the boat landing. This sign should be maintained in good condition to help prevent boaters from bringing *additional* exotic species into Thomas Lake or transferring EWM to other lakes.

Exotic Species Advisory sign at Thomas Lake boat landing

If this sign become damaged or are stolen the WDNR should be notified.

5. **Lake Residents' Involvement**

The effects of these control methods may not be immediately visible. It may take years for weevil populations to increase enough to have an effect on the EWM population, and that effect will be *control*, not eradication. Residents should be informed about what to expect and the long-term goals of the control plans. Also, the success of the predator fish in controlling the pan fish populations may be a contributing factor. Residents can participate in supporting weevil populations by refraining from harvesting the larger predator fish.

6. **Trained Volunteer Watercraft Inspectors**

Because aquatic invasive species spread primarily by hitch hiking from lake to lake on boats and boating equipment, information about invasive species must get into the hands of every boater. The presence of trained volunteer watercraft inspectors, especially on major boating weekends, would be helpful to educate boaters about the invasive nature of exotic species and the importance of checking boats and trailers for "hitch hikers". These trained volunteers could also play a critical role in the early detection of new exotic species or other emerging water quality issues at Thomas Lake.

Thomas Lake is a quiet, minimally developed lake that provides its residents and area communities with a scenic, peaceful recreational alternative to the more heavily trafficked lakes in the area. Lake residents, as well as other conservation groups in Portage County, are encouraged to participate in the volunteer watercraft inspector training workshops and the support network offered by the Clean Boats, Clean Water Program through the Wisconsin Lakes Partnership. More information about this program is given in Section III.c.

X. REFERENCES

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XI. APPENDICES

Appendix A. How to Prevent the Spread of Aquatic Invasive Species
(Modified from WDNR and UW-Extension Informational Materials)

Steps YOU Can Take to Help Prevent the Spread of Aquatic Invasive Species

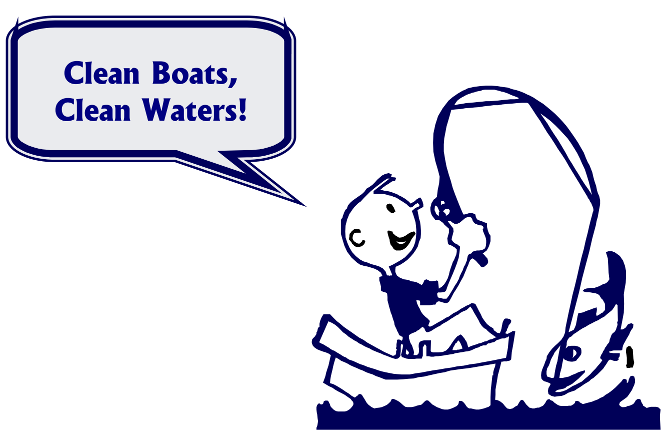
Reminder sign at Lake Emily public boat landing

- ✓ **Clean your boat**. Inspect your boat and other equipment, such as anchors, fishing lines and boat trailer for aquatic plants, animals and mud, and remove them before leaving the boat landing.

- ✓ **Drain all water**. Drain the water from your boat, motor, live wells, bilge and other equipment before leaving the boat landing.

- ✓ **Dispose of live bait**. Dispose of unwanted live bait in the trash or share it with a fellow angler. Do *not* transfer bait or water from one body of water to another.

- ✓ **Rinse your boat**. Rinse your boat and equipment with high pressure or hot water, especially if moored for more than one day,
  OR
  Dry everything for at least 5 days before entering another water body.



Appendix B. How to Help Your Milfoil Weevils
(Compiled from various public education materials)

How **YOU** Can Help Your Milfoil Weevils Battle Eurasian Water Milfoil

Research on distribution of the native milfoil weevil, *Euhrychiopsis lecontei*, has found the weevil to be present in almost every lake surveyed. However, some important factors may affect the success of the weevil on some lakes. Here's what you can do to help your native population of milfoil weevils do the best job they can at battling Eurasian Water Milfoil…

✓ **Provide Habitat**. Create "Buffer Zones" along the lakeshore, where vegetation and leaf litter within 35 feet of shore is left natural and not mowed, raked or removed. If tidy lawns are "your thing", at least refrain from mowing or raking from Labor Day to Memorial Day. This will provide milfoil weevils with good winter habitat for hibernation and help keep the lake healthy, too! (If you don't live on the water, you can still encourage your local park department to use buffer zones!)

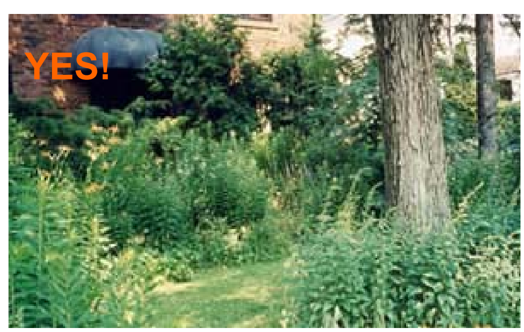
Natural vegetation helps milfoil weevils, adds beauty, protects water quality and attracts wildlife, too! A buffer zone of 35 feet is good, but MORE IS BETTER!

✓ **No-wake Zones**. Work with your lake association to establish no-wake zones, marked with buoys, around Eurasian Water Milfoil beds where stems are within reach of boat props or wash. This will help prevent the spread of Eurasian Water Milfoil and help the weevils get established in that bed.

✓ **Discourage Eurasian Water Milfoil**. Removal of native aquatics, like bull rushes or lily pads, not only impacts wildlife and increases shore erosion, but also opens up new territory for invasive species to get established. Scores of scattered new growths may help milfoil spread faster than the weevils can find the plants.

Sandy beaches, sea-walls, rip-rap and mowed lawns do NOT offer good winter habitat for milfoil weevils.

Decorative edging, bird houses, eye-catching wildflowers or a winding path to access the waterfront can add to the attractiveness of your buffer zone.



Appendix C. Contacts and Resources

- Local Contact Point for EWM Reports:
  Steve Bradley, County Conservationist, Portage County Land Conservation Division of the Planning & Zoning Department, Portage County Courthouse Annex, 1462 Strongs Avenue, Stevens Point, WI 54481, (715) 346-1334

- Questions About this Report:
  Amy Thorstenson, Project Assistant, Golden Sands Resource Conservation & Development Council, Inc., Portage County Courthouse Annex, 1462 Strongs Avenue, Stevens Point, WI 54481, (715) 343-6215, *thorstea@co.portage.wi.us*

- WDNR Aquatic Plants Contact:
  Deborah Konkel, Aquatic Plant Specialist, WDNR, 1300 West Clairemont Avenue, PO Box 4001, Eau Claire, WI 54702, (715) 839-2782

- Clean Boats, Clean Waters Program:
  Laura Felda, Volunteer Monitoring Coordinator, UW-Extension Lakes Program, UW-Stevens Point-CNR, 1900 Franklin Street, Stevens Point, WI 54481-3897, (715) 346-3366

- Contacts and Resources On-Line:
  The Wisconsin WDNR and Wisconsin Lakes Partnership have compiled a directory, "The Wisconsin Lakes Partnership Contacts", which lists the Wisconsin Association of Lakes, WDNR contacts, UW-Extension Statewide Lake Specialists, Self–Help Lake Monitors; Adopt-A-Lake contacts and other resources. It is Publ-FH-407 "**The Lake List"** and can also be viewed at http://www.dnr.state.wi.us/org/water/fhp/lakes/contacts.htm.

- Aquatic Plant Identification Guide:
  An excellent aquatic plant field guide, *Through the Looking Glass: A Field Guide to Aquatic Plants*, by S. Borman, R. Korth and J. Temte is available from the Wisconsin Lakes Partnership, UW-Extension Lakes Program, UW-Stevens Point-CNR, 1900 Franklin Street, Stevens Point, WI 54481-3897, (715) 346-3366.

- Grant Funding for Control of EWM:
  Aquatic Invasive Species Grant Program: Provides state cost-sharing assistance for the plan development, invasive species surveys, watercraft inspections, development of educational materials and WDNR approved control plans. This program does not cover routine control of wide-spread infestations, such as mechanical harvesting or annual herbicide applications. Only units of local government, such as counties, villages, tribes, lake districts and sanitary districts, are eligible for this program. For more information, contact the WDNR Lake Coordinator or Environmental Grant Specialist for the West Central Region at (715) 839-3700.

  Recreational Boating Facilities Program: Provides state cost-sharing assistance for various lake recreation improvement projects, including the routine EWM control projects not covered under the Aquatic Invasive Species Grant Program. Only government units and qualified lake associations are eligible for this program. For more information, contact the Community Services Specialist for the West Central Region at (715) 836-6574.

Appendix D. Terms and Definitions

Watershed = Land surface over which water flows before reaching a lake or water body.

Surface Watershed = Land area where water runs off the surface of the land and drains toward the lake (UWSP and Portage County 2003, Preliminary Results).

Groundwater Shed = Land area where water soaks into the ground and travels underground to the lake (UWSP and Portage County 2003, Preliminary Results).

Oligotrophic = A waterbody poor in nutrients, biomass and plant life and rich in oxygen (Collins English Dictionary ©2000). Phosphorus is the limiting nutrient in over 80% of Wisconsin's lakes (UWSP and Portage County 2003, Preliminary Results). Usually a "young" lake with very clear water.

Mesotrophic = A waterbody of intermediate levels of nutrients, biomass, plant growth and water clarity.

Eutrophic = A waterbody rich in organic and mineral nutrients and supporting abundant biomass and plant life, which while living supplies the oxygen for animal life but in the process of decaying also depletes oxygen. (Collins English Dictionary ©2000) Phosphorus is the limiting nutrient in over 80% of Wisconsin's lakes, and levels of 30 parts-per-billion indicate a eutrophic status. Excessive phosphorus leads to nuisance plant growth and frequent algae blooms. Usually an "old" lake, but lakes can be prematurely aged by excessive phosphorus inputs from human activities. (UWSP and Portage County 2003, Preliminary Results)

Secchi Depth Reading = The depth to which a secchi disk can be lowered into the water and still be visible. A measurement of water clarity. A low secchi depth numbers indicate poor water clarity, which may be due to sedimentation, algae blooms, tannins and other dissolved or suspended materials.

Drawdown = To lower the water level of a water body by a desired amount using a water level control structure, such as a dam.

Appendix E. Plant Survey Spreadsheets – McDill Pond*

(See attached pages)

Portage County Eurasian Milfoil Assessment - McDill Pond Aquatic Plant Relative Abundance Ratings

				Milfoils	Curly pondweed	Water plantain	Algae	Muskgrass	Coontail	White water crowfoot	Elodea	Common rush	Small duckweed	Slender naiad	Stoneworts	Spatterdock	White water lily	Reed canary grass
Sample Date	Transect	Depth Zone (feet)		*Myriophyllum* spp.	*Potamogeton crispus*	*Alisma sp.? (immature)*	*UK sp.*	*Chara sp.*	*Ceratophyllum demersum*	*Ranunculus longirostris*	*Elodea canadensis*	*Juncus effusus*	*Lemna minor*	*Najas flexilis*	*Nitella sp.*	*Nuphar variegata*	*Nymphaea odorata*	*Phalaris arundinacea*
6/2/04	**1**	0-1.5	Rating:	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
	1	1.5-5	Rating:	2	3	0	4	1	1	0	4	0	0	0	0	0	0	0
	1	5-10	*ID*															
	1	10-20	*ID*															
6/8/04	**2**	0-1.5	Rating:	4	2	0	4	0	1	0	2	0	0	0	0	0	0	0
	2	1.5-5	Rating:	4	2	0	3	0	3	0	2	0	0	0	0	0	0	0
	2	5-10	Rating:	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0
	2	10-20	*ID*															
6/8/04	**3**	0-1.5	Rating:	4	3	0	4	0	5	0	3	0	2	0	0	0	0	1
	3	1.5-5	Rating:	5	2	0	5	0	3	0	3	0	2	0	0	0	0	0
	3	5-10	Rating:	2	4	0	3	0	2	0	0	0	0	0	0	0	0	0
	3	10-20	*ID*															
6/2/04	**4**	0-1.5	Rating:	3	0	0	1	3	1	0	2	0	0	0	0	0	0	0
	4	1.5-5	Rating:	3	3	0	0	2	2	0	3	0	0	0	0	0	0	0
	4	5-10	Rating:	3	0	0	0	1	2	0	4	0	0	0	0	0	0	0
	4	10-20	*ID*															
6/2/04	**5**	0-1.5	Rating:	4	1	0	0	0	2	0	3	0	0	0	0	0	0	0
	5	1.5-5	Rating:	4	1	0	0	0	0	0	2	0	0	0	0	0	0	0
	5	5-10	Rating:	1	0	0	0	0	2	0	2	0	0	0	0	0	0	0
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	6	1.5-5	Rating:	2	0	0	4	2	2	0	2	0	0	0	0	0	0	0
	6	5-10	*ID*															
	6	10-20	*ID*															
6/2/04	**7**	0-1.5	Rating:	1	0	0	0	0	1	0	2	0	0	0	0	0	0	0
	7	1.5-5	Rating:	0	0	0	2	2	0	0	1	0	0	0	0	0	0	0
	7	5-10	*ID*															
	7	10-20	*ID*															
6/2/04	**8**	0-1.5	Rating:	1	0	0	2	3	1	0	1	0	2	0	0	0	0	0
	8	1.5-5	Rating:	1	0	0	4	3	0	0	0	0	0	3	0	0	0	0
	8	5-10	*ID*															
	8	10-20	*ID*															
6/2/04	**9**	0-1.5	Rating:	4	0	0	1	0	0	0	2	0	0	1	0	0	0	0
	9	1.5-5	Rating:	3	1	0	0	0	1	0	4	0	0	0	0	0	0	0
	9	5-10	Rating:	3	0	0	0	1	1	0	3	0	0	0	0	0	0	0
	9	10-20	*ID*															
6/1/04	**10**	0-1.5	Rating:	1	2	0	2	2	1	0	1	0	0	0	0	0	0	0
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	10	5-10	Rating:	1	0	0	0	4	0	0	0	0	0	0	0	0	0	0
	10	10-20	*ID*															
6/2/04	**11**	0-1.5	Rating:	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
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	12	5-10	Rating:	1	0	0	0	2	1	0	0	0	0	0	0	0	0	0
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	13	5-10	*ID*															
	13	10-20	*ID*															
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	15	10-20	Rating:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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	16	5-10	Rating:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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6/1/04	**18**	0-1.5	Rating:	2	2	0	4	0	2	0	2	0	4	0	0	0	0	0
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	18	5-10	Rating:	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
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6/1/04	**20**	0-1.5	Rating:	2	2	0	4	0	0	0	1	0	0	0	0	0	0	0
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	20	10-20	Rating:	0	0	0	0	0	0	0	0	0	0	0	0			0
6/1/04	**21**	0-1.5	Rating:	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
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	25	5-10	*ID*															
	25	10-20	*ID*															
5/26/04	**26**	0-1.5	Rating:	3	1	0	0	2	1	0	2	0	0	1	0	0	0	0
	26	1.5-5	Rating:	1	0	0	0	4	0	0	0	0	0	0	0	0	0	0
	26	5-10	*ID*															
	26	10-20	*ID*															
5/26/04	**27**	0-1.5	Rating:	3	1	0	0	1	0	0	3	0	0	0	0	0	0	0
	27	1.5-5	Rating:	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	27	5-10	*ID*															
	27	10-20	*ID*															
5/26/04	**28**	0-1.5	Rating:	5	4	0	0	0	1	0	3	0	0	1	0	0	0	0
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5/26/04	**29**	0-1.5	Rating:	4	1	0	0	0	0	0	2	0	0	1	0	0	0	0
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	31	5-10	Rating:	4	4	0	0	0	1	0	0	0	0	0	0	0	0	0
	31	10-20	*ID*															
# of Sample Pts			**Average Ratings:**															
30		0-1.5		**1.967**	1.033	0.033	1.933	0.733	0.967	0.033	*1.500*	0.000	0.567	0.133	0.000	0.000	0.033	0.067
30		1.5-5		**2.067**	1.333	0.000	1.567	1.167	1.133	0.033	*1.800*	0.000	0.200	0.133	0.000	0.000	0.000	0.000
22		5-10		**1.364**	*1.136*	0.000	0.500	0.864	0.545	0.045	0.864	0.000	0.000	0.045	0.000	0.000	0.000	0.000
2		10-20		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
84		All Depths:		**1.798**	1.143	0.012	1.381	0.905	0.893	0.036	*1.405*	0.000	0.274	0.107	0.000	0.000	0.012	0.024

Bold = Most abundant species

Italics = Second most abundant species

Gray = Not ranked, non-vascular

"ID" = Insufficeint Depth

Rating Values = At each sample point, relative density of each species was rated from 1 to 5. A rating of 1, 2, 3 or 4 indicated the species was present on 1, 2, 3 or 4 rake samples. A rating of 5 was given if the species was *abundantly* present on all four rake samples.

Portage County Eurasian Milfoil Assessment - McDill Pond Aquatic Plant Relative Abundance Ratings (continued)

				Leafy pondweed	Sago pondweed	White-stem pondweed	Small pondweed	Flat-stem pondweed	Common bur-reed	Large duckweed	Common watermeal	Horned pondweed
Sample Date	Transect	Depth Zone (feet)		*Potamogeton foliosus*	*Potamogeton pectinatus*	*Potamogeton praelongus*	*Potamogeton pusillus*	*Potamogeton zosteriformis*	*Sparganium eurycarpum*	*Spirodela polyrhiza*	*Wolfia columbiana*	*Zannichellia palustris*
6/2/04	**1**	0-1.5	Rating:	0	0	0	0	0	0	0	0	0
	1	1.5-5	Rating:	0	0	0	0	0	0	0	0	0
	1	5-10	*ID*									
	1	10-20	*ID*									
6/8/04	**2**	0-1.5	Rating:	0	1	0	0	0	0	0	0	1
	2	1.5-5	Rating:	0	4	0	0	0	0	0	0	0
	2	5-10	Rating:	0	0	0	0	0	0	0	0	0
	2	10-20	*ID*									
6/8/04	**3**	0-1.5	Rating:	0	0	0	0	0	0	2	4	0
	3	1.5-5	Rating:	0	0	0	0	0	0	2	5	0
	3	5-10	Rating:	0	0	0	0	0	0	0	3	0
	3	10-20	*ID*									
6/2/04	**4**	0-1.5	Rating:	0	0	0	0	0	0	0	0	0
	4	1.5-5	Rating:	0	0	0	0	0	0	0	0	0
	4	5-10	Rating:	0	0	0	0	0	0	0	0	0
	4	10-20	*ID*									
6/2/04	**5**	0-1.5	Rating:	0	0	0	0	0	0	0	0	0
	5	1.5-5	Rating:	0	0	0	0	0	0	0	0	2
	5	5-10	Rating:	0	0	0	0	0	0	0	0	0
	5	10-20	*ID*									
6/2/04	**6**	0-1.5	Rating:	0	0	0	0	0	0	0	0	0
	6	1.5-5	Rating:	0	0	0	0	0	0	0	1	0
	6	5-10	*ID*									
	6	10-20	*ID*									
6/2/04	**7**	0-1.5	Rating:	0	0	0	0	0	0	0	0	0
	7	1.5-5	Rating:	0	0	0	0	0	0	0	0	0
	7	5-10	*ID*									
	7	10-20	*ID*									
6/2/04	**8**	0-1.5	Rating:	0	0	0	0	0	0	0	0	0
	8	1.5-5	Rating:	0	0	0	0	0	0	0	0	0
	8	5-10	*ID*									
	8	10-20	*ID*									
6/2/04	**9**	0-1.5	Rating:	0	0	0	0	0	0	0	0	0
	9	1.5-5	Rating:	0	0	0	0	0	0	0	0	0
	9	5-10	Rating:	0	0	0	0	0	0	0	0	0
	9	10-20	*ID*									
6/1/04	**10**	0-1.5	Rating:	0	0	0	0	0	0	0	0	0
	10	1.5-5	Rating:	0	0	0	0	0	0	0	0	0
	10	5-10	Rating:	0	0	0	0	0	0	0	0	0
	10	10-20	*ID*									
6/2/04	**11**	0-1.5	Rating:	0	0	0	0	0	0	0	0	0
	11	1.5-5	Rating:	0	0	0	0	0	0	0	0	0
	11	5-10	*ID*									
	11	10-20	*ID*									
6/2/04	**12**	0-1.5	Rating:	0	0	0	0	0	0	0	0	0
	12	1.5-5	Rating:	0	0	0	0	0	0	0	0	1
	12	5-10	Rating:	0	0	0	0	0	0	0	0	0
	12	10-20	*ID*									
5/28/04	**13**	0-1.5	Rating:	0	0	0	0	0	0	0	3	0
	13	1.5-5	Rating:	0	0	0	0	0	0	0	4	0
	13	5-10	*ID*									
	13	10-20	*ID*									

5/28/04	**14**	0-1.5	Rating:	0	0	0	0	0	0	0	0	0
	14	1.5-5	Rating:	0	0	0	0	0	0	0	0	0
	14	5-10	Rating:	0	0	0	0	0	0	0	0	0
	14	10-20	*ID*									
5/28/04	**15**	0-1.5	Rating:	0	0	0	0	0	0	0	4	0
	15	1.5-5	Rating:	0	0	0	0	0	0	0	0	0
	15	5-10	Rating:	0	0	0	0	0	0	0	0	0
	15	10-20	Rating:	0	0	0	0	0	0	0	0	0
5/28/04	**16**	0-1.5	Rating:	0	0	0	2	0	3	0	0	0
	16	1.5-5	Rating:	0	0	0	0	0	0	0	0	0
	16	5-10	Rating:	0	0	0	0	0	0	0	0	0
	16	10-20	*ID*									
5/28/04	**17**	0-1.5	Rating:	0	0	0	2	0	1	0	0	0
	17	1.5-5	Rating:	0	0	0	0	0	0	0	0	0
	17	5-10	Rating:	0	0	0	0	0	0	0	0	0
	17	10-20	*ID*									
6/1/04	**18**	0-1.5	Rating:	0	0	0	0	0	0	0	4	0
	18	1.5-5	Rating:	0	0	0	0	0	0	0	0	0
	18	5-10	Rating:	0	0	0	0	0	0	0	0	0
	18	10-20	*ID*									
6/1/04	**19**	0-1.5	Rating:	0	0	0	0	0	0	0	0	0
	19	1.5-5	Rating:	0	0	0	0	0	0	0	0	0
	19	5-10	Rating:	0	0	0	0	0	0	0	0	0
	19	10-20	*ID*									
6/1/04	**20**	0-1.5	Rating:	0	0	0	0	0	0	0	0	0
	20	1.5-5	Rating:	0	0	0	0	0	0	0	0	0
	20	5-10	Rating:	0	0	0	0	0	0	0	0	0
	20	10-20	Rating:	0	0	0	0	0	0		0	0
6/1/04	**21**	0-1.5	Rating:	0	0	0	0	0	0	0	0	0
	21	1.5-5	Rating:	0	0	0	0	0	0	0	0	0
	21	5-10	Rating:	0	0	0	0	0	0	0	0	0
	21	10-20	*ID*									
6/2/04	**22**	0-1.5	Rating:	0	0	0	0	0	0	0	0	0
	22	1.5-5	Rating:	0	0	0	0	0	0	0	0	0
	22	5-10	Rating:	0	0	0	0	0	0	0	0	0
	22	10-20	*ID*									
6/2/04	**23**	0-1.5	Rating:	0	0	0	0	0	0	0	0	0
	23	1.5-5	Rating:	0	0	0	0	0	0	0	0	0
	23	5-10	Rating:	0	0	0	0	0	0	0	0	0
	23	10-20	*ID*									
6/8/04	**24**	0-1.5	Rating:	0	0	0	0	1	0	0	0	0
	24	1.5-5	Rating:	0	1	0	0	0	0	0	0	0
	24	5-10	Rating:	0	0	0	0	0	0	0	0	0
	24	10-20	*ID*									
6/8/04	**25**	0-1.5	Rating:	0	2	0	3	0	0	0	0	0
	25	1.5-5	*ID*									
	25	5-10	*ID*									
	25	10-20	*ID*									
5/26/04	**26**	0-1.5	Rating:	2	0	0	1	0	0	0	0	0
	26	1.5-5	Rating:	0	0	0	0	0	0	0	0	0
	26	5-10	*ID*									
	26	10-20	*ID*									
5/26/04	**27**	0-1.5	Rating:	0	0	0	1	0	0	0	0	0
	27	1.5-5	Rating:	1	1	0	0	0	0	0	0	0
	27	5-10	*ID*									
	27	10-20	*ID*									
5/26/04	**28**	0-1.5	Rating:	0	0	0	0	0	0	0	0	0
	28	1.5-5	Rating:	0	0	0	2	0	0	0	0	0
	28	5-10	Rating:	0	0	0	0	0	0	0	0	0

	28	10-20	*ID*									
5/26/04	**29**	0-1.5	Rating:	0	0	0	0	0	0	0	0	0
	29	1.5-5	Rating:	0	0	0	0	0	0	0	0	0
	29	5-10	Rating:	0	0	0	0	0	0	0	0	0
	29	10-20	*ID*									
5/26/04	**30**	0-1.5	Rating:	0	0	0	0	0	0	0	0	0
	30	1.5-5	Rating:	0	0	0	0	0	0	0	0	0
	30	5-10	Rating:	0	0	0	0	0	0	0	0	0
	30	10-20	*ID*									
5/26/04	**31**	0-1.5	*ID*									
	31	1.5-5	Rating:	0	0	0	0	0	0	0	0	0
	31	5-10	Rating:	0	0	0	0	0	0	0	0	0
	31	10-20	*ID*									
# of Sample Pts			**Average Ratings:**									
30		0-1.5		0.067	0.100	0.000	0.300	0.033	0.133	0.067	0.500	0.033
30		1.5-5		0.033	0.200	0.000	0.067	0.000	0.000	0.067	0.333	0.100
22		5-10		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.136	0.000
2		10-20		0	0	0	0	0	0	0	0	0
84		All Depths:		0.036	0.107	0.000	0.131	0.012	0.048	0.048	0.333	0.048

Bold = Most abundant species

Italics = Second most abundant species

Gray = Not ranked, non-vascular

"ID" = Insufficeint Depth

Rating Values = At each sample point, relative density of each species was rated from 1 to 5. A rating of 1, 2, 3 or 4 indicated the species was present on 1, 2, 3 or 4 rake samples. A rating of 5 was given if the species was *abundantly* present on all four rake samples.