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

EURASIAN WATER MILFOIL STUDIES

Bear Lake
Lake Emily
Springville Pond
Thomas Lake

Summary: 2003 - 2007

Euhrychiopsis lecontei: Note raised bumps at the base of the 7th stripe.

VS.

Phytobius sp.: Note raised bumps at the base of the 5th stripe.

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

Prepared by:
Amy L. Thorstenson

Golden Sands
Resource Conservation &
Development Council, Inc.

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

December, 2007

Acknowledgments

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Table of Contents

Portage County

Eurasian Water Milfoil Studies

Springville Pond
Thomas Lake
Lake Joanis

I. INTRODUCTION

Eurasian water milfoil (EWM) (*Myriophyllum spicatum*) is an exotic aquatic plant that has been gaining notoriety across the United States for its aggressively 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. 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 native aquatic plants need. This dense mat increases fluctuations in dissolved oxygen content, carbon dioxide content, pH level, and temperature stratification, while also inhibiting water circulation.

EWM Reports in Portage Co.

Confirmed - Present:
1. Bear Lake[1]
2. Lake Emily[1]
3. Lake Joanis[2]
4. McDill Pond[1]
5. Lake Pacawa
6. Springville Pond[1]
7. Thomas Lake[1]
8. Lime Lake[3]

([1] control plan being implemented)
([2] control plan under development)
([3] control plan under development)

Confirmed - Not Present:
(should be watched)
1. Jordan Pond

The cumulative effect of EWM impacts creates a chain reaction of changes in 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 tourism-related 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 manual removal, bottom barriers, mechanical removal/harvesting, winter water level drawdowns, herbicides, and biological control. 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… 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, by Amy Thorstenson, Golden Sands Resource Conservation & Development, Council, Inc. (RC&D). In 2004, the remaining two lakes with known EWM infestations were mapped, and milfoil weevil (*Euhrychiopsis lecontei*) population surveys were conducted on four lakes that were candidates for biological control. In 2005 and 2006, assistance was given to lake management units wishing to implement the recommendations developed by this study. Additional EWM mapping and weevil surveys were done, as well as a milfoil weevil rearing trials on Thomas Lake and Springville Pond.

Complete summary of study findings (2003 to 2006) and treatment recommendations for the nine subject lakes have been provided in previous reports, which are available in hardcopy or electronic format from Golden Sands RC&D. Contact Amy Thorstenson at 715-346-1264 or thorstea@co.portage.wi.us .

This report summarizes the results of the 2007 studies, and includes all background information on only the four subject lakes (Bear Lake, Lake Emily, Springville Pond, Thomas Lake). It does NOT include any study results for lakes not included in the 2007 studies. For study results on those lakes, please refer to the report referred to in the paragraph above.

Protect your favorite

There is too much for any one governmental unit to do alone. Any citizen can learn about exotic species, help control the spread of those species, express their concern about AIS to government representative, and be an advocate for their favorite lake.

The 'Clean Boats, Clean Waters' volunteer watercraft inspection program, the Citizen Lake Monitoring Network – AIS Monitoring Program are just two of the ways you can take action to protect your favorite lake. For more information about these volunteer programs, visit the UW-Extension Lakes Program website at http://www.uwsp.edu/cnr/uwexlakes/default.asp or contact Amy Thorstenson, Golden Sands RC&D, at 715-346-1264 or thorstea@co.portage.wi.us .

For more tips on how to slow the spread of aquatic invasive species, see Appendix A.

"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. Project coordination and report preparation was completed by Amy Thorstenson, Golden Sands Resource Conservation & Development (RC&D) Council, Inc. All fieldwork was performed or overseen by Amy Thorstenson, with the help of various field assistants. (See Appendix B for contact information.)

All vegetation 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. Milfoil weevil surveys and rearing trials were planned with technical guidance from Dr. Ray Newman, University of Minnesota, and personnel from the Vermont Department of Environmental Conservation.

All EWM treatment recommendations for each lake were developed with, reviewed by and approved by WDNR. (See Appendix B 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 (UWSP).

a. Background Data Collection

Background lake data was gathered for each lake from multiple sources, including records maintained by WDNR, the UWSP Robert W. Freckmann Herbarium and the Portage County Lake Study, conducted by the UWSP and Portage County.

b. EWM Mapping Surveys

All EWM surveys, 2003 – 2006, on Lake Joanis, Springville Pond, and Thomas Lake were conducted from a canoe. In the case of 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. In 2006, Springville Pond was surveyed using a Point Intercept method used by WDNR. (These methods will be detailed in following paragraphs.) On Thomas Lake and Lake Joanis, the depth at the centers of these lakes precludes EWM from growing anywhere but around the lakeshore. In this situation, observers circled the shoreline slowly while visually searching for EWM. Thomas Lake was surveyed in 2004 and 2005, but due to problems with water clarity and time limitations, no survey was done in 2006 and, therefore, no new map was created.

During visual searches, wherever EWM was found, GPS coordinates were recorded to sub-meter accuracy with a Trimble Pro XR GPS unit. 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.

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 Freckmann, professor emeritus, UWSP. The mounted specimens are retained at the Robert W. Freckmann Herbarium at UWSP.

In 2006, the Point Intercept method was used on Springville Pond because of the extent of the EWM infestation making the visual search mapping method impractical. A sample grid was laid over the pond using GIS, placing a total of 87 sample points at 30-meter intervals.

These sample points were navigated to in the field using a Trimble Pro XR GPS unit, and at each sample point a double-headed metal thatching rake was dropped straight down, then pulled straight back up. The plants snared with the rake were identified and "rake fullness" for each species was ranked, 1 through 3. A rating of "1" indicated few plants present on the rake head, "2" indicated the rake head about ½ full, and "3" indicated the rake was overflowing. If nothing was found, the entry was left blank. These rankings were then plotted on the map and used to interpolate boundaries of EWM beds of "sparse" ("1"), "dense" ("2") and "very dense" ("3") rankings. If a plant species was observed within 6-feet of the boat but did not appear on the sample rake, it was noted as "observed", but not included in the rankings.

Voucher specimens of plants 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 Freckmann, professor emeritus, UWSP. The mounted specimens are retained at the Robert W. Freckmann Herbarium on the UWSP campus.

c. Weevil Surveys

Milfoil weevil survey methodology was modeled after the 1996-97 study completed by Laura Jester, in cooperation with the WDNR, 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 lake. Where four individual beds were not available, a large bed was divided into two equal halves. Where EWM grows in a complete ring around the lake, samples were randomly collected four quadrants of the lake.

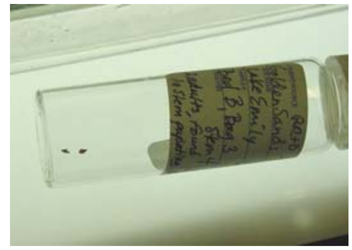
Milfoil weevils *(Euhrychiopsis lecontei*) live within the top 20 inches of EWM stems, therefore, only the top 20-inches of the stem was retained for examination. The Jester report stated that 120 samples had been collected for each lake, but in conversations with Jester, she stated that the study had found statistical confidence at about half that number. (Jester 2003, *pers. comm*.) Therefore, in 2004, 2005, and most of the surveys from 2006, only 60 stem samples per lake (15 per sample bed or quadrant) were collected. At the end of 2006, because bed sizes were quite large, 120 stem samples per lake were collected to ensure statistical confidence.

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 was very difficult. Staying on a perfectly straight transect line at the same time was 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. Stem samples were stored with water in labeled plastic bags, kept cool in covered buckets of water while in the field and later kept refrigerated at approximately 3 to 4°C until they were examined. Any samples that could not be processed within approximately eight days of collection were preserved with ethyl alcohol or isopropyl 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 were preserved in a labeled glass vial. Weevils found in the stem were carefully extracted with dissecting equipment so they could still be identifiable. Because RC&D personnel lacked experience in identification of *E. lecontei* in 2004, all 2004 weevil specimens were mailed to Laura Jester, of Jester Consulting in Eden Prairie, Minnesota, for species identification confirmation. After 2004, weevil specimens were examined for identification confirmation by Amy Thorstenson, the project leader for RC&D. A sample of questioned 2006 specimens were sent to Dr. Ray Newman, University of Minnesota, for confirmation.



Extracted weevil adults preserved in a sample vial.

In 2007, questioned specimens were examined by Thorstenson, with the assistance of a 30x Carson Magniscope™. Additional assistance with distinguishing between *E. lecontei* and *Phytobius sp.* was received from Jeff Dimick, WDNR, and Laura Herman, UW-Extension, with the use of a Nikon SMZ 1500 miscroscope and high-resolution, SPOT INSIGHT FireWire camera at the UW-Stevens Point College of Natural Resources. Appendix C shows photographic differentiation between the two species.

Carson Magniscope™
(www.forestry-suppliers.com)

d. Weevil Rearing (2005 & 2006)

(See 2005 and 2006 reports for full discussion of weevil rearing methods)

e. Freeboard Measurements

The distance from the water surface to the top of the EWM, or "freeboard", was measured by cruising each sample bed and randomly taking a minimum of six measurements. Field personnel criss-crossed the entire sample bed, randomly stopping to take measurements, taking care not to control where they were stopped in order to avoid introducing sampling bias. Freeboard measurements were always taken with the same measuring stick, which was held fast against a marked point on the canoe, and measured the distance from the surface of the water to the first EWM stem the stick touched. If the stick did not reach to the EWM stems below, it was recorded as "greater than 36-inches".

Measuring freeboard at Thomas Lake.

f. Temperature Measurements

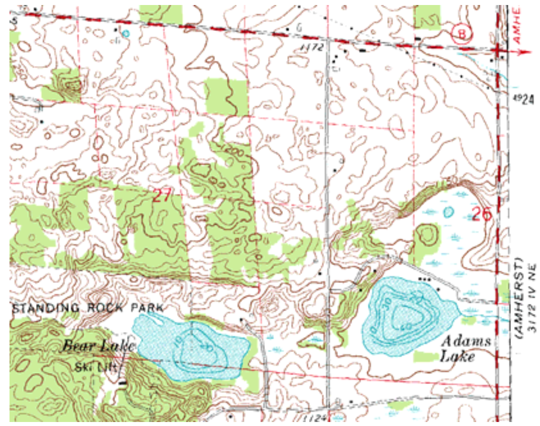
Water temperatures were taken at the same time as freeboard measurements, always with the same Penn Plax thermometer. The thermometer was held perpendicularly in the water, deep enough to submerge the green marking, which resulted in a measurement of the temperature approximately 2½-inches below the water surface. The thermometer was held for at least five seconds, or until the temperature stopped changing.

Measuring surface temps at Thomas Lake.

(FOR A FULL DESCRIPTION AND EVALUATION OF WEEVIL REARING METHODS of 2005 and 2006, SEE 2006 REPORT.)

III. BEAR LAKE

a. Lake Background



Bear Lake on USGS topographic map.

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.

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. Freckmann 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 (*Myriophyllum 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. Freckmann Herbarium on the University of Stevens Point campus. However, no other EWM (washed-up, rooted or floating) could be located within the lake.

g. EWM Studies Summary: 2003-2006

Field mapping efforts for this assessment on October 8, 2003 could not locate EWM, either rooted, floating or washed-up on shore. Therefore, **no EWM map was produced** for Bear Lake. It was suspected that EWM may turn up again, therefore recommendations focused on prevention and annual monitoring. Specific recommendations included: 1) Maintain Invasive Species Information Sign, 2) Annual Surveying, 3) Trained Volunteer Watercraft Inspectors.

Volunteers for annual monitoring were sought in 2005. A Bear Lake resident, Tom Zielinski, stepped forward to take on the responsibility. Tom reported that his first survey in spring of 2005 came up empty handed… which was a *good* thing!

f. Action in 2007

In spite of annual surveys by WDNR and the resident volunteer, a pioneer infestation was discovered in June, 2007, by Nancy Turyk, a research specialist with the UW-Stevens Point Center for Watershed Science and Education, while visiting the lake during a weekend outing.

Best treatment options (hand-pulling) were implemented, as outlined in Section IV.I.2.b., above. Two hand-pulling sessions were conducted, July 25th and October 29th, 2007. Amy Thorstenson, RC&D, and Nancy Turyk, UWSP, participated in both hand-pulling sessions, with Tom Zielinski, resident, and an anonymous citizen helping during the October session. At least one large EWM plant was located in waters too deep for thorough removal from a boat. Divers are needed to survey and hand-pull the deeper edges of the littoral zone.

Press releases were issued after each hand-pulling event to inform the public and solicit volunteers for future hand-pulling efforts, which generated some phone inquiries.

1. Recommendation, 2007 - Continue monitoring and hand-pulling

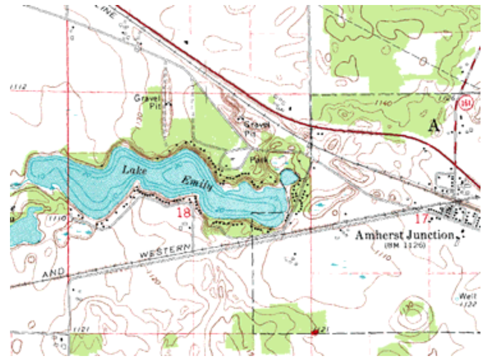
Continue monitoring and hand-pulling. More volunteers should be sought, as this is a pioneer population that could explode if left unchecked. Divers will be needed to survey deeper edges of the littoral zone.

> *What will we find in 2008?*
>
> If EWM turns out to be well-established, biological control may be a good option.

If EWM surveys find that the infestation is actually greater than first believed and beyond what is manageable with hand-pulling alone, Bear Lake may be a good candidate for **biological control**, due to the high amount of natural shoreline and lack of lake group representation.

IV. 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 D 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)

b. History of Aquatic Plant Control in Lake Emily

There were no DNR records of aquatic plant treatments prior to the onset of this study in 2003. WDNR records show EWM was first reported in this lake in 1993. (WDNR website) Table 2 lists aquatic vegetation species documented in Lake Emily. See Section f. for details on recent aquatic plant treatments resulting from recommendations presented in the 2004 EWM Assessment.

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. Freckmann 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. EWM Studies Summary: 2004-2006

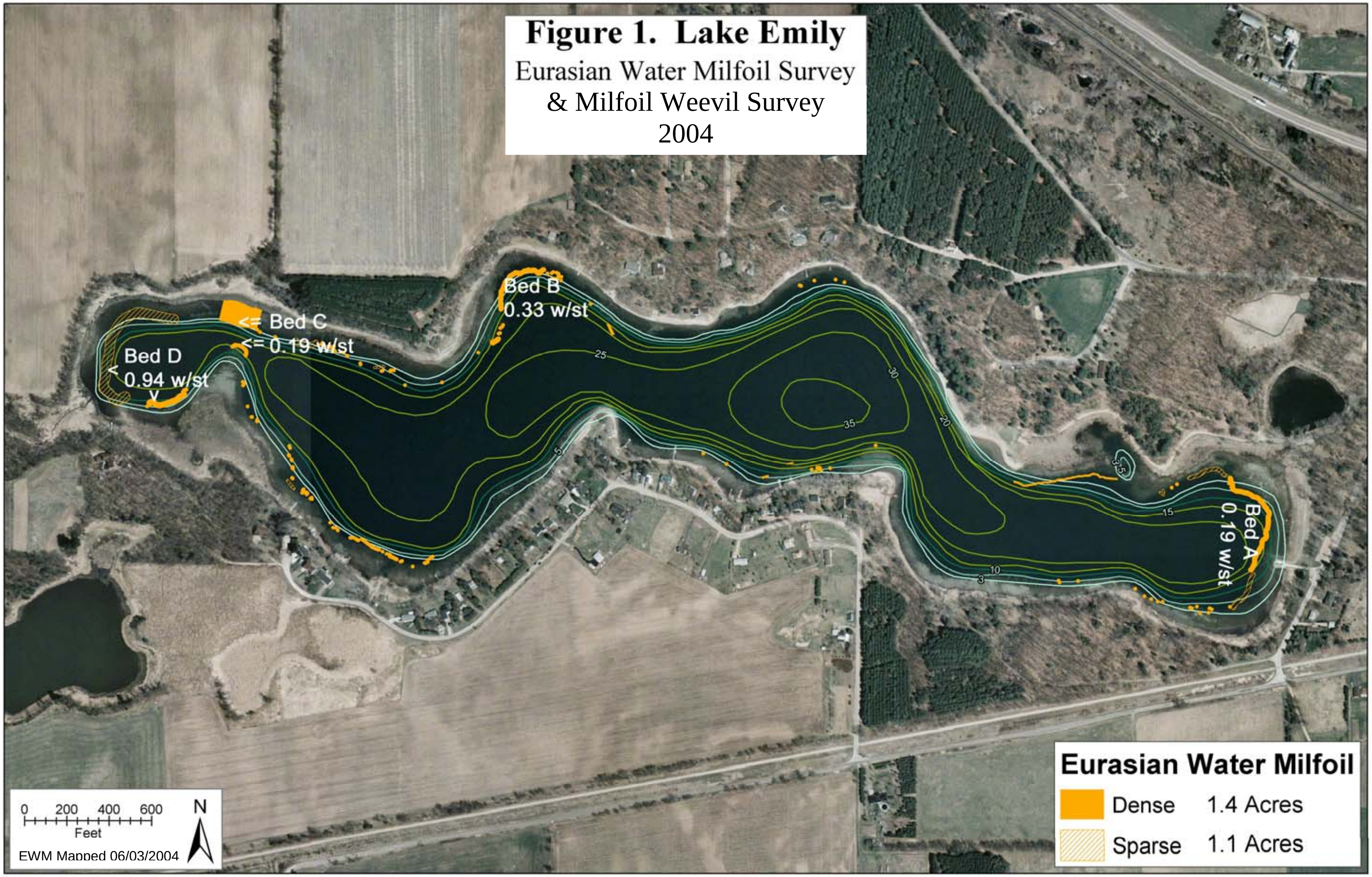
On June 30th, 2004, multiple areas of sparse to dense EWM growth were mapped. Dense EWM growth totaled 1.4 acres and sparse growth totaled 1.1 acres. (See Figure 1.)

Population density surveys were performed in August 2004 to determine the existing natural population of the aquatic milfoil weevil, *Euhrychiopsis lecontei*. (See Section II for methods.), Figure 1 shows sample bed locations and weevil populations.

Because Lake Emily appeared to be at a point where aggressive control measures could still prevent a full-blown infestation, two different treatment options were recommended: Option 1 – Push for Eradication with Chemical Treatments, and Option 2 – Invest in Biological Control. Both options stressed the need to incorporate hand-pulling to keep new beds from becoming established, the need to restore natural shoreline to enhance milfoil weevil habitat for long term control, and the need to establish a volunteer watercraft inspection team. Friends of Lake Emily, Inc. chose to pursue Option 1, reserving Option 2 as a treatment option for the future.

In 2005, the Portage County EWM Studies assisted the Friends of Lake Emily, Inc. with implementing Option 1 from their EWM control recommendations. The herbicide treatment was performed on June 1st.by Aquatic Engineering, Inc., utilizing RC&D's pre-treatment GIS mapping for guidance. Because of public concern about potential impacts to spawning fish, GPS locations of spawning beds were marked and no herbicide was applied within 50 feet of the beds. (See Figure 2.)

To remove the smaller EWM beds and individual plants, over 50 volunteers, both kids and adults, held volunteer work-parties on May 21st and June 25th. These volunteer efforts helped to reduce the size and cost of the herbicide treatments. The hand-pulling / herbicide combo appeared to be effective, as follow-up surveys and found very good control of EWM around the lake.



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**.

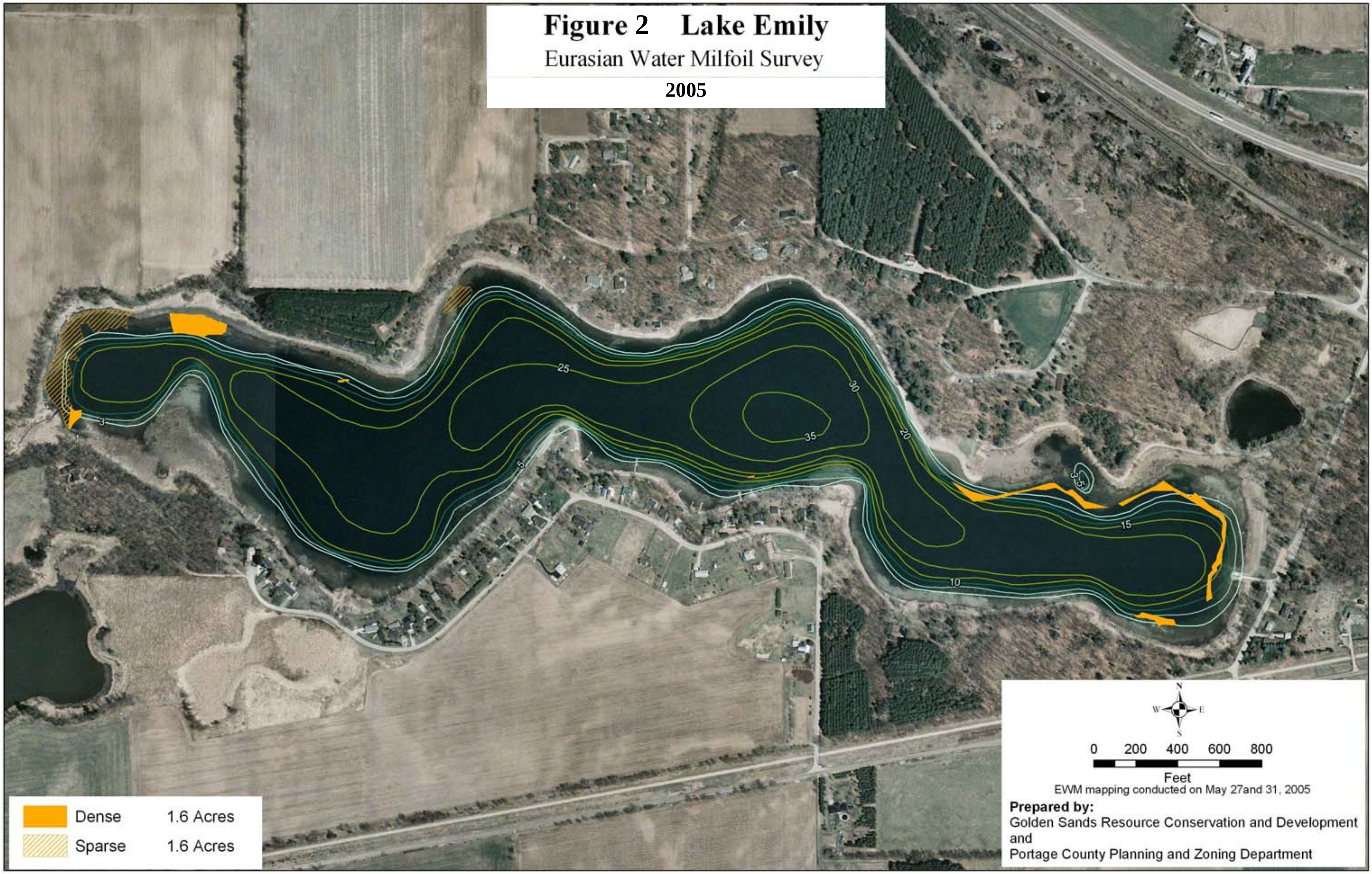


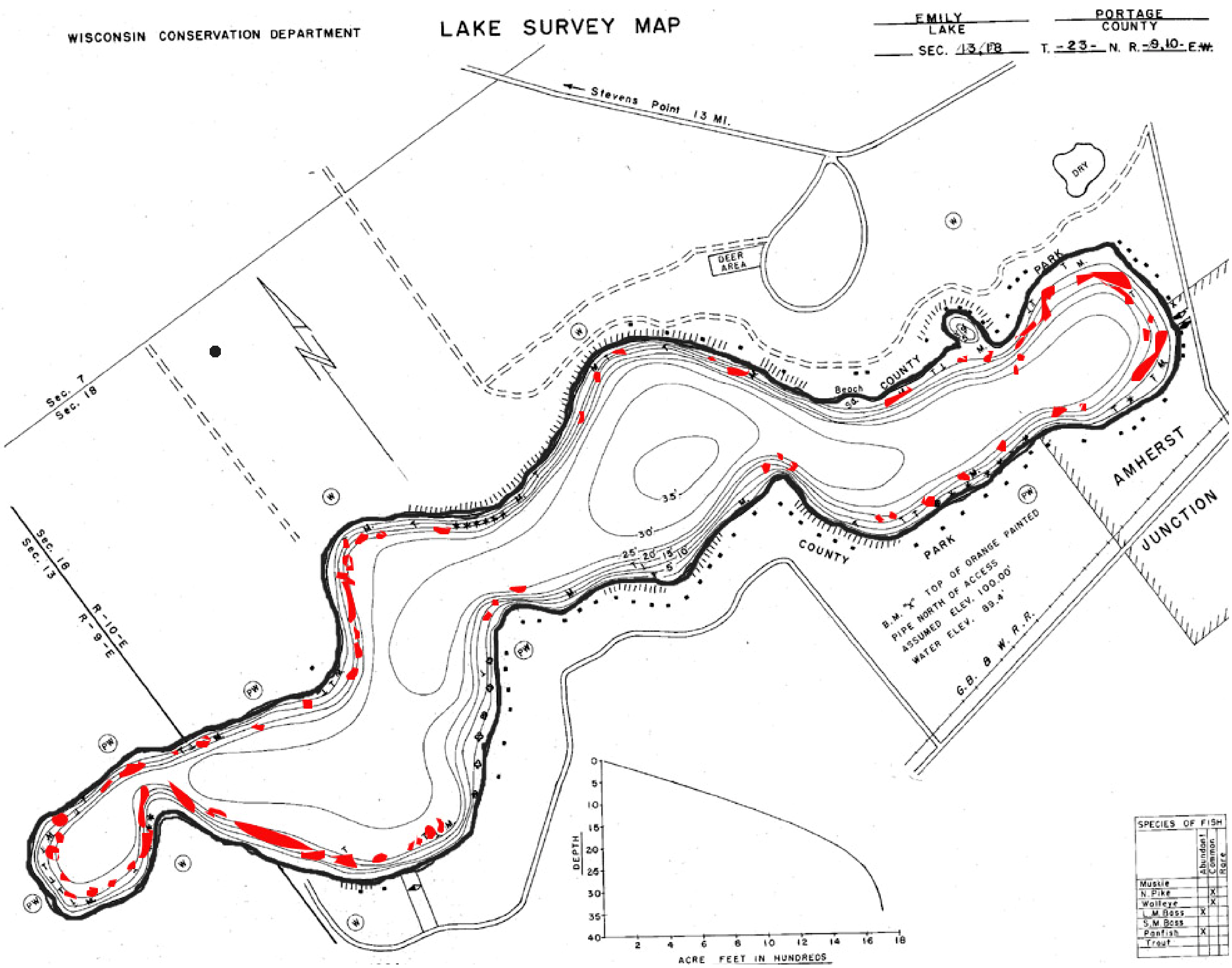
Figure 2 Lake Emily
Eurasian Water Milfoil Survey
2005
Dense 1.6 Acres
Sparse 1.6 Acres
25
30
35
20
15
10
5
3
N
S
W
E
0 200 400 600 800
Feet
EWM mapping conducted on May 27and 31, 2005
Prepared by:
Golden Sands Resource Conservation and Development
and
Portage County Planning and Zoning Department

The control recommendations proposed by the Portage County EWM Studies suggested that the hand-pulling / herbicide combination should be done up to three years in a row. Then, the Friends of Lake Emily, Inc., would need to work with their WDNR Aquatic Plant Specialist to assess the remaining EWM population and select control methods appropriate to the situation.

In 2006, due to public controversy over the use of chemicals, Friends of Lake Emily, Inc. opted not to continue with Option 1, and did not pursue chemical treatments in 2006. Instead, Friends opted to capitalize on the support they had for hand-pulling, a non-controversial control method, and focus on milfoil hand-pulling parties for 2006.

In 2006, a EWM hand-pulling party with volunteer divers took place, focusing primarily on the boat landing area at the eastern end of the lake. Below is a map of EWM remaining at the end of the 2006 growing season, mapped using GPS by Gary Nilsen, Friends of Lake Emily, Inc.

Figure 3. Lake Emily EWM Survey Map, 2006

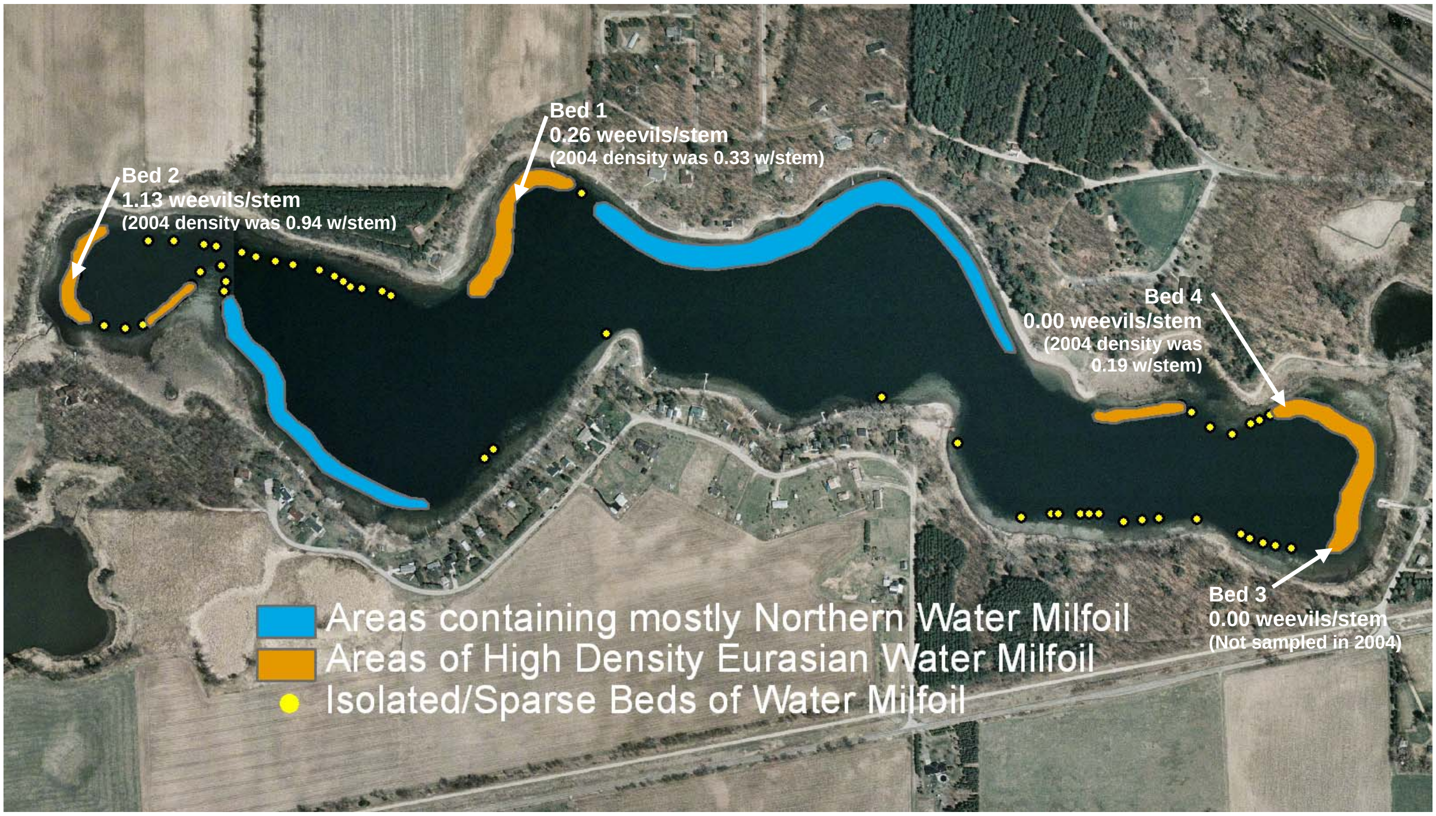


d. Action in 2007:

With the sense that they were losing the battle against EWM, in 2007, the Friends pursued an Aquatic Invasive Species Grant from the WDNR to receive assistance in a stronger implementation of their EWM control plan. Two seasonal staff persons were hired to organize EWM hand-pulling parties, perform watercraft inspections at the boat landing, and to conduct a rusty crayfish study to test a new trap design.

In 2007, four EWM hand-pulling parties took place, with over 50 volunteers helping out. Below is a map of EWM remaining at the end of the 2006 growing season, mapped using GPS by seasonal field staff.

Figure 4. Lake Emily EWM Survey Map, 2007



Mapping conducted by AIS field staff, 07/18/07 - 08/06/07. Beds 1, 2, 3 and 4 surveyed for milfoil weevils (*Eurychiopsis lecontei*) on 08/15/04. Stem samples collected by AIS field staff. Stem samples examined in laboratory on 09/24/07 – 10/12/07. Values on map represent average number of weevils per stem for each bed. Average weevil density overall for Lake Emily was found to be **0.36 weevils per stem**.

Upon the request of the Friends of Lake Emily, Inc., sample stems were collected by seasonal field staff on August 15th, 2007, to determine the current natural population of the aquatic milfoil weevil, *Euhrychiopsis lecontei*. Stem samples were immediately preserved with isopropyl alcohol, and kept refrigerated until examination. They were examined in the laboratory from September 24th through October 12th. (See Section II for methods.) Extracted weevil specimens were placed in labeled sample vials, preserved in isopropyl alcohol and species ID confirmed by Amy Thorstenson, Golden Sands RC&D. (See Figure 4 for sample bed locations and Table 4 for summarized results.)

Table 4. Weevil Population Density Survey – Results Summary, 2007

Lab Date (2007)	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)
9/24-10/2	**1**	8 - 13	34	0%	0.18	2.56	24%	0.09	0.18	0.00	0.00	**0.26**
10/2-10/9	**2**	4 – 11	32	0%	0.72	4.81	66%	0.28	0.75	0.03	0.06	**1.13**
9/25-10/12	**3**	4 - 11	29	0%	0.21	2.83	7%	0.00	0.00	0.00	0.00	**0.00**
9/25-10/3	**4**	2 - 13	30	0%	0.03	2.03	0%	0.00	0.00	0.00	0.00	**0.00**
Whole Lake Results		2 - 13	125	0%	0.30	3.10	25%	0.10	0.24	0..01	0.02	**0.36**

*See Figure 1 for EWM sample bed locations.

Survey Notes:

Sample Date: 8/15/2007

Land Cover @ Shore: Bed 1 = Residential (most mowed to shoreline), Natural (forest and wetlands)
Bed 2 = Natural (forest and wetlands)
Bed 3 = Park (natural shoreline buffer, boat launch nearby)
Bed 4 = Park (natural shoreline buffer, boat launch and beach nearby)

Sample Preservation: Samples were kept in water in labeled plastic bags at 3-4°C and preserved with isopropyl alcohol until examination. All samples appeared to be in good condition at the time of examination.

1. Recommendations, 2007

Option 1

Prepare Lake Emily to be a case study in biological control, by collecting needed baseline data in 2008.

DNR and UW-Stevens Point are collaboratively planning a several-year study on biological control of EWM. Baseline data to collect is yet to be determined, but may include: EWM stem density, monthly weevil population surveys, surface temperature, freeboard, and possibly sediment and water chemistry. This option will necessitate that the **Friends continue hand-pulling** of scattered EWM plants, to restrict EWM from spreading further.

Option 2

Chemical treatments of dense beds, with hand-pulling of scattered plants.

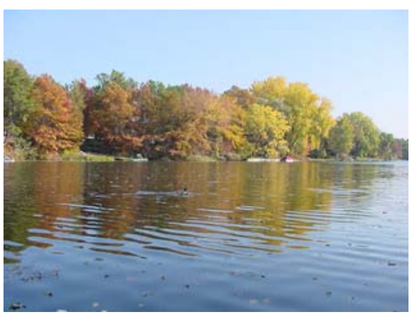
Some beds are too dense and too large to be managed with hand-pulling alone. Utilize chemical control treatments in the dense beds, and continue hand-pulling to clean up the scattered plants that could lead to the establishment of new beds. To assure that divers are not exposed to concentrations of residual 2,4-D above the drinking water standard (70 parts per billion), an assay test can be done after the treatments to monitor residual 2,4-D levels.

V. 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, ground-water, 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) 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 and 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) This is a modestly recreated pond 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 and algae 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 and Portage County 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)

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 10 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), the use of chemical treatments has drawbacks, such as toxicity to aquatic insects, residual by-products, unintended drift, and excessive plant decay causing oxygen depletion. Chemical treatments can also result in increased nutrient release and sediment enrichment, which can lead to algal blooms and excessive plant growth in following years. 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 of EWM in the deeper water of the western end, which has been persistent throughout treatment efforts and was present in October 2003.

Table 5. List of Documented Aquatic Vegetation
(Submergent and Floating-Leaf Aquatics Only)

	Herbarium Records for Springville Pond *	
	Scientific Name	Common Name
1	*Ceratophyllum demersum*	Coontail
2	*Chara sp.*	Muskgrass
3	***Elodea Canadensis***	**Waterweed**
4	*Elodea nuttallii***	Slender waterweed
5	***Lemna minor***	**Small duckweed**
6	*Myriophyllum sibiricum*	Northern water milfoil
7	***Myriophyllum spicatum*** **(e)**	**Eurasian water milfoil**
8	***Potamogeton crispus*** **(e)**	**Curly leaf pondweed**
9	***Potamogeton pectinatus***	**Sago pondweed**
10	*Zannichellia palustris*	Horned pondweed

* Robert W. Freckmann Herbarium records through December 2006, 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.)

** Elodea nuttallii has not been documented at Springville Pond since 1974.

(e) Exotic invasive

Bolded species indicate those documented during 2006 aquatic plant surveys, described further in Section IV.g. (Note that Elodea Canadensis was only observed during the surveys, but was not recorded at a sample point.) Voucher specimens of plants collected at sample points have been submitted to the Robert W. Freckman Herbarium.

c. EWM Studies Summary: 2003-2006

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 2.) The growths mapped were comparable in size and location to growths seen approximately six years prior.

In 2004, weevil population density surveys were performed to determine the existing natural population of the aquatic milfoil weevil, *Euhrychiopsis lecontei*. See Figure 4 for sample locations and results. Average milfoil weevil density for Springville Pond was found to be 1.65 weevils per stem, which seems to be a healthy natural density.

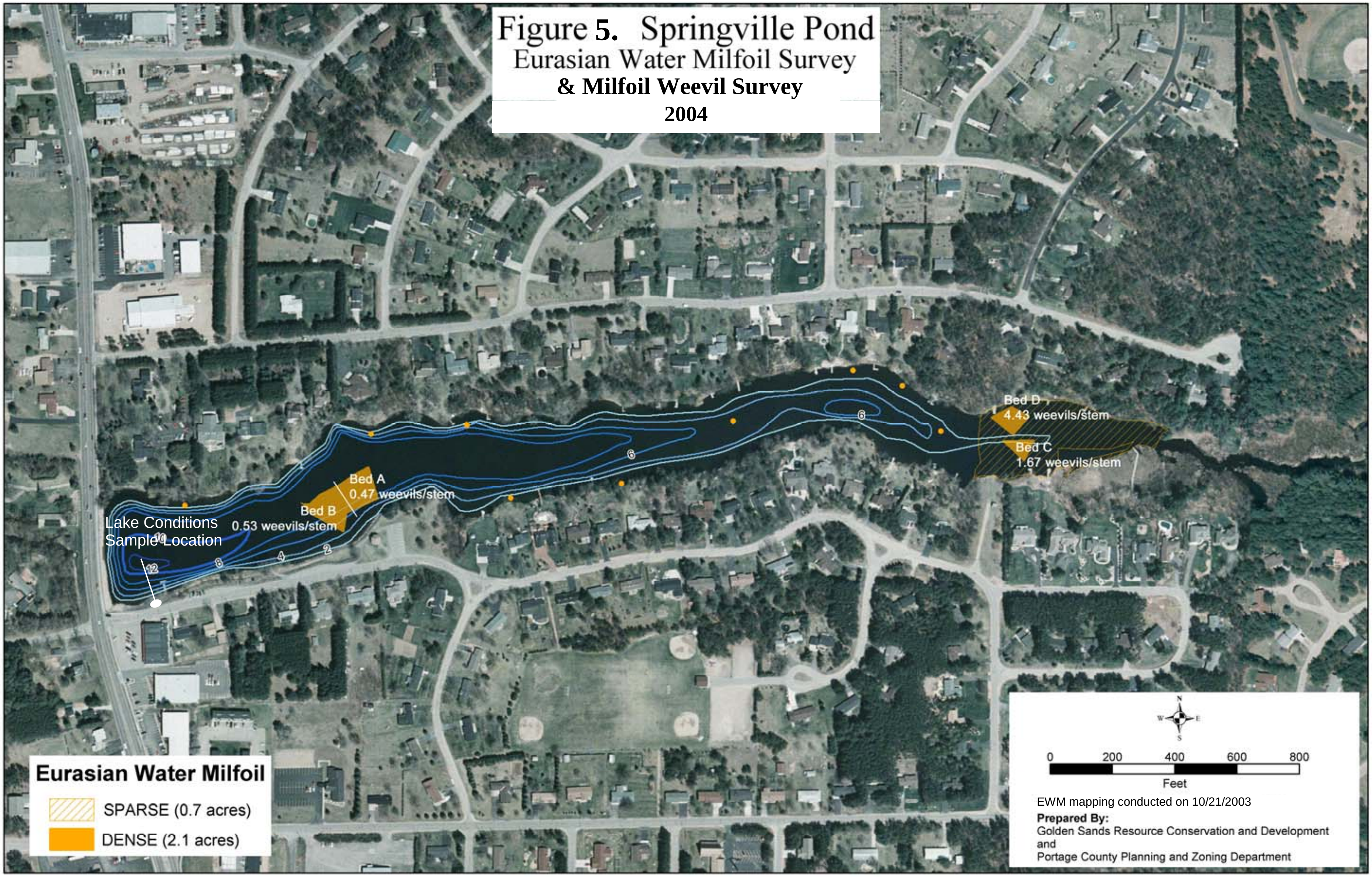
On September 8th, 2004, a site visit to Springville Pond discovered that EWM in Beds C and D had severely declined, with just a few, sickly EWM stems remaining. While it could not be said for certain whether the weevils were responsible for this sharp EWM decline, this was a very good sign for Springville Pond. The recommended management plan included: 1) Maximize biological control by enhancing shoreland buffers, 2) No additional control treatments, 3) Establish a trained volunteer monitoring program, 4) Post exotic species advisory signage, 5) Evaluate management plan.

In 2005, the Village of Plover opted to follow the recommendation of biological control. Mid-season observations found many positive signs that weevils were active and having an impact on the milfoil. However, the sunny, hot, and dry weather resulted in record low water levels to the Little Plover River, which feeds into the pond. This meant almost no fresh, cool water coming into the pond during the hottest, driest parts of the summer. The stagnant water conditions, coupled with the hot, sunny weather, created extreme conditions just *perfect* for rapid EWM growth.

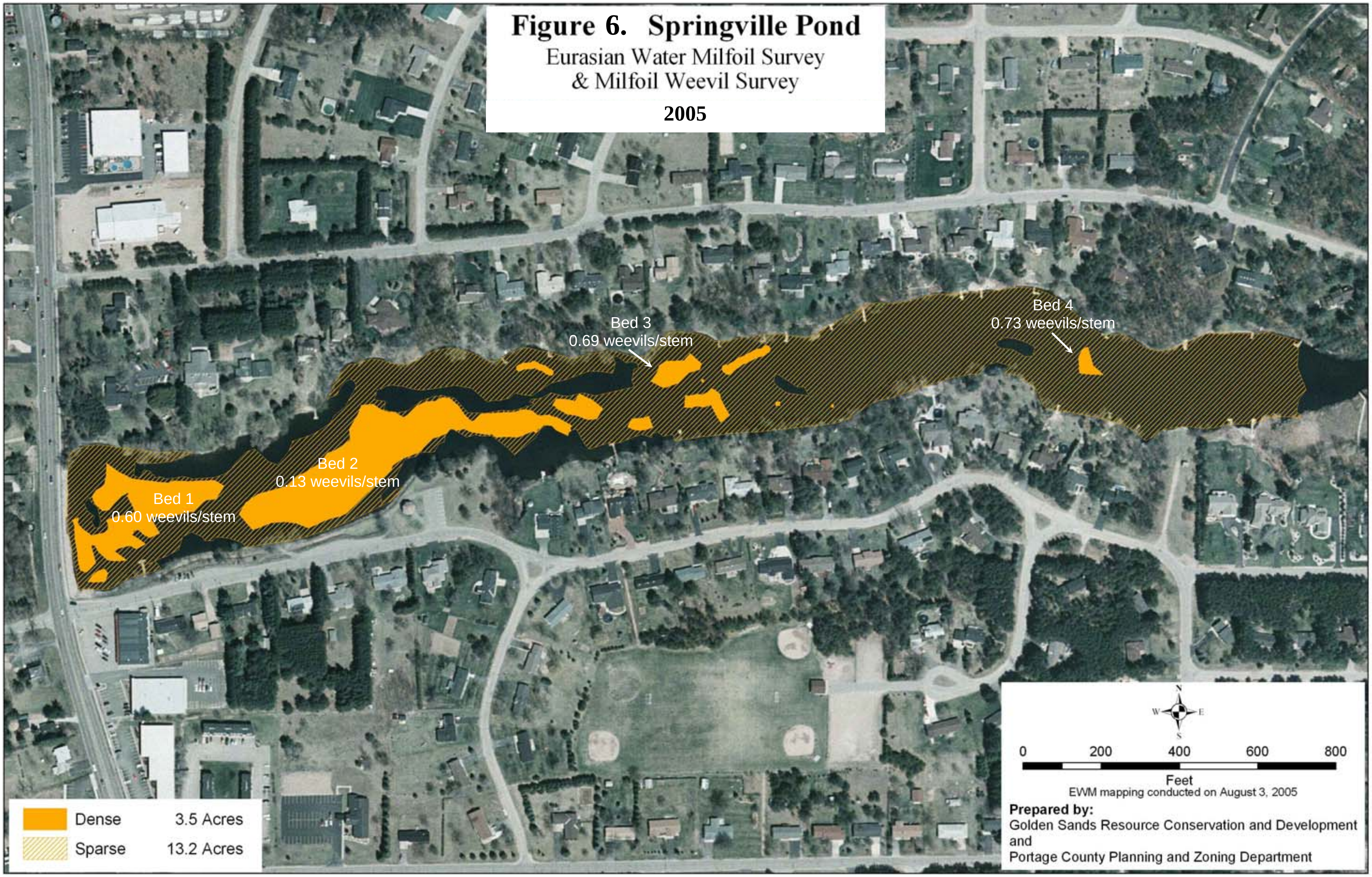
In August, EWM mapping found that the dense EWM beds had increased from 2.1 total acres in 2003 to 3.5 acres in 2005. (See Figure 3.) Even more dramatic was the increased area colonized by sparse growth of EWM, from 0.7 acres in 2003 to 13.23 acres in 2005. This documented that new EWM growths had appeared in almost every area of the pond.

Weevil surveys showed the average population in the pond was 0.54 weevils per stem, a decreased density from the 2004 average of 1.65 weevils per stem. It was believed that the weevil population in Springville Pond is still healthy and increasing but was simply unable to keep pace with the abnormally rapid EWM growth in 2005.

Whether due to abnormal conditions or not, the alarmingly rapid EWM and algae growth caused a great deal of concern among community members and landowners around the pond. The recommended management plan included: 1) Boost the weevil population through weevil-rearing, 2) Residents support milfoil weevils with shoreland buffers, 3) Residents control EWM around individual dock areas.



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.**



Bed 1, 2, 3 and 4 surveyed for milfoil weevils (*Euhrychiopsis lecontei*) on 08/05/05. Stem samples collected from sample beds were examined in laboratory on 08/09/05. Values on map represent average number of weevils per stem for each bed. Average weevil density overall for Springville Pond was found to be **0.54 weevils per stem.**

In 2006, weevils were collected from the pond during the summer of 2006 and reared in a predator-free environment, and released at a strategically–positioned stocking location at the near–shore edge of Bed 2. (See Figure 7.) Various difficulties with the process were encountered, therefore production results were lower than expected. (Full Methods and Discussion of this method are found in *Portage County Eurasian Water Milfoil Assessment Summary: 2003-2005.*) Table 8 shows those production results.

Table 8. Springville Pond Weevil Production Results, 2006

	Springville Pond **- Total -**	Springville Pond **- June only -** (excludes tub)	Springville Pond **- July only -** (excludes tub)	Springville Pond **- August only -** (excludes tub)
Total Tanks Filled	178, +tub[1]			
Total Input	1397 weevils			
Total Output	2616 weevils			
Net Increase	1219 weevils	-29 weevils	508 weevils	509 weevils
% Increase	176%			
Average Return Rate[2]	1.88	0.99	2.99	2.24

[1] *A 100-gallon tub was used experimentally for rearing.*
[2] *Return Rate = number produced divided by number started with*

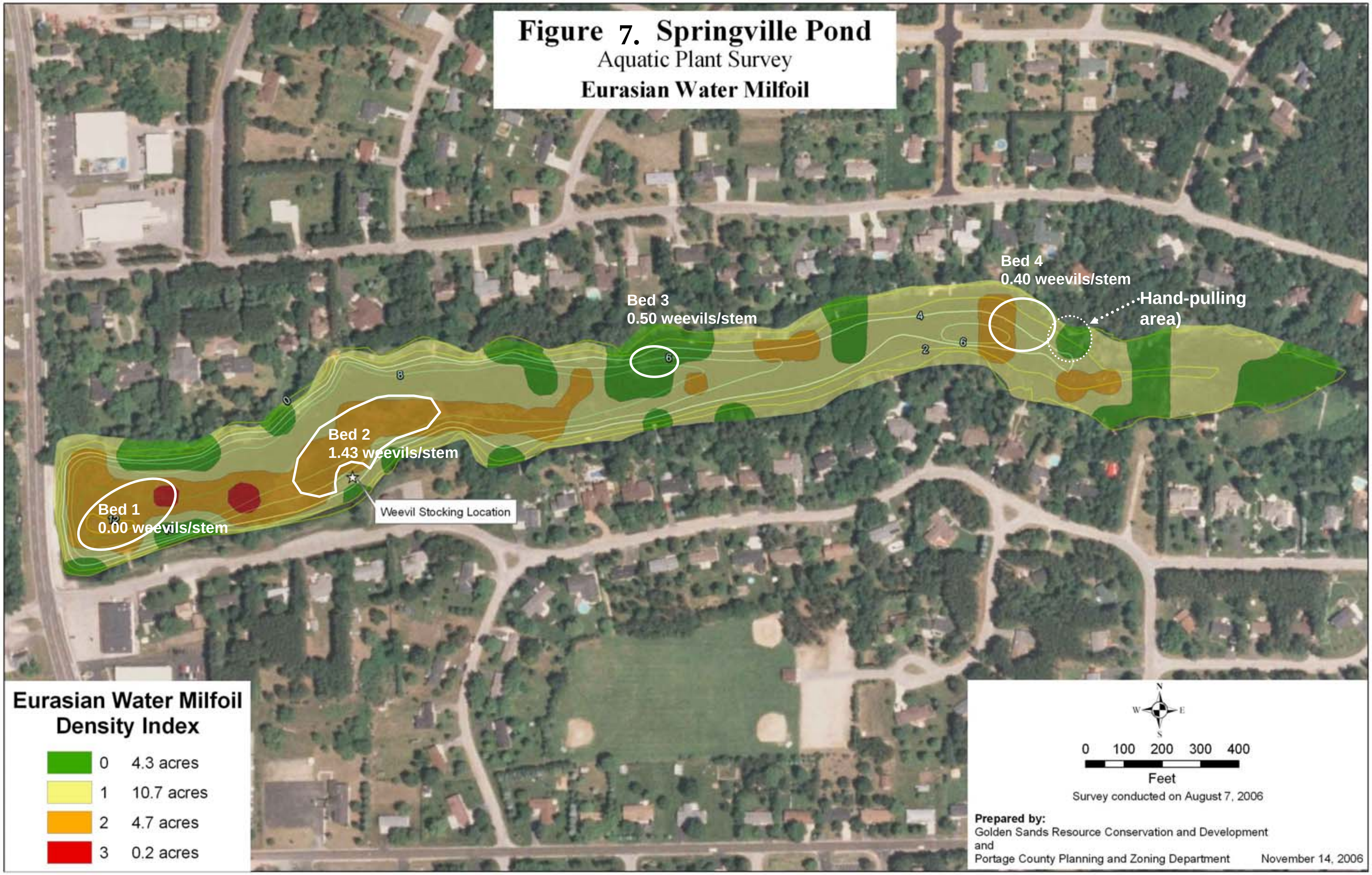
Figure 7 shows 2006 EWM mapping and weevil survey results. Weevil survey results again showed a rather low Whole Pond Average of 0.58 weevils per stem. (Note that survey sampling excluded the weevil stocking area.)

Weevil densities were sampled monthly during 2006 in an effort to understand what factors may be influencing the weevil population in Springville Pond. This data may reflect measurable effects of weevil stocking (i.e. Bed 2), but it may also reflect other factors, such as weevil movement around the pond over the summer, or possible changes in the suitability of these beds as habitat.

The June survey showed quite low results, which may be expected if winter survival rates are low. Improvements to winter hibernation habitat may help to improve the survival rate and promote early season weevil levels. (See Table 11 and Chart 1.)

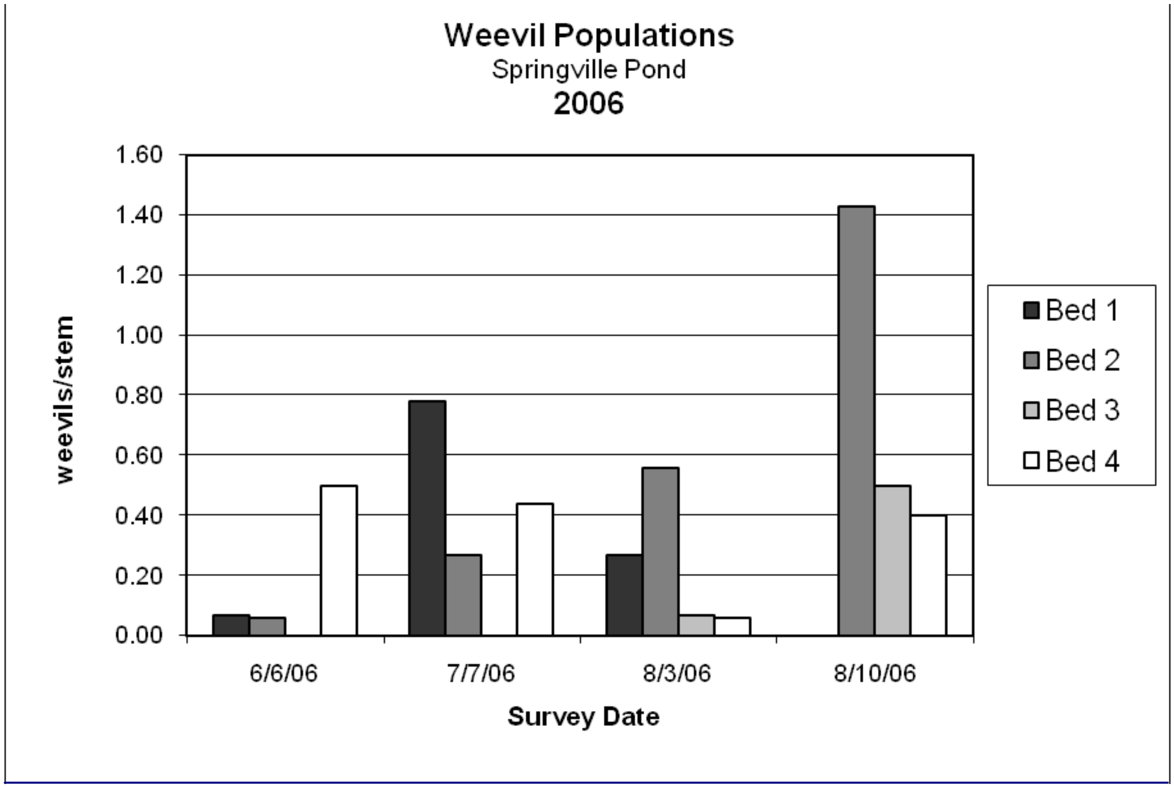
Table 11. Weevil Population Density Survey – Seasonal Movement, 2006

2006	Bed 1	Bed 2	Bed 3	Bed 4	Whole Pond Ave:
6/6/06	0.07	0.06	0.00	0.50	0.16
7/7/06	0.78	0.27	0.00	0.44	0.42
8/3/06	0.27	0.56	0.07	0.06	0.24
8/10/06	0.00	1.43	0.50	0.40	0.58



Aquatic plant survey conducted on 8/7/06. Sampling method: Point Intercept with rake. Density index indicates rating of "rake fullness". (See Section II.c.) Beds 1, 2, 3 and 4 surveyed for milfoil weevils on 08/10/06. Stem samples collected were examined in laboratory 08/11-8/24/06. Values on map represent average number of weevils per stem for each bed. Average weevil density overall for Springville Pond was found to be **0.58 weevils per stem.**

Chart 1. Weevil Population Density Survey – Seasonal Movement, 2006



Freeboard and temperature measurements in 2006 did not indicate discernable trends. (Note that survey freeboard surveys avoided the immediate stocking area.) Because the bulk of the stocked weevils were released late in the season, it was unlikely that measurable impacts would be present so soon. These surveys do, however, establish some historical data for comparison in future years. (See Chart 2 & Chart 3.)

Chart 2. Average Freeboard Measurements – Springville Pond

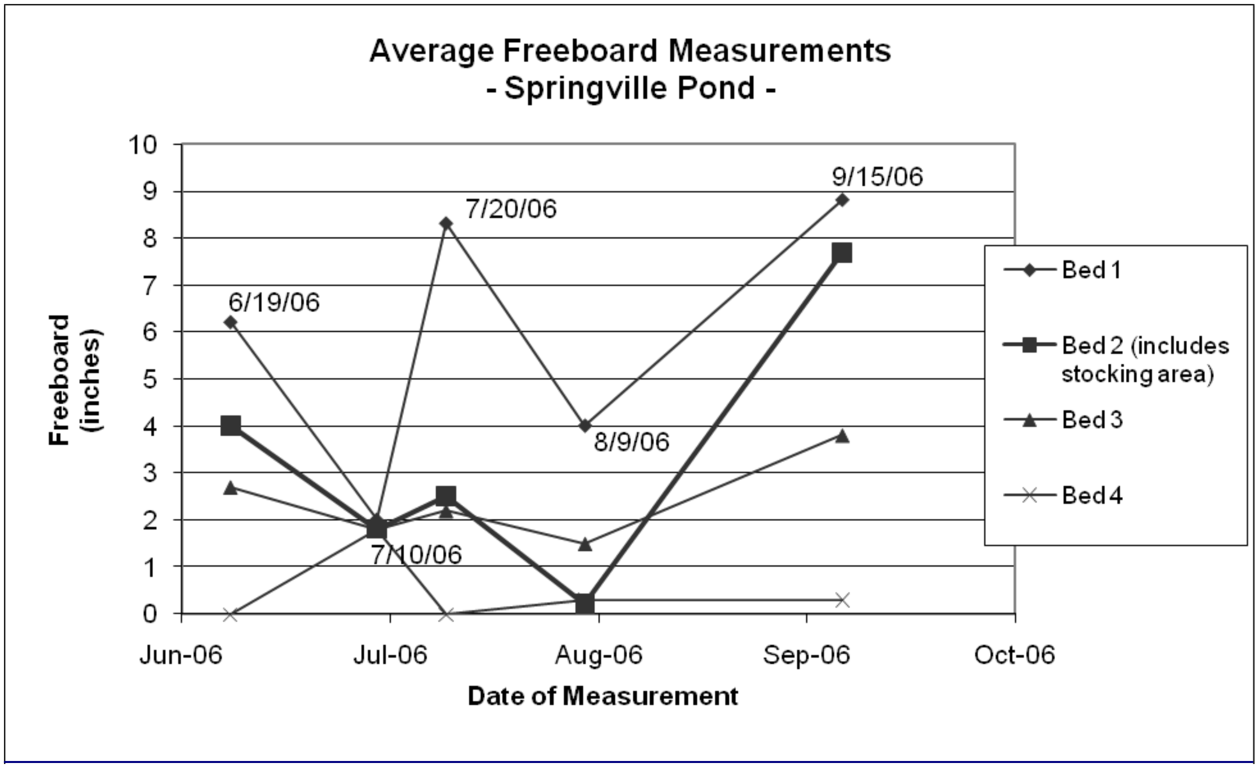
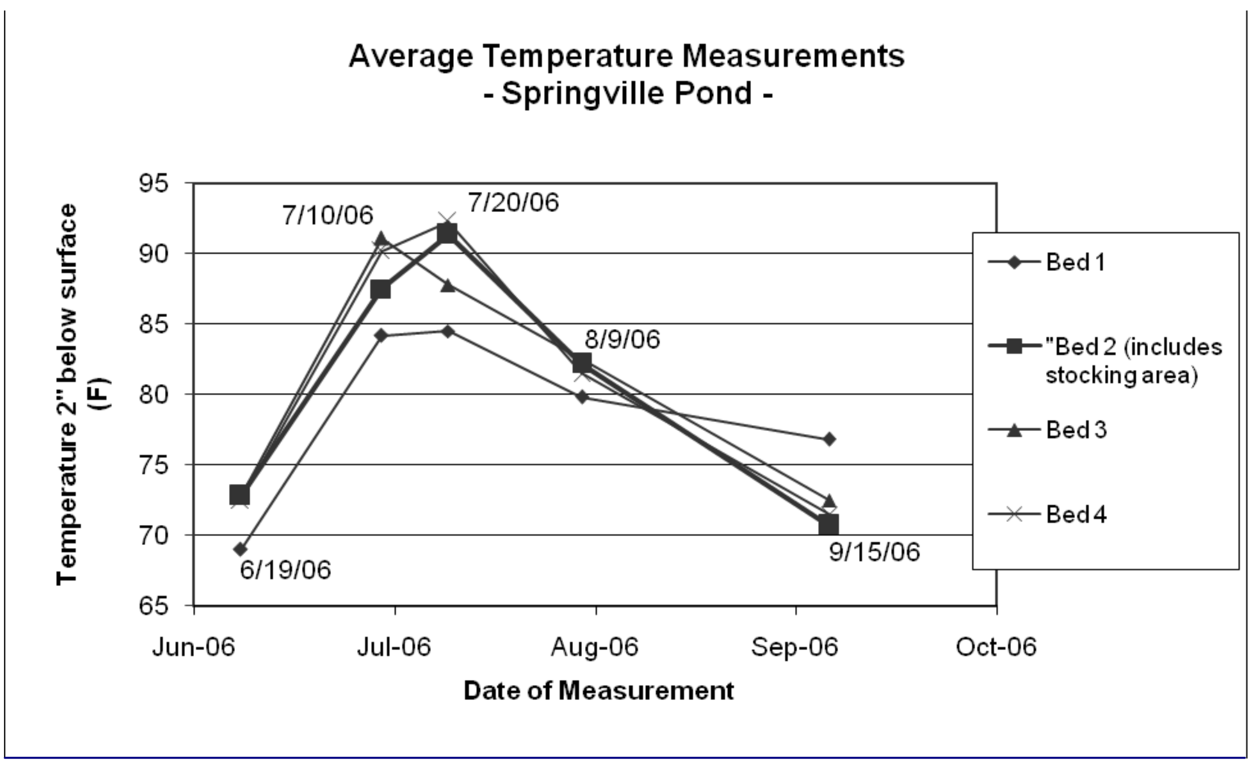


Chart 3. Average Temperature Measurements – Springville Pond



Biological control takes more than one season to have its full effect, and larger stocking numbers were needed at Springville Pond. Residents were not content with the results they were seeing. Through cooperative meetings in 2006 between the Village of Plover, the Springville Pond landowners group, UWSP, and DNR, an EWM management plan was developed. A winter water level drawdown was planned for winter 2006-2007, and targeted chemical and harvesting treatments were planned for 2007 on Springville Pond.

Recommendations in 2006 were: 1) Continue weevil surveys to track response to the combination treatments, 2) Shoreline restoration to fortify the lake's "immune system", 3) Residential control of EWM in individual dock areas.

d. Action in 2007

Because there are few (no?) waterbodies in the country where there is historical weevil survey data available, 2007 was viewed as a critical opportunity to collect new, important data about how the weevil populations are influenced by the use of other EWM control methods. Therefore, population surveys were conducted again in 2007.

Assistance with distinguishing between the two weevil species present in Springville Pond (*E. lecontei* and *Phytobius sp.*) was received from Jeff Dimick, WDNR, and Laura Herman, UW-Extension, with the use of a Nikon SMZ 1500 miscroscope and high-resolution, SPOT INSIGHT FireWire camera at the UW-Stevens Point College of Natural Resources.

Milfoil weevil counts from samples collected on August 1, 2007, show an average weevil density of 0.20 weevils per stem. This is lower than the 2004, 2005, and 2006 Whole Pond Averages of 1.65, 0.54, and 0.58 weevils per stem, respectively.

In a lake with long, narrow shape like Springville Pond, weevil populations can vary greatly from one end to the other. Individual bed results may be more important than Whole Pond Averages. (See Figure 8 for EWM sample bed locations and EWM density mapping.)

Table 12. Weevil Population Density Survey, 2007

Lab Date (2007)	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)
8/3/07	**3**	1-7	17	41%	0.24	2.06	12%	0.12	0.00	0.00	0.00	**0.12**
8/2-8/3/07	**4**	1-4	14	64%	0.00	3.14	0%	0.29	0.00	0.00	0.07	**0.36**
8/3/07	**5**	1-2	16	25%	0.00	2.56	13%	0.06	0.00	0.06	0.19	**0.31**
8/3/07	**D**	2-2 1/2	17	47%	0.41	2.47	24%	0.06	0.00	0.00	0.00	**0.06**
Whole Lake Results		1-7	64	44%	0.2	2.5	17%	0.13	0.00	0.02	0.06	**0.20**

*See Figure 8 for EWM sample bed locations.

Survey Notes:

Sample Date: 8/10/2006

Weather Conditions: Partly sunny, 80°F

Land Cover @ Shore: Bed 1 = Dam, Park, Residential
Bed 2 = Park, Residential
Bed 3 = Residential (some mowed, but more natural along shoreline)
Bed 4 = Residential (mostly natural shoreline)

Sample Preservation: Samples were kept in water in labeled plastic bags at 3-4°C until time of examination. Samples held for more than several days prior to examination were preserved with isopropyl alcohol.

Other notes: Another hot, sunny drought year = low water levels, stagnant conditions. 2005 had 50 days above 80°F by Labor Day. 2006 had 55 days above 80°F by Labor Day.

Note that Sample Bed 1 and Sample Bed 2 (the 2006 weevil stocking bed) were not present at the time of sample collections on August 1st, and so could not be sampled. Only a few, scattered stems were observed. This may be due to the combined effects of the winter drawdown, the spring chemical treatments on the northern half of this section of the pond, and the 2006 weevil stocking on the southern half of this section. With such a rapid, significant decline of the milfoil beds in the western part of the pond, the fate of the weevils that were stocked to Bed 2 in 2007 is unknown. There is some chance that some adults were able to evacuate to other beds. (See Figure 9 for historical survey comparisons.)

To compensate for the loss of sample beds in the western part of the pond, sample stems were collected from the western-most milfoil bed that could be found on August 1st, which was named Bed 5. It cannot be said for sure whether this bed represents the residual population (evacuees) from the 2006 stocking program to Bed 2.

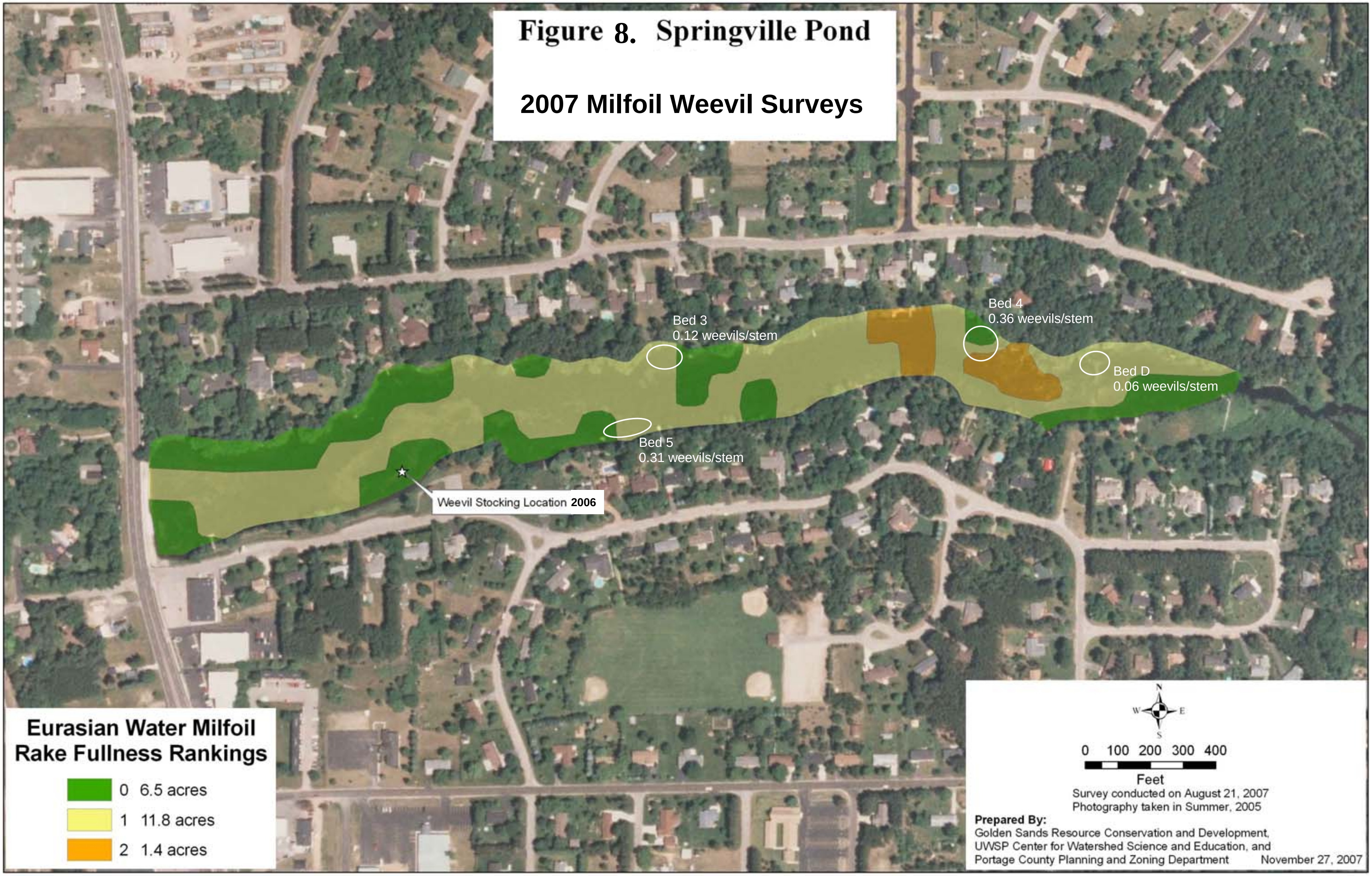
Sample Bed 3 was more heavily composed of sago pondweed than in years past, but EWM was still of sufficient density to collect samples from.

Sample Bed 4 was impacted in July by mechanical harvesting activities, which may adversely impact weevil populations and population survey results. The bed was also more heavily composed of sago pondweed than in years past, but EWM was still of sufficient density to collect samples from.

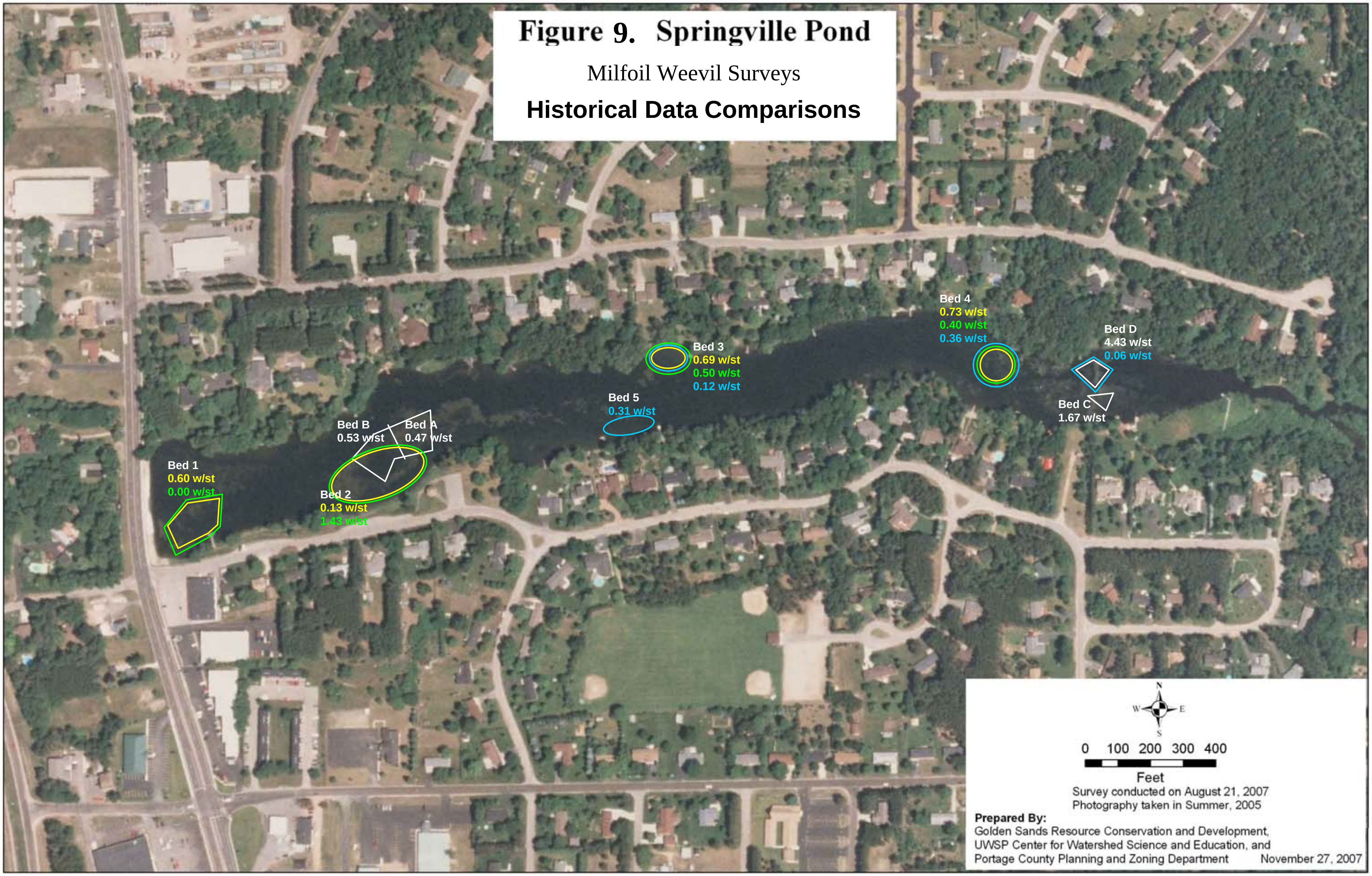
Bed D, in August of 2004, had a robust weevil population of 4.43 weevils per stem and then disintegrated in September of 2004, possibly due to weevil damage. The bed was not present during 2005 or 2006 surveys. In 2007, the bed was heavily composed of curly-leaf pondweed and sago pondweed, but EWM had rebounded to sufficient density to collect samples from.

Weevil specimens were examined further to determine the percentage of weevils collected that were *Phytobius sp.* vs. *Euhrychiopsis lecontei*. While *Phytobius sp*. do feed on EWM, their feeding habits do not damage the plant as severely as *E. lecontei* feeding habits do. Therefore, determining whether the existing weevil population is mostly *E. lecontei* may be helpful in evaluating future EWM control options.

Only the adult stage is distinctive enough to discriminate between the two species, therefore, only adult specimens were examined. Species ID confirmation was assisted by Jeff Dimick, WDNR, and Laura Herman, WDNR. Appendix C shows photographic differentiation between the two species. Species breakdown is shown in Table 13.



Eurasian water milfoil density mapping based on aquatic plant surveys conducted by the UW-Stevens Point Center for Watershed Science & Education, 8/21/07. Beds 3, 4, 5, and D surveyed for milfoil weevils on 8/1/07. Collected stem samples were examined in laboratory 8/2-8/3/07. Values on map represent average number of weevils per stem for each bed. Average weevil density overall for Springville Pond was found to be **0.20 weevils per stem.**



Sample beds and survey results, compared from 2004 to 2007.
White = 2004 Yellow = 2005 Green = 2006 Blue = 2007
Note that Bed 1 and Bed 2 were gone in 2007. Bed 5 was the western-most bed found for sampling.

Table 13. Weevil Species Breakdown in Springville Pond Samples

Year	Sample Date	Total adult specimens	E. lecontei specimens	Phytobius specimens
2004	August 4-5	*	*	*
2005	August 8	1	1	0
2006	June 6	0	0	0
2006	July 6	2	0	2
2006	August 10	4	3	1
2007	August 1	4	4	0

* = Specimens unavailable for examination. Retained at UWSP

While there were not enough adult specimens to base confident estimates on, the results suggest that the weevil populations at Springville Pond are dominated by *E. lecontei*, the preferred weevil for biological control. The presence of both weevil species may be a positive factor, since *Phytobius sp.* prefer to lay eggs on the EWM flowering stalk, whereas *E. lecontei* do not prefer flower stalks. Therefore, the two species are unlikely to conflict with each other, and may provide strategic complements to each other for biological control.

1. Summary and Recommendations, 2007

Weevil population densities were lower than hoped for in 2007. Because two of the survey beds disappeared, it is difficult to say what happened to the weevils stocked in 2006, and this may account for the lowered average.

The western half of the pond, which historically showed low weevil populations, had been boosted (weevil densities approximately tripled) through the 2006 stocking program. With those beds disappearing, it appears the western end is low in weevils again. The remaining EWM growth (around Bed 3 and Bed 5) is sparse, and not ideal for weevil stocking.

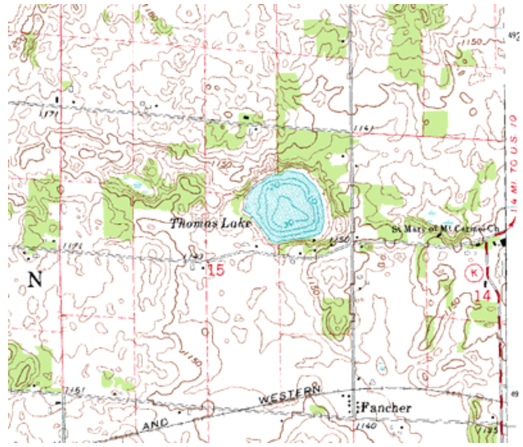
Bed 4 again showed modest weevil populations, similar to densities in years past. Bed D was very low in weevil densities, but this could be expected in a "new" (re-forming) bed where stems are still sparse and weevil populations are still migrating to it. This eastern end of the pond has very good natural shoreline for winter hibernation habitat, and shallow beds that are close to shore. It would be reasonable to predict that in future seasons, weevil populations are likely to slowly rebuild in Bed D, however this area (including Bed 4) may be ideally suited to a stocking program to speed that process along.

The weevil species found to be dominant in Springville Pond was *E. lecontei*, the preferred species for biological control. The presence of *Phytobius sp.* may be a complement to how *E. lecontei* impacts EWM, but if a stocking program takes place again, it may be advantageous to select for *E. lecontei* when collecting "starter-stock" for rearing.

Stocking programs should not be attempted again, however, unless the current control plan is modified to leave a stocking bed unaltered by the mechanical and chemical treatments. The current control plan creates too much disturbance to maintain a stable weevil population.

VI. 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 D 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)

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 and Portage County 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)

b. History of Aquatic Plant Control in Thomas Lake

No records of previous aquatic plant treatments were found to report for this assessment. Table 14 lists aquatic vegetation species documented in Thomas Lake.

Table 14 - 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. Freckmann 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

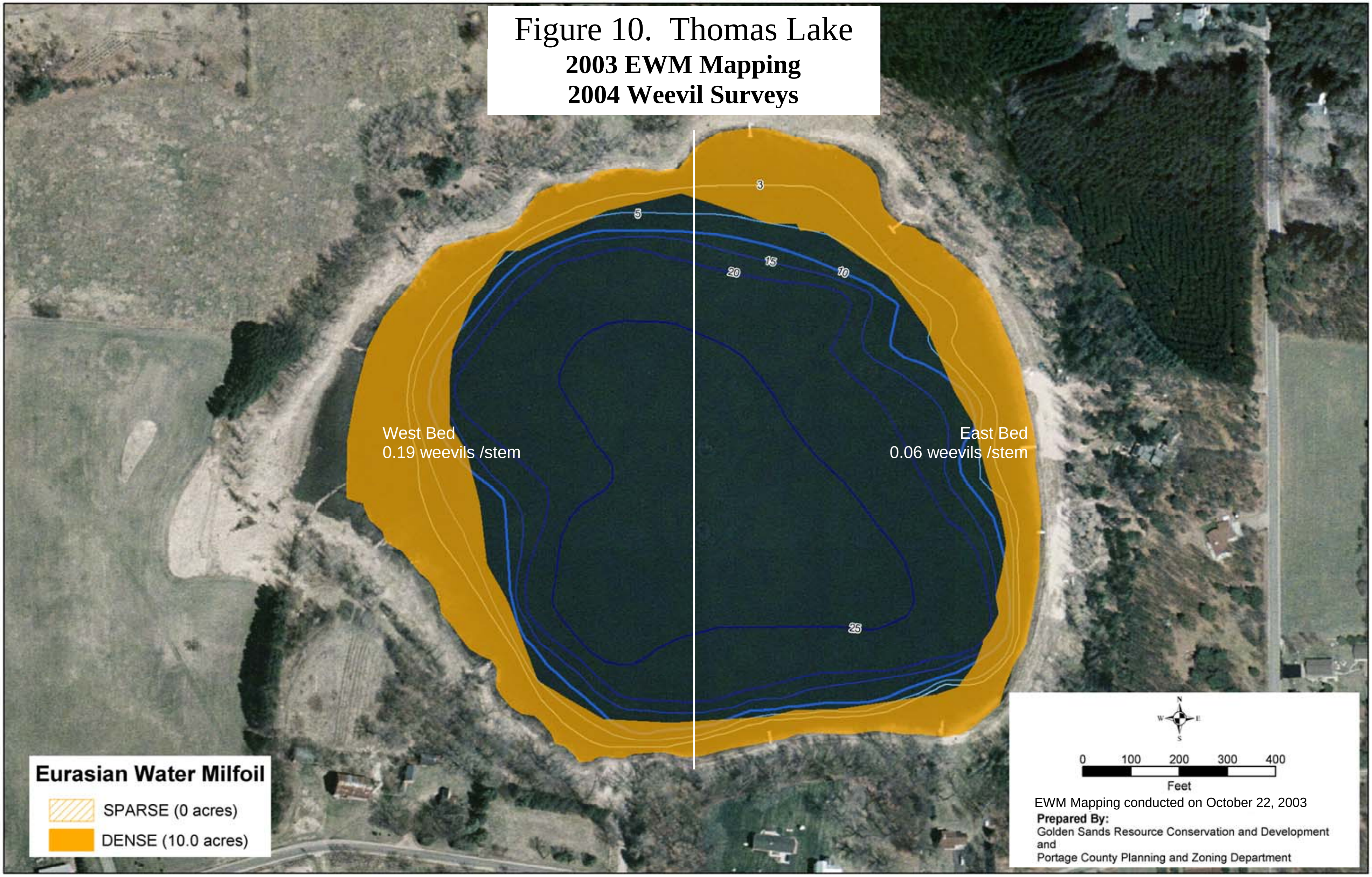
c. EWM Studies Summary, 2003-2006

EWM was not identified in Thomas Lake until sometime around the year 2000, but the exotic plant spread rapidly, likely due to high phosphorus levels in this eutrophic lake. EWM has become a dense mass of weeds surrounding the entire periphery of the lake.

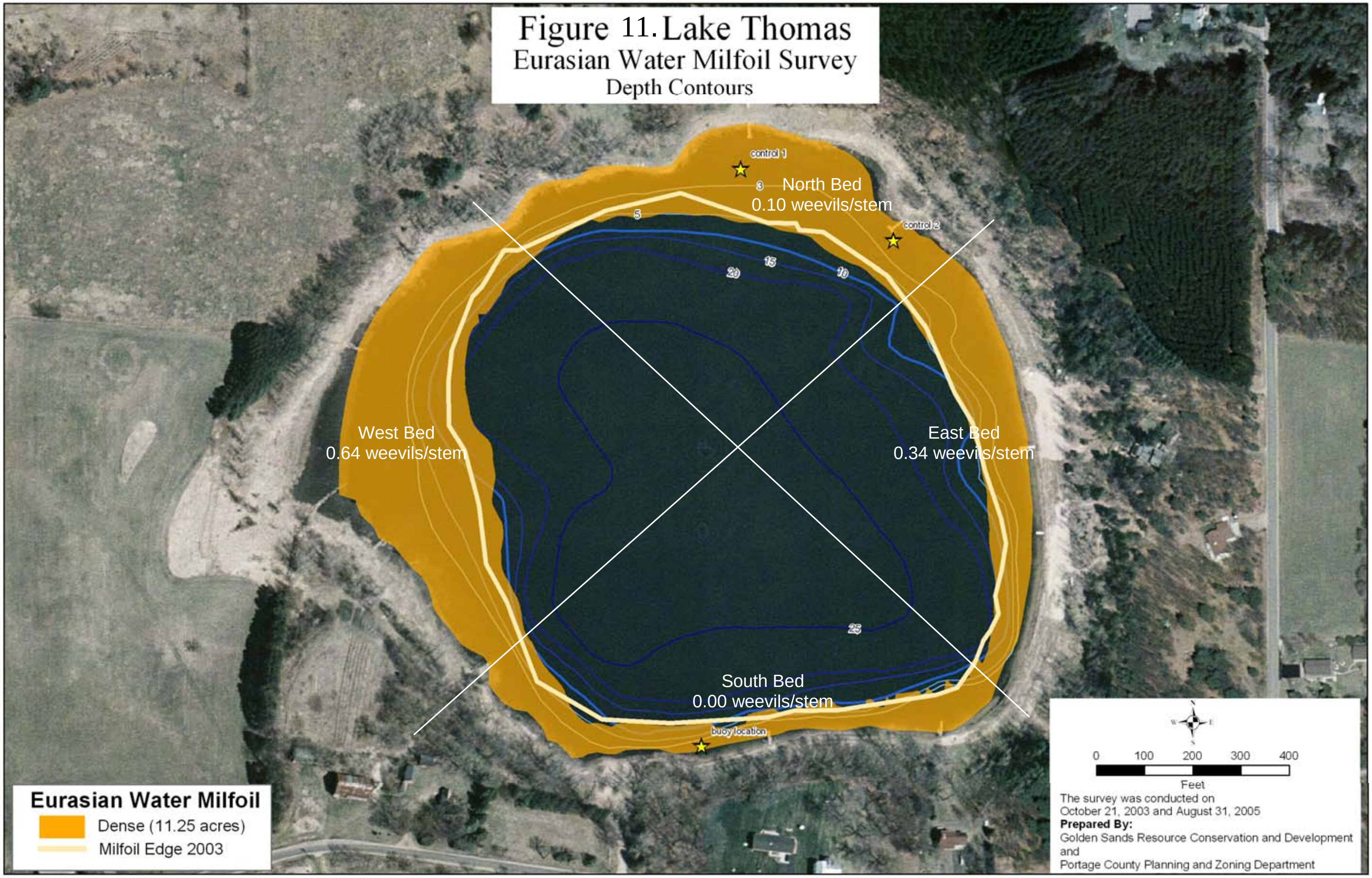
In 2003, field mapping found the EWM growth to be mostly limited to a depth or 10 or 12 feet or less. The total surface area of the infestation is approximately 10.0 acres. (See Figure 10.) The recommended management plan included: 1) Biological control or mechanical harvesting to create fish lanes, 2) Annual monitoring, 3) Establishment of a trained volunteer watercraft inspection team.

In 2004, weevil population density surveys were performed to determine the existing natural milfoil weevil population. (See Figure 10.) Average milfoil weevil density 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) The recommended management plan included: 1) Biological control, 2) Optional mechanical harvesting of fish lanes, 3) Establishment of a trained volunteer watercraft inspection team. The Town of Stockton opted to pursue the recommendation of biological control.

In 2005, the EWM Studies worked in partnership with Dr. Ronald Crunkilton and the University of Wisconsin-Stevens Point (UWSP) to boost biological control of EWM on Lake Thomas. (Full Methods and Discussion of this method are found in *Portage County Eurasian Water Milfoil Assessment Summary: 2003-2005.*) The project produced a net increase of 2,362 weevils to the lake. The project was intended to produce a much higher number of weevils, but despite the disappointingly low numbers, by the end of summer an absence of flowering was noted within 15-feet of the release site. This appears to indicate that the weevils stocked were having an impact on plant vigor. Figure 11 shows the EWM map and weevil survey results for 2005. The recommended management plan included: 1) Weevil stocking in 2006 using improved methodology, 2) Residents' support milfoil weevil hibernation habitat through shoreline maintenance practices, 3) Residents' control of individual dock areas through raking or localized chemical treatments. The Town of Stockton opted to pursue weevil stocking in 2006.



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.**



North, South, East and West Beds were surveyed for milfoil weevils (*E. lecontei*) on 08/08/05. Stem samples collected from sample beds were examined in laboratory on 08/19/05. Values on map represent average number of weevils per stem for each bed. Average weevil density overall for Thomas Lake was found to be **0.27 weevils per stem**. Buoy location on map indicates stocking site. Locations of two control sites are also indicated.

In 2006, the EWM Studies again worked in partnership with UWSP to boost biological control of EWM on Lake Thomas, using a refined methodology. (Full Methods and Discussion of this method are found in *Portage County Eurasian Water Milfoil Assessment Summary: 2003-2006.*) Multiple difficulties were encountered early in the season, resulting in a disappointingly low net increase of 1,683 weevils to the lake. (See Table 17.)

Table 17. Thomas Lake Weevil Production Results, 2006

	Thomas Lake **- Total -**	Thomas Lake **- June only -**	Thomas Lake **- July only -**	Thomas Lake **- August only -**
Total Tanks Filled	109			
Total Input	779 weevils			
Total Output	2462 weevils			
Net Increase	1683 weevils	28 weevils	682 weevils	1001 weevils
% Increase	316%			
Average Return Rate[1]	3.23	---*	3.63	3.03

* Not enough data points for statistics.
[1] Return Rate = number produced divided by number started with

Freeboard and temperature measurements in 2006 appear to indicate weevil impacts were having a greater effect on EWM in the south quadrant, where stocking took place in 2005 and 2006, than in other quadrants. (Note that freeboard surveys avoided the immediate stocking area.) (See Section II, Methods, for more detail.) (See Chart 4 & Chart 5.)

Chart 4. Average Freeboard Measurements – Thomas Lake

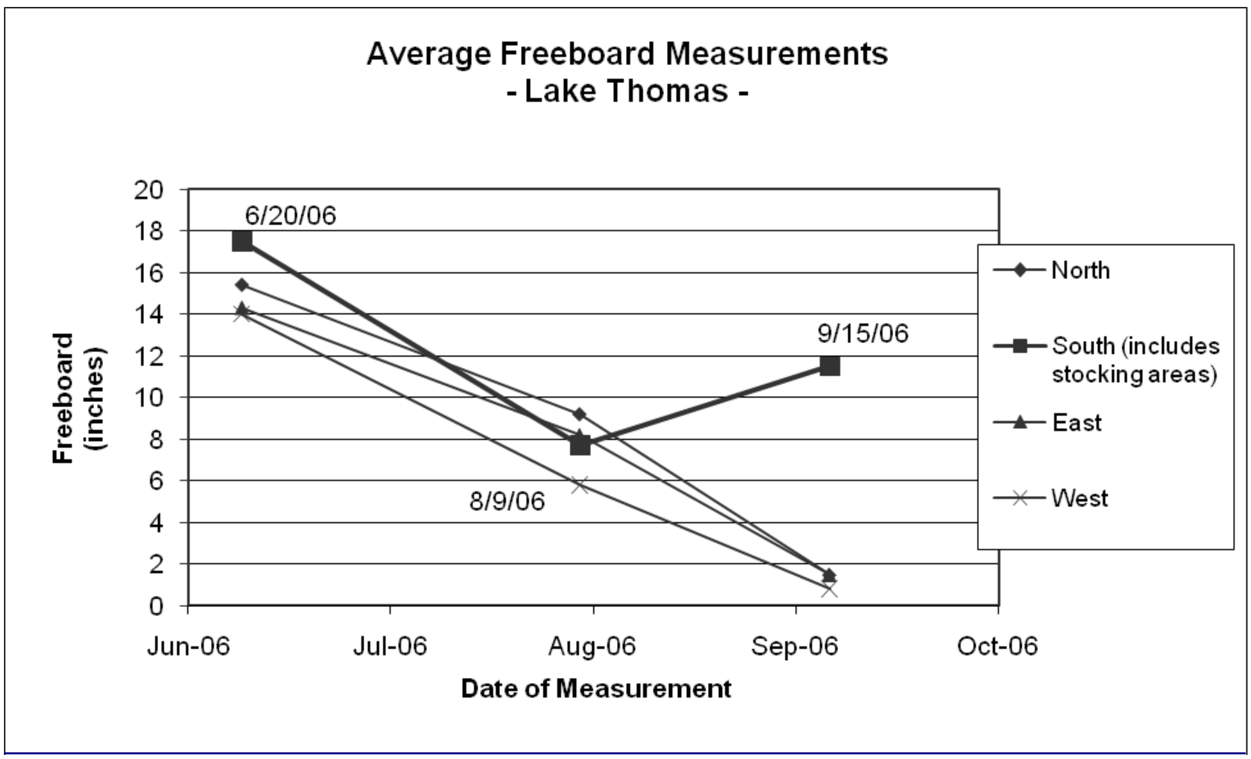


Chart 5. Average Temperature Measurements – Thomas Lake

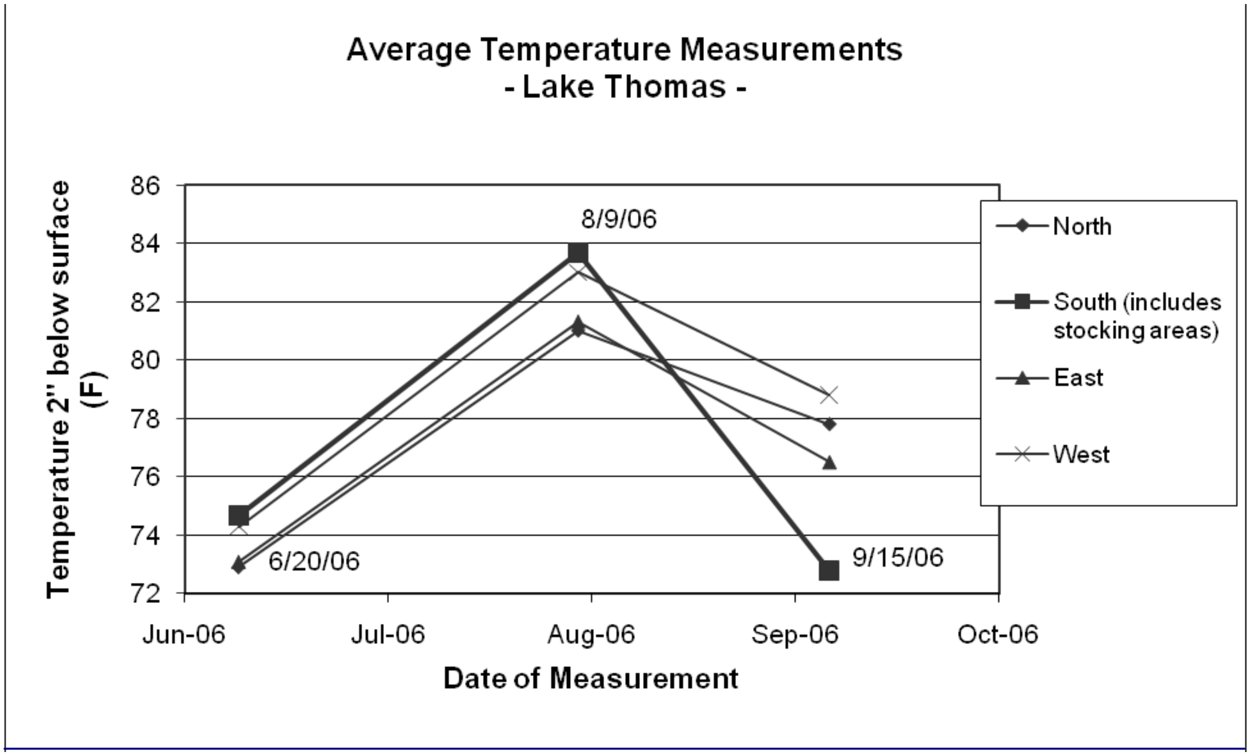


Figure 12 shows the EWM map and weevil survey results for 2006. The recommended management plan included: 1) Earlier and larger weevil stocking, 2) Shoreline protection and restoration to "fortify the lake's immune system" and support milfoil weevil hibernation habitat, 3) Residents' control of individual dock areas through raking or localized chemical treatments. The Town of Stockton opted to pursue weevil stocking in 2006.

d. Action in 2007:

In order to continue tracking the long-term results of the two weevil stocking operations, weevil population density surveys were conducted again in 2007. Table 19 shows those results.

Table 19. Weevil Population Density Survey – Results Summary, 2007

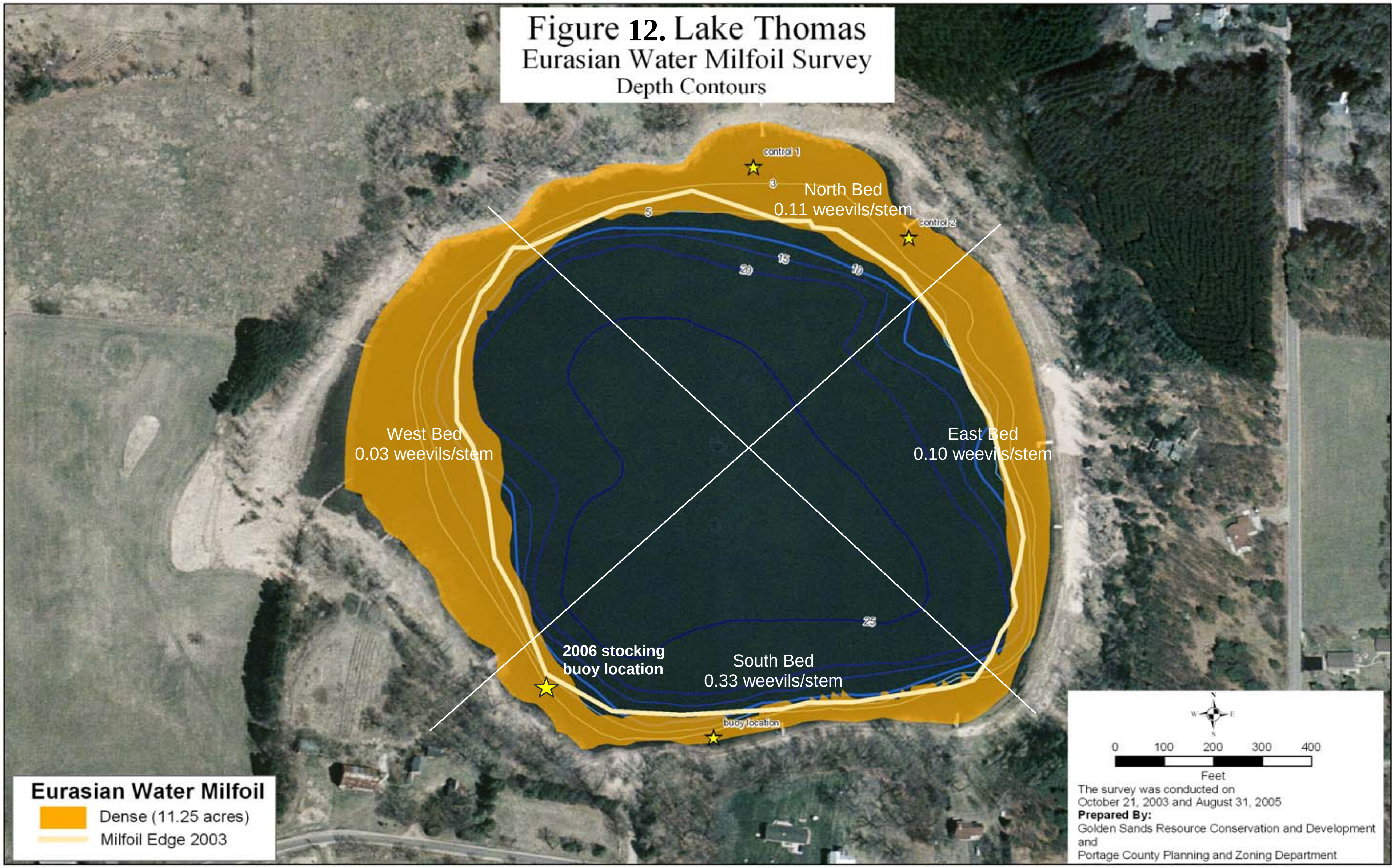
Lab Date	Bed No.*	Depth Range (ft)	Tot # Stem Samples	Ave # Broken Tips	Ave # of Apical Tips	% Stems w/ Weevil Damage	Ave # Eggs per Stem	Ave # Larvae per Stem	Ave # Pupae per Stem	Ave # Adults per Stem	Ave Weevils per Stem (All Life Stages)
9/17-9/20	**South**	0-12	31	0.85	2.33	45%	0.00	0.10	0.03	0.03	**0.16**
9/5-9/7	**North**	0-12	31	1.00	2.71	55%	0.03	0.06	0.10	0.16	**0.35**
8/3-9/21	**West**	0-12	30	0.83	3.00	53%	0.00	0.30	0.00	0.07	**0.37**
9/7-9/21	**East**	0-12	32	0.67	3.10	69%	0.00	0.41	0.03	0.03	**0.47**
Whole Lake Results		0-12	124	0.83	2.80	55%	0.01	0.22	0.04	0.07	**0.34**

*Refer to Figure 13 for EWM sample bed locations.

Survey Notes:

Sample Date: 8/1/2007

Land Cover @ Shore: North Bed = Residential (some mowed to shore)
South Bed = Residential / boat landing (natural residential / gravel boat landing)



North, South, East and West Beds were surveyed for milfoil weevils (*E. lecontei*) on 08/10/06. Stem samples collected from sample beds were examined in laboratory on 08/24-09/01/06. Values on map* represent average number of weevils per stem for each bed. Average weevil density overall for Thomas Lake was found to be **0.14 weevils per stem**. See map for 2006 stocking location. Locations of two control sites are also indicated.

(*Due to problems with water clarity and time limitations, no survey was completed in 2006 and, therefore, no new map was created. Field observations noted that EWM appears to be spread to the same extent, therefore, the 2005 map created was felt to be sufficiently representative. Additionally, field observations noted that the EWM did not appear to be reaching the surface, or "topping out", as badly as the last few years. The cause for this is undetermined.)

	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 isopropyl alcohol.
Other Notes:	Another hot, sunny drought year.

A comparison of surveys over the last four years shows that overall weevil densities have remained low but concentrations from bed to bed have varied. The 2006 surveys showed low averages overall, but higher levels in the South Bed, which is where the stocking operations took place in 2005 and 2006. The 2007 surveys showed the highest lake average measured to date. Whole Lake Averages for percentage of weevil-damaged stems appears to have increased over the last four years, as well. (See Table 20.)

Table 20. Weevil Population Density Survey – Results Comparison, 2004-2007

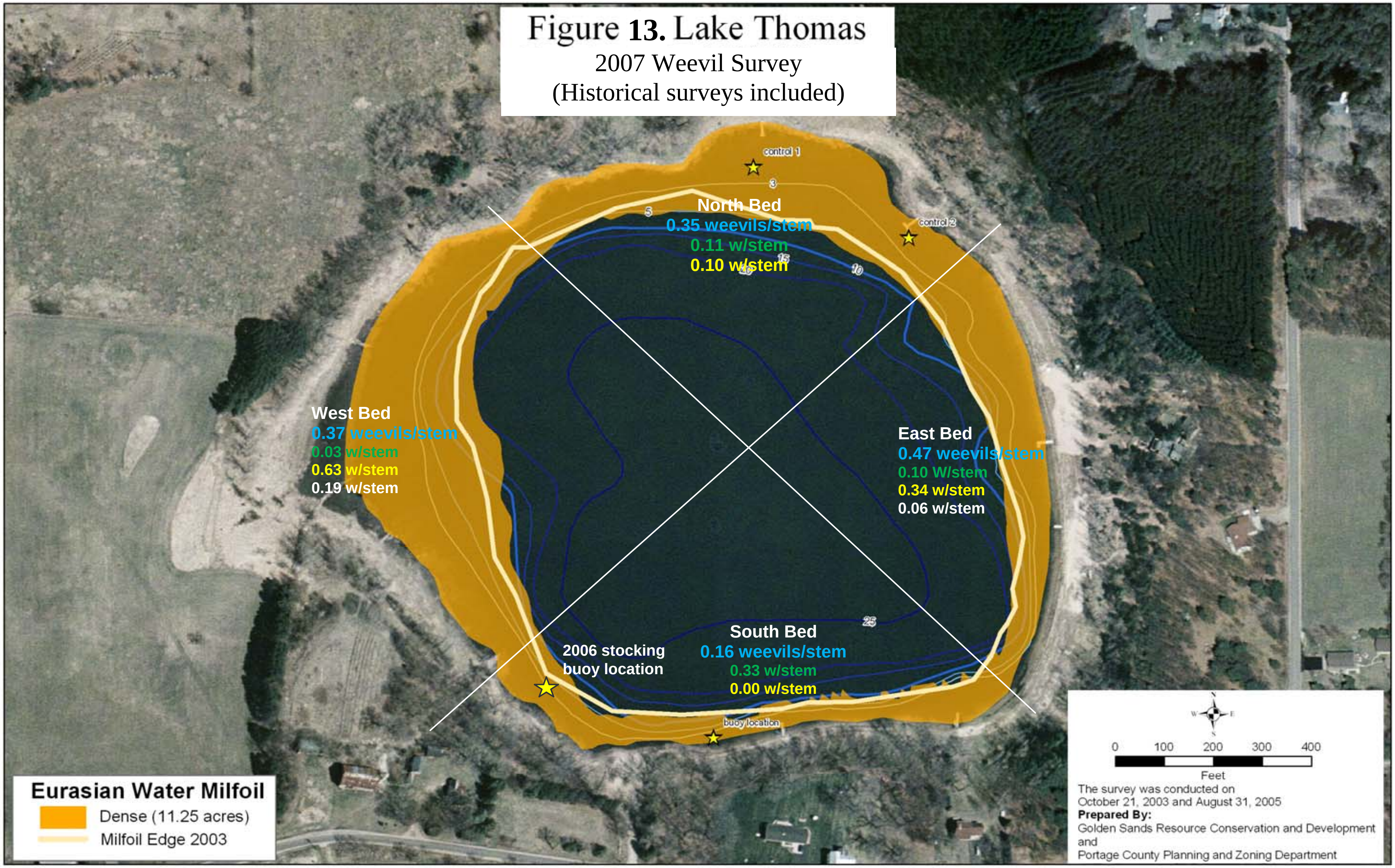
Bed No.	Survey Year	Survey Date	# stem samples in survey	% of stems algae covered	% of stems w/ weevil damage	Ave eggs per stem	Ave larvae per stem	Ave pupae per stem	Ave adult per stem	Ave weevils per stem (all stages)
West	2004	8/5/04	36	31%	25%	0.00	0.17	0.00	0.03	0.19
East	2004	8/5/04	31	48%	10%	0.03	0.00	0.03	0.00	0.06
Whole Lake Averages:					**16%**					**0.13**
North	2005	8/19/05	30	40%	17%	0.00	0.00	0.00	0.10	0.10
South	2005	8/19/05	30	40%	14%	0.00	0.00	0.00	0.00	0.00
East	2005	8/19/05	30	20%	40%	0.17	0.14	0.00	0.04	0.34
West	2005	8/19/05	30	7%	27%	0.47	0.14	0.00	0.04	0.63
Whole Lake Average:					**25%**					**0.27**
North	2006	8/10/06	**27**	90%	85%	0.00	0.04	0.04	0.04	0.11
South	2006	8/10/06	**30**	89%	58%	0.10	0.23	0.00	0.00	0.33
East	2006	8/10/06	**30**	93%	10%	0.03	0.03	0.03	0.00	0.10
West	2006	8/10/06	**32**	94%	44%	0.00	0.00	0.03	0.00	0.03
Whole Lake Average:					**34%**					**0.14**
North	2007	8/1/07	**31**	94%	55%	0.03	0.06	0.10	0.16	0.35
South	2007	8/1/07	**31**	100%	45%	0.00	0.10	0.03	0.03	0.16
East	2007	8/1/07	**32**	94%	69%	0.00	0.41	0.03	0.03	0.47
West	2007	8/1/07	**30**	92%	53%	0.00	0.30	0.00	0.07	0.37
Whole Lake Average:					**55%**					**0.34**

1. Summary and Recommendations, 2007

   During the 2004 and 2005 surveys, EWM was commonly seen reaching the water surface in water 10-feet deep or more. During 2006 and 2007 surveys, EWM was rarely seen reaching the water surface in water over several feet deep, and some rebounding of native vegetation has been observed.

   Freeboard and surface temperature measurements in 2006 indicate that weevil impacts are higher in the south quadrant where stocking took place in 2005 and 2006. Weevil populations were higher in the south quadrant than in any other quadrant in 2006 (post-stocking), and the overall lake average in 2007 was the highest recorded so far at Lake Thomas.

   Lake Thomas is a good candidate for successful biological control, and additional weevil stocking and monitoring is recommended.



North, South, East, and West Beds were surveyed for milfoil weevils (*E. lecontei*) on 08/01/07. Stem samples collected from sample beds were examined in laboratory on 08/03-09/21/07. Values on map* represent average number of weevils per stem for each bed. Average weevil density overall for Thomas Lake was found to be **0.34 weevils per stem**. See map for 2005 and 2006 stocking locations. (*Weevil population survey results shown on 2005 EWM map.)

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VIII. 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

1. **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.

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

3. **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.

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

Appendix B. Contacts and Resources

- For copies or questions about this report:
  Amy Thorstenson, Regional AIS Specialist, 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*

- To report an new EWM infestation:
  Scott Provost, Water Resource Specialist, WDNR, 473 Griffith Avenue, Wisconsin Rapids, WI 54494, (715) 421-7881.

- Clean Boats, Clean Waters Program:
  Erin Henegar, Volunteer Monitoring Coordinator, UW-Extension Lakes Program, UW-Stevens Point-CNR, 1900 Franklin Street, Stevens Point, WI 54481-3897, (715) 346-4978.

- Shoreline Restoration Assistance:
  Portage County Land Conservation Division of the Planning & Zoning Department, Portage County Annex, 1462 Strongs Avenue, Stevens Point, WI 54481, (715) 346-1334. Technical assistance available. Some locations may be eligible for cost-sharing assistance.

- Contacts and Resources On-Line:
  "The Wisconsin Lakes Partnership Contacts" 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 be viewed at http://www.WDNR.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. The program also offers a "Rapid Response" grant option, with no deadline, to expediently implement control on newly-discovered infestations. For more information, contact the WDNR Lake Coordinator or Environmental Grant Specialist for the West Central Region at (715) 839-3700.

Appendix C. Photographic Differentiation: Euhrychiopsis lectonei vs. Phytobius

Euhrychiopsis lecontei: Note raised bumps at the base of the 7th stripe.

Phytobius sp.: Note raised bumps at the base of the 5th stripe.

Euhrychiopsis lecontei: Note fine hairs on legs.

Phytobius sp.: No hairs on legs.

Appendix D. Terms and Definitions

Littoral Zone = Extends from the shoreline of a lake and continues to depth where sufficient light for plant growth reaches the sediments and lake bottom.

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.

Return Rate = (As in weevil production) The number produced divided by the number started with. Average Return Rate is the average of all return rates throughout production.

Freeboard = The distance from the water surface to the top of the plant (EWM) stems.

Appendix E. 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…

1. **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**. This will provide milfoil weevils with good winter habitat for hibernation and help keep the lake healthy, too! If tidy lawns are your preference, you can still provide winter habitat for weevils by refraining from mowing or raking from Labor Day to Memorial Day. If you don't live on the water, you can still advocate for lake health by encouraging 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!

2. **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.

3. **Discourage Eurasian Water Milfoil**. The presence of native aquatic plants, like bull rushes or lily pads, not only provides wildlife habitat and reduces shoreline erosion, but also provides competition against new invasive species. Think of native vegetation as "the lake's immune system"!

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

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