

**BASS LAKE, STARKE COUNTY
AQUATIC VEGETATION MANAGEMENT
PLAN UPDATE – 2009**



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Executive Summary

The Bass Lake Conservancy District (BLCD) contracted V3 Companies (V3) to complete aquatic vegetation sampling required for the Aquatic Vegetation Management Plan 2009 Update. The update was funded in part by the Lake and River Enhancement (LARE) fund as part of the Indiana Department of Natural Resources (IDNR) Division of Fish and Wildlife. Funding for the LARE program is provided by an annual fee charged to boat owners. Additional funding for this study was provided by the BLCD. The purpose of an aquatic vegetation management plan is to identify areas with aquatic weed problems, describe management objectives, and determine the funding needs and the sources necessary to control nuisance and exotic vegetation. This update will serve as a prerequisite to continue future LARE program funding to control exotic species within Bass Lake.

Bass Lake is a 1,440 acre natural lake located five miles southeast of Knox, Indiana in Starke County. Bass Lake has many recreational uses such as boating, swimming and fishing. Aquatic vegetation is the foundation of healthy sustainable lake ecosystems and requires management to maintain balance within the vegetative community. Invasive exotic species, such as Eurasian watermilfoil (*Myriophyllum spicatum*) and curlyleaf pondweed (*Potamogeton crispus*), displace native species, degrade biodiversity, impede recreational uses, and reduce real estate and aesthetic values. In order to promote diverse and stable native vegetative communities within Bass Lake, it is vital to prevent the spread and establishment of exotic species.

Bass Lake's primary exotic species is Eurasian watermilfoil as it spreads rapidly through fragmentation and quickly forms dense beds. Herbicide treatment is an effective management tool to control invasive species. Eurasian watermilfoil has been treated at Bass Lake since 1985 with the first whole lake fluridone treatment conducted in 2007. Weed Patrol performed a whole lake fluridone treatment of Sonar AS on May 14, 2007, with a concentration of 8 parts per billion (ppb) to control Eurasian watermilfoil. A second treatment of 3 ppb, or bump, was applied on June 15, 2007, to maintain a fluridone concentration of 6 ppb within the lake. In 2008, 11 acres of Eurasian watermilfoil were treated in the southern basin and 0.5 acres were treated in the north eastern shoreline with granular 2,4-D (Navigate®). Clarke Aquatics treated 17 acres of Eurasian watermilfoil on June 26, 2009 with granular 2,4-D (Navigate®). V3 conducted the post treatment Tier II survey on July 21, 2009 and collected Eurasian watermilfoil at nine sampling locations and observed Eurasian watermilfoil within the vicinity of one sampling location. Clarke Aquatics treated an additional 31.5 acres of Eurasian watermilfoil with granular 2,4-D on August 20, 2009 in response to V3's post treatment survey results.

The 2009 post treatment sampling effort had vegetation at 31 of the 100 sampling locations and collected 6 native species and one exotic species (Eurasian watermilfoil). Vegetation was present up to a maximum depth of 8 feet and the secchi disk reading was 3.5 feet. Chara (*Chara sp.*) was present at the highest percentage of sampling locations (23%), followed by Eurasian watermilfoil (9%) and Illinois pondweed (*Potamogeton illinoensis*) (9%). Bass Lake's depth zone ranging from 0 to 5 feet was the most diverse and was represented by 7 species. Bass Lake's native plant diversity has improved but density still remains low. The number of native species collected in 2009 remains consistent with the 2008 sampling results. The plant community at Bass Lake prior to the 2007 fluridone treatment was dominated by Eurasian watermilfoil and native species were present in low number and abundance.



The primary goal of the BLCD is to reduce the impact of Eurasian watermilfoil while preserving and enhancing native plant communities. It is the recommendation of this plan that the BLCD pursue funding to conduct follow-up treatments and monitoring in 2010. Detection and early treatment of Eurasian watermilfoil and curlyleaf pondweed locations will be the primary focus of future management. Curlyleaf pondweed was not collected during the 2009 post treatment survey but it is included in the budget as it has an early growth cycle which may not coincide with the timing of the post treatment survey.

The following actions are proposed to identify and treat areas with exotic or nuisance species as well as document the overall health, diversity, and distribution of desirable native vegetation within Bass Lake. The proposed management schedule and budget for 2010 is summarized below. The Bass Lake, Starke County Aquatic Plant Management Plan Update 2007 (V3) anticipated 10 acres of Eurasian watermilfoil would require treatment in 2010. The budget for 2010 increased from this plan based on increased presence of Eurasian watermilfoil and need for treatment. The 2010 treatment acreage was estimated based on the 2009 herbicide treatment of 48.5 acres and Eurasian watermilfoil's frequency of occurrence during post treatment sampling (9%). 2010 and 2011 budget projections are estimated at maximum values and will fluctuate depending on treatment needs. Herbicide treatment of Eurasian watermilfoil will require the application of either Renovate or 2,4-D and will not be used in conjunction with one another. Renovate and 2,4-D are equally effective, however, Renovate is typically more expensive.

2010

Target Species Distribution Map and Proposed Treatment Area Map	\$1,000
Early Spring Systemic Herbicide Application of granular 2,4-D (Navigate ®) (assumed 50 acres)	\$22,500
Early Spring Systemic Herbicide Application of liquid Renovate (assumed 50 acres)	\$25,000
Application of Aquathol K 1 ppm for curlyleaf pondweed (assumed 5 acres)	\$1,500
Late season post treatment aquatic vegetation survey (Tier II) and plan update	\$7,500

*Herbicide applications will depend on the results of the plant surveys.

The overall goals established by the IDNR for all lakes applying for LARE funding are: 1) develop or maintain a stable, diverse aquatic plant community that supports a good balance of predator and prey fish and wildlife species, good water quality, and is resistant to minor habitat disturbances and invasive species; 2) direct efforts to preventing and/or controlling the negative impacts of aquatic invasive species; and 3) provide reasonable public recreational access while minimizing the negative impacts on plant and wildlife resources.



Acknowledgements

We would like to acknowledge Angela Sturdevant and Greg Biberdorf with IDNR's LARE program for providing funding and assistance in the completion of this study. We would like to recognize Chip Long and Jeremy Price, IDNR District Fisheries Biologist, for consultation and information. We would like to acknowledge the Bass Lake Conservancy District as the local sponsor that provided assistance and guidance including Joseph Carey and Cinni Carey. We would like to recognize Tony Cunningham and Leslie Cunningham for their mapping, recommendations, and consultation. Finally, we would like to acknowledge V3 staff involved in the research, sampling, and document preparation including: Scott Brejcha, Phil Rezin, and Jessica Dunn.



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Introduction and Background

The Bass Lake Conservancy District (BLCD) received a grant as part of the Indiana Department of Natural Resources (IDNR), Division of Fish and Wildlife Lake and River Enhancement (LARE) program. The grant covered herbicide treatment of exotic species, aquatic vegetation mapping, Tier II inventorying, and development of an aquatic vegetation management plan update – 2009. V3 was contracted by the BLCD to complete aquatic vegetation sampling in order to create the Bass Lake Aquatic Vegetation Management Plan Update – 2009. This update will serve as a tool to track changes in the vegetative community, update action plans and budget, and continue eligibility in the LARE program. The focus of aquatic vegetation management will be the control of exotic species as they disrupt lake ecosystems and provide poor habitat for aquatic organisms. Topics discussed in this update include a review of Bass Lake's treatment history, the 2009 sampling results, comparison of quantitative sampling between 2004 and 2009, summary of the public meeting, and updates to the budget and action plans.

Bass Lake is a 1,440-acre natural lake in Starke County, Indiana and is located five miles southeast of Knox. An aquatic vegetation survey was conducted on July 21, 2009 to evaluate the aquatic vegetative community and provide the data necessary to make scientifically based recommendations for future aquatic vegetation management. The primary nuisance exotic species within Bass Lake are Eurasian watermilfoil (*Myriophyllum spicatum*) and Curlyleaf pondweed (*Potamogeton crispus*). Eurasian watermilfoil has the potential to reach nuisance levels without proactive management such as herbicide treatment. Aquatic vegetation management at Bass Lake must have an integrated approach and include stakeholders' concerns and views for successful implementation. This plan provides management recommendations which integrate scientific data with public concerns to successfully reduce nuisance levels of exotic invasive species within Bass Lake.

The overall goal of the LARE program is to ensure the continued viability of public-access lakes and streams by utilizing a watershed approach to reduce non-point source sediment and nutrient pollution of Indiana's and adjacent states' surface waters to a level that meets or surpasses state water quality standards. To accomplish this goal, the LARE program provides technical and financial assistance to qualified projects. These include: a) studies, management plans, sediment removal, and design and construction activities involving specific lakes and streams; b) land treatment practices or management plans for designated watersheds; and c) management plans and control of exotic plants and animals in targeted lakes. Funding for the LARE program is provided by an annual fee charged to boat owners.



Waterbody Characteristics

Bass Lake is Indiana's third largest natural lake and has a surface area of 1,440 acres. Bass Lake is a shallow lake with a maximum depth of 30 feet and an average depth of 3.5 feet. Bass Lake's many shallow areas and sandbars are frequently used for recreational activities such as swimming, fishing, boating and water volleyball. Bass Lake accounts for 47% of the total watershed acreage which is 3,060 acres. The remaining land uses within the Bass Lake Watershed are forested (21%), residential (15%) or agricultural (9.5%) purposes (J.F. New, 2002). Bass Lake's shoreline demographics are 90% developed and 10% wetland. Bass Lake is classified as Mesotrophic, which means the lake is moderately productive. Mesotrophic lakes are characterized by moderate nutrient levels (total phosphorus 10-30 $\mu\text{g/L}$), water is moderately turbid, less dissolved oxygen in the hypolimnion, and are able to support healthy populations of algae (Jones and Medrano 2006).

Bass Lake has many recreational uses and is used heavily for swimming, boating and fishing. Bass Lake has a state owned public access located on the southwest shore and is one of the busiest access sites in northwest Indiana. Bass Lake offers many recreational activities around the lake such as picnic areas, handicapped-accessible camping, and the Bass Lake State Beach and beach house (Figure 1). There were no additional fisheries studies conducted since the 2007 Bass Lake Aquatic Vegetation Management Plan Update. A fisheries and creel study is tentative for 2010.



Figure 1: Aquatic vegetation sampling near Bass Lake State Park.

Problem Statement

A diverse aquatic vegetative community is fundamental in promoting a balanced lake ecosystem. Bass Lake is a shallow sandy lake which provides many areas for exotic species to establish when native vegetative communities are sparse. Vegetative studies conducted since 2004 have identified Eurasian watermilfoil as the primary exotic species within Bass Lake. Eurasian watermilfoil is an aggressive, extremely adaptable invasive species that can destroy a diverse native aquatic vegetative community within a short period of time. Eurasian watermilfoil spreads rapidly through fragmentation and forms dense weed beds. Monotypic stands of Eurasian watermilfoil provide poor habitat for waterfowl, fish and other wildlife and make recreational access difficult. Dense Eurasian watermilfoil mats alter water quality by raising pH, decreasing oxygen under the mats, and increasing temperature. Significant rates of plant sloughing and leaf turnover, as well as the decomposition of high biomass at the end of the growing season, increase the internal loading of phosphorus and nitrogen to the water column. Relative to other submersed plants, Eurasian watermilfoil requires low light, has a high photosynthetic rate, and can grow over a broad temperature range (Madsen et al., 1991). Eurasian watermilfoil was collected at 9% of sampling locations and was observed near 1 sampling location during the July 2009 Tier II survey.

Curlyleaf pondweed is another submersed exotic species recorded in Bass Lake and has the ability to create nuisance conditions in the early recreational season. Curlyleaf pondweed was collected in 2007 and 2008 at 5% of sampling locations within Bass Lake. Curlyleaf pondweed was not collected during the 2009 post treatment survey. Curlyleaf pondweed typically reaches peak biomass in the late spring or early summer months, forms turions, then declines and remains in a dormant state during the warmer months (Nichols and Shaw 1986). As water temperatures cool during the late summer or fall months, the turions germinate, grow through the winter months and reach peak biomass in the spring before most other submersed macrophytes begin their growth cycle. Once established, the plants form colonies from rhizomes. Dense colonies of curlyleaf pondweed restrict access to docks and sport fishing areas during spring and early summer months. Curlyleaf pondweed usually declines during the summer months and does not directly compete with many of the native submersed species. Curlyleaf pondweed had a low site frequency in 2007 and 2008 and requires early surveying to assess current abundance.



Aquatic Vegetation Management Goals and Objectives

The following management goals have been established by the IDNR for all lakes applying for LARE funding. Any management practices implemented at Bass Lake must facilitate the achievement of these three goals.

1. Develop or maintain a stable, diverse aquatic plant community that supports a good balance of predator and prey fish and wildlife species, good water quality, and is resistant to minor habitat disturbances and invasive species;
2. Direct efforts to preventing and/or controlling the negative impacts of aquatic invasive species; and
3. Provide reasonable public recreational access while minimizing the negative impacts on plant and wildlife resources.

The Bass Lake Conservancy District identified specific objectives and actions to achieve these three goals in the Bass Lake, Starke County Aquatic Plant Management Plan Update – 2007 (V3, 2008) as well as the 2008 update. The timeframe for achievement of the following goals has extended by two years since the 2007 update due to increased frequency of Eurasian watermilfoil. Herbicide treatments that are more aggressive than spot treatment applications may be necessary in the future to achieve Bass Lake's management objectives. However, the actions of each goal are unchanged and continue to be a focus for future outreach and management.

Specific Objectives

1. **Reduce Exotic Invasive Species.** Reduce Eurasian watermilfoil to less than 5% of littoral zone surface area and curlyleaf pondweed to 10% of littoral zone surface area in the early recreational season by 2011. Surface area of the littoral zone will be measured by site frequency.
2. **Maintain and Enhance Diversity of the Native Aquatic Plant Community.** Reduce seeding of Eurasian watermilfoil and curlyleaf pondweed through educational outreach and herbicide control which will allow native plants to establish. The substrate of Bass Lake is primarily of sand with areas of muck and clay substrate. The type of substrate affects a lake's ability to support aquatic vegetation. Lakes that have mucky, organic, nutrient-rich substrates have an increased potential for plant growth compared to lakes with gravelly, rocky substrates. While sandy substrates typically support healthy aquatic plant communities, this is only true when sufficient organic material is mixed in with the sand to provide a nutritional base for the rooted plants. (Giolitto and Olyphant, 2002)
3. **Control Vegetation around Public Access Sites.** Control vegetation through educational outreach and herbicide treatment. Public access sites are a vector for the spread of exotic species, therefore signage is most effective in these areas. Currently there is signage at the Bass Lake public access site informing lake users of the exotic species advisory from Sea Grant and DNR Regulations. Continued maintenance of these advisory signs will encourage lake users to be cognizant of exotic species negative impact on lake ecosystems. Herbicide treatments focused in the area 100 feet from the public access site may be effective in reducing the spread of Eurasian watermilfoil throughout Bass Lake.



Specific actions are proposed as follows to facilitate achievement of the overall LARE management goals for Bass Lake.

1. **Tier II Plant Surveys.** Tier II surveys should be conducted to monitor the distribution and abundance of Eurasian watermilfoil and curlyleaf pondweed. Any changes in the native plant community of Bass Lake will be documented during the plant surveys. Survey results will be used to determine future management strategies and evaluate the success of past management efforts.
2. **Chemical/Follow-up Treatment of Eurasian Watermilfoil and Curlyleaf Pondweed.** Eurasian watermilfoil and curlyleaf pondweed should be closely monitored during 2010, and more concentrated dosages or aggressive treatments should be applied if necessary. Treatment applications for curlyleaf pondweed should be undertaken in spring or very early summer to maximize treatment results and benefits.
3. **Promote and Maintain the Diversity of Native Aquatic Plant Species.** Promote and maintain a healthy diversity of native aquatic plant species, while recognizing that some vegetation management may be necessary to provide reasonable public access for recreation.



Bass Lake Treatment History

Bass Lake has used herbicide treatments as an effective management tool for the control of nuisance and exotic species. Herbicide treatments have been applied since 1985, with granular 2,4-D (Navigate ®) being the primary herbicide utilized (Table 1). An average of approximately 100 acres of Eurasian watermilfoil required treatment each year.

Table 1. Bass Lake Treatment History 1985 – 2009.

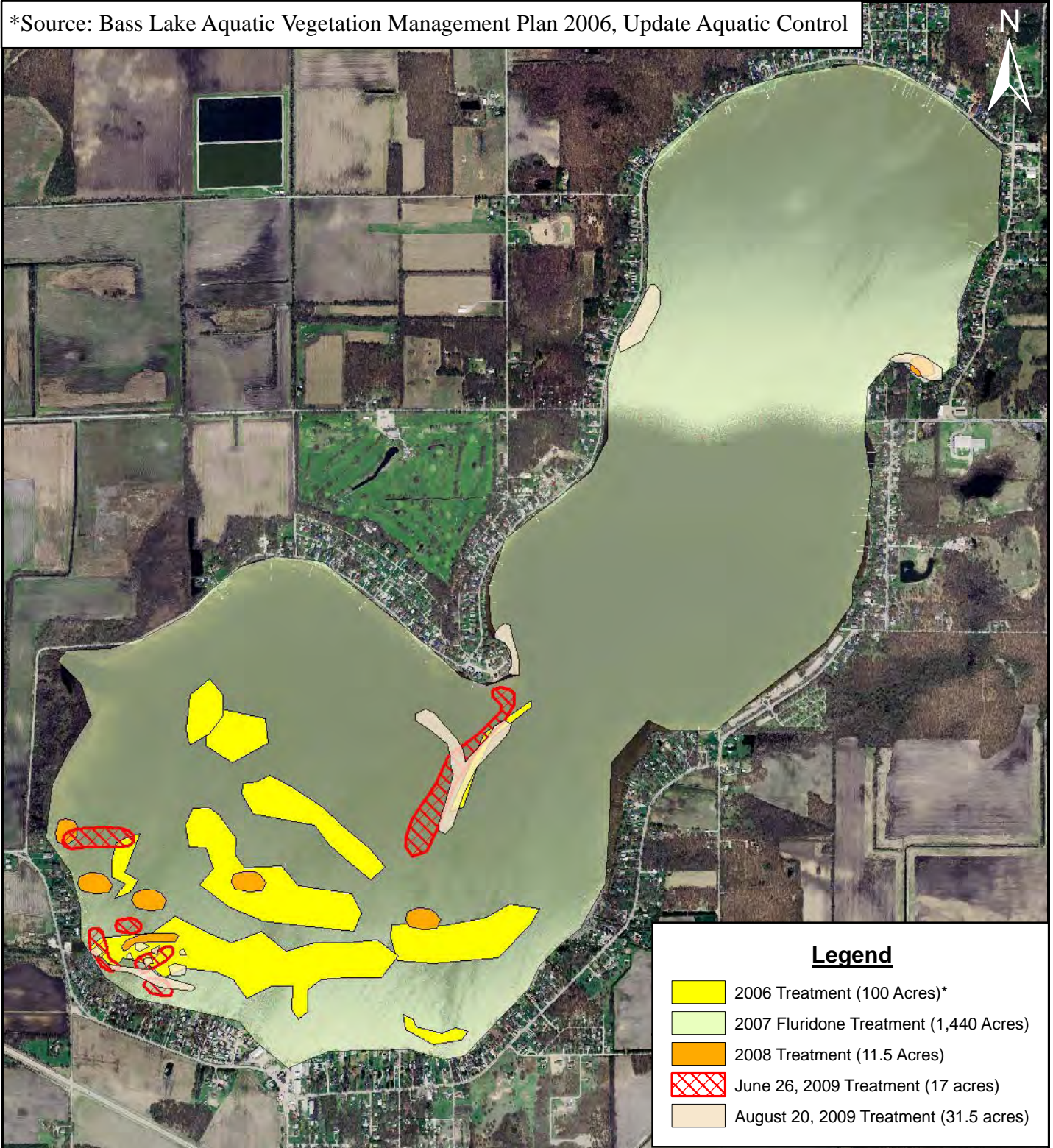
Year	Method of Control
1985	Bass Lake Property Owners Association treated Eurasian watermilfoil area in the south basin with 2,4-D herbicide
1990	Aquatic Control treated 120 acres of Eurasian watermilfoil in the south basin with 2,4-D herbicide
1991	Aquatic Control treated 100 acres of Eurasian watermilfoil in the south basin with 2,4-D herbicide
1993	Aquatic Control treated 105 acres of Eurasian watermilfoil in the south basin with 2,4-D herbicide
1998	Aquatic Control treated 140 acres of Eurasian watermilfoil with 2,4-D herbicide
2000	Aquatic Control treated 150 acres of Eurasian watermilfoil with 2,4-D herbicide
2003	Aquatic Control treated 150 acres of Eurasian watermilfoil with 2,4-D herbicide
2004	Aquatic Control treated 115 acres of Eurasian watermilfoil in the south basin with triclopyr herbicide
2005	Aquatic Control treated 136 acres of Eurasian watermilfoil with Renovate
2006	Aquatic Control treated 100 acres of Eurasian watermilfoil with Renovate
2007	Weed Patrol performed a whole lake fluridone treatment at 8 parts per billion
2008	Weed Patrol treated 11.5 acres of Eurasian watermilfoil with granular 2,4-D
2009	Clarke Aquatics treated 48.5 acres of Eurasian watermilfoil with granular 2,4-D

**Years omitted from the table indicate years that herbicide was not applied.*

Aquatic Control treated 150 acres of Eurasian watermilfoil in 2000 and 2003, primarily in the southern basin with scattered populations throughout the northern basin. Eurasian watermilfoil was present only in the southern basin in 2004 and expanded into the northern basin in 2005. The 2005 Renovate treatment was successful as Eurasian watermilfoil was treated exclusively in the southern basin in 2006 (Figure 2). The IDNR permitted a whole lake fluridone treatment for 2007 as a proactive response to the 100 acres of Eurasian watermilfoil that required treatment in 2006, (Figure 2). Weed Patrol performed a whole lake fluridone treatment of Sonar AS on May 14, 2007, with a concentration of 8 parts per billion (ppb) which was the first fluridone treatment conducted on Bass Lake. A second bump treatment of 3 ppb was applied on June 15, 2007, to maintain a concentration of 6 ppb within the lake. Eurasian watermilfoil was concentrated in the southern basin in 2008. In 2008, 11 acres of Eurasian watermilfoil were treated in the southern basin and 0.5 acres were treated in the north eastern shoreline (Figure 2). Clarke Aquatics treated a total of 48.5 acres of Eurasian watermilfoil in late June and August of 2009 primarily in the southern basin of Bass Lake (Figure 2).



*Source: Bass Lake Aquatic Vegetation Management Plan 2006, Update Aquatic Control



Legend

- 2006 Treatment (100 Acres)*
- 2007 Fluridone Treatment (1,440 Acres)
- 2008 Treatment (11.5 Acres)
- June 26, 2009 Treatment (17 acres)
- August 20, 2009 Treatment (31.5 acres)



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TITLE:	Eurasian Watermilfoil 2006 - 2009 Treatment Areas
BASE LAYER:	Indiana Spatial Data 2006 Orthophotography
CLIENT:	Bass Lake Conservancy District 3620 South CR 210 Knox, IN 46534

PROJECT AND SITE LOCATION:		
Bass Lake Aquatic Plant Management Plan Update - 2009		
PROJECT No.	FIGURE:	SHEET:
07122.02	2	OF: 1 1
QUADRANGLE:	DATE:	SCALE:
N/A	6/1/06	1" = 1,750'

2009 Vegetation Control

Clarke Aquatics treated 17 acres of Eurasian watermilfoil on June 26, 2009 with granular 2,4-D (Navigate®). The application rate for Navigate® is 100 lbs/acre and a total of 1,700 lbs of Navigate was used during the June milfoil treatment. Clarke Aquatics performed reconnaissance surveys on June 21st, July 23rd, and August 13th of 2009 to locate areas of Eurasian watermilfoil and monitor Eurasian watermilfoil's response to treatment. V3 conducted the post treatment Tier II survey on July 21, 2009 and collected Eurasian watermilfoil at nine sampling locations and observed Eurasian watermilfoil within the vicinity of one sampling location. Clarke Aquatics treated an additional 31.5 acres with granular 2,4-D on August 20, 2009 in response to the collection of Eurasian watermilfoil during V3's sampling effort (Figure 2). Clarke Aquatics used a GPS unit with V3 sampling stations coordinates to locate milfoil areas and used a total of 3,150 lbs of 2,4-D (Navigate®) to treat remaining milfoil.



Sampling Results 2009

On July 21, 2009 a Tier II post treatment survey was conducted on Bass Lake. The Tier II Aquatic Vegetation Survey Protocol, designated by the IDNR, serves as a standardized method to document the distribution and abundance of aquatic vegetation within selected areas at a state-wide scale. The information collected can be used to compare present trends in distribution and abundance of the aquatic vegetative community to past conditions. A table outlining the scientific and common names of species collected or observed in Bass Lake is listed below (Table 2.) Seven species were collected and one additional native species was observed.

Table 2. Species collected or observed in Bass Lake during 2009 Tier II sampling.

Scientific Name	Common Name
<i>Chara sp.</i>	Chara
<i>Myriophyllum spicatum</i>	Eurasian watermilfoil
<i>Najas flexilis</i>	Slender naiad
<i>Najas marina</i> *	Spiny naiad
<i>Potamogeton illinoensis</i>	Illinois pondweed
<i>Potamogeton nodosus</i>	American pondweed
<i>Stuckenia pectinata</i>	Sago pondweed
<i>Vallisneria americana</i>	Eel grass

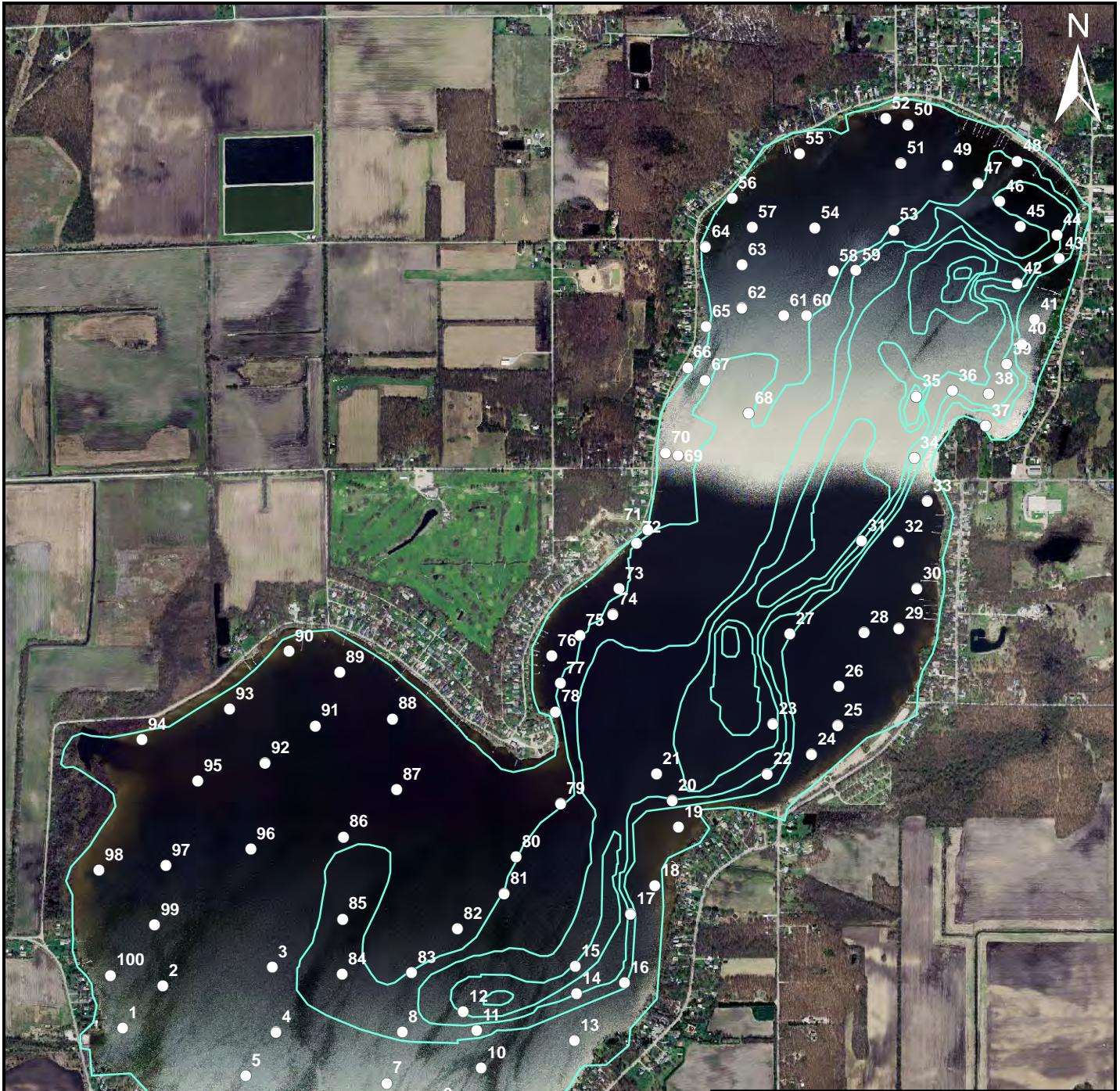
*Species observed during sampling effort

Sampling Methodology for Summer Tier II Survey

Plant communities typically reach peak diversity between July 15 and August 31. One sampling effort occurred during this time which included a representative sample of the species within Bass Lake. According to the IDNR protocol, the number and depth of sampling locations is based on trophic status and acreage. Bass Lake is a 1,440-acre Mesotrophic lake that would require 10 sampling locations within the 15-20 foot depth zone but the maximum sampling depth for Bass Lake is 15 feet. The Tier II sampling was conducted at the eutrophic status so sampling locations were apportioned to the required depth zones. One hundred sites were sampled within the littoral zone (57 sites 0-5ft, 33 sites 5-10ft, and 10 sites 10-15ft) (Figure 3). Sampling locations were located with a GPS unit and remained consistent throughout vegetation surveys from 2007 to 2009. Using the same survey locations documents trends in vegetative community and treatment response. According to the sampling protocol, V3 threw ten random rake throws at depths greater than 15 feet, but did not retrieve any vegetation. Extending sampling locations into deeper contours of Bass Lake is not necessary as no plants were retrieved.

At each station, a sampling rake is used for collecting vegetation samples. Once a species is identified, vegetation abundance is scored as a 1 (1-19%), 3 (20-100%), or 5 (+100%) based on the vegetation density on the rake. Species are recorded if they are observed within the vicinity of the sampling station but not collected. After completion of the sampling effort, a secchi disk reading and water quality measurements are taken. Tier II data sheets and the sampling locations' latitude and longitude can be found in Appendix I.





Legend

- Tier II Sampling Locations
- Bathymetric Contours (5' depth contours)



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TITLE: Tier II Sampling Locations (2007 - 2009)	
BASE LAYER: Indiana Spatial Data 2006 Orthophotography	
CLIENT: Bass Lake Conservancy District 3620 South CR 210 Knoxville, IN 46534	

PROJECT AND SITE LOCATION: Bass Lake Aquatic Plant Management Plan Update - 2009		
PROJECT No. 07122.02	FIGURE: 3	SHEET: 1 OF: 1
QUADRANGLE: N/A	DATE: 7/20/09	SCALE: 1" = 1,750'

Results of Summer Tier II Survey- July 21, 2009

Seven species were collected up to a maximum depth of 8 feet. Spiny naiad was observed within the vicinity of one location. Emergent species observed during the sampling effort included soft rush (*Juncus effuses*), spatterdock (*Nuphar advena*) and white water lily (*Nymphaea oderata*). Bass Lake's sampling results from depth ranges of 0 to 10 feet are provided below (Table 3a-3c). Results for the 10 to 15 foot depth range are not included as the maximum plant depth was 8 feet. The secchi disk reading was 3.5 feet.

Table 3a: Bass Lake Tier II survey results all depths (0 – 15 feet).

County: Starke		Total Sites: 100	Mean species/site: 0.51				
Date: 7/21/2009		Sites with plants: 31	SE Mean species/site: 0.09				
Secchi (ft): 3.5		Sites with native plants: 26	Mean native species/site: 0.42				
Maximum Plant Depth (ft): 8.0		Number of species: 7	SE Mean natives/site: 0.09				
Trophic Status: Mesotrophic		Number of native species: 6	Species diversity: 0.72				
		Maximum species/site: 5	Native species diversity: 0.63				
All Depths (0 to 15 ft)		Frequency of Occurrence	Rake score frequency per species				Plant Dominance
Species	Common Name		0	1	3	5	
<i>Chara sp.</i>	Chara	23.0	77.0	19.0	4.0	0.0	6.2
<i>Myriophyllum spicatum</i>	Eurasian watermilfoil	9.0	91.0	6.0	2.0	1.0	3.4
<i>Potamogeton illinoensis</i>	Illinois pondweed	9.0	91.0	6.0	3.0	0.0	3.0
<i>Najas flexilis</i>	Slender naiad	6.0	94.0	4.0	2.0	0.0	2.0
<i>Stuckenia pectinata</i>	Sago pondweed	2.0	98.0	1.0	1.0	0.0	0.8
<i>Potamogeton nodosus</i>	American pondweed	1.0	99.0	1.0	0.0	0.0	0.2
<i>Vallisneria americana</i>	Eel grass	1.0	99.0	1.0	0.0	0.0	0.2

Table 3b: Bass Lake Tier II survey results 0-5 foot depth zone.

County: Starke		Total Sites: 57	Mean species/site: 0.77				
Date: 7/21/2009		Sites with plants: 26	SE Mean species/site: 0.15				
Secchi (ft): 3.5		Sites with native plants: 24	Mean native species/site: 0.67				
Maximum Plant Depth (ft): 8.0		Number of species: 7	SE Mean natives/site: 0.13				
Trophic Status: Mesotrophic		Number of native species: 6	Species diversity: 0.70				
		Maximum species/site: 5	Native diversity: 0.63				
Depth: 0 to 5 ft		Frequency of Occurrence	Rake score frequency per species				Plant Dominance
Species	Common Name		0	1	3	5	
<i>Chara sp.</i>	Chara	36.8	63.2	31.6	5.3	0.0	9.5
<i>Potamogeton illinoensis</i>	Illinois pondweed	14.0	86.0	8.8	5.3	0.0	4.9
<i>Myriophyllum spicatum</i>	Eurasian watermilfoil	10.5	89.5	8.8	1.8	0.0	2.8
<i>Najas flexilis</i>	Slender naiad	8.8	91.2	5.3	3.5	0.0	3.2
<i>Stuckenia pectinata</i>	Sago pondweed	3.5	96.5	1.8	1.8	0.0	1.4
<i>Potamogeton nodosus</i>	American pondweed	1.8	98.2	1.8	0.0	0.0	0.4
<i>Vallisneria americana</i>	Eel grass	1.8	98.2	1.8	0.0	0.0	0.4



Table 3c: Bass Lake Tier II survey results 5-10 foot depth zone.

County: Starke		Total Sites: 33	Mean species/site: 0.21				
Date: 7/21/2009		Sites with plants: 5	SE Mean species/site: 0.09				
Secchi (ft): 3.5		Sites with native plants: 2	Mean native species/site: 0.12				
Maximum Plant Depth (ft): 8.0		Number of species: 4	SE Mean natives/site: 0.08				
Trophic Status: Mesotrophic		Number of native species: 3	Species diversity: 0.69				
		Maximum species/site: 2	Native diversity: 0.63				
Depth: 5 to 10 ft		Frequency of Occurrence	Rake score frequency per species				Plant Dominance
Species	Common Name		0	1	3	5	
<i>Myriophyllum spicatum</i>	Eurasian watermilfoil	9.1	90.9	3.0	3.0	3.0	5.5
<i>Chara sp.</i>	Chara	6.1	93.9	3.0	3.0	0.0	2.4
<i>Najas flexilis</i>	Slender naiad	3.0	97.0	3.0	0.0	0.0	0.6
<i>Potamogeton illinoensis</i>	Illinois pondweed	3.0	97.0	3.0	0.0	0.0	0.6



Aquatic Vegetation Sampling Results Discussion

The goal of this plan is to reduce nuisance exotic species and promote the establishment and expansion of beneficial native species throughout Bass Lake. A diverse native community is vital in preventing the establishment of exotic invasive species such as Eurasian watermilfoil.

The results of the Tier II survey identified chara at the highest percentage of sample sites (23%). Eurasian watermilfoil and Illinois pondweed followed in frequency of occurrence (9%). Location and density of chara is illustrated in Figure 4. Eurasian watermilfoil was present at depths ranging from 2 to 8 feet. Eurasian watermilfoil was collected with a rake score of 1 (1-19% rake teeth filled) at 6 sampling locations, a rake score of 3 (20-100% rake teeth filled) at 2 sampling locations, and a rake score of 5 (+100% rake teeth filled) at one location. Distribution and abundance of Eurasian watermilfoil within Bass Lake is illustrated in Figure 5. The maximum number of species collected at a sampling location was 5 and the average number of species collected was 0.5.

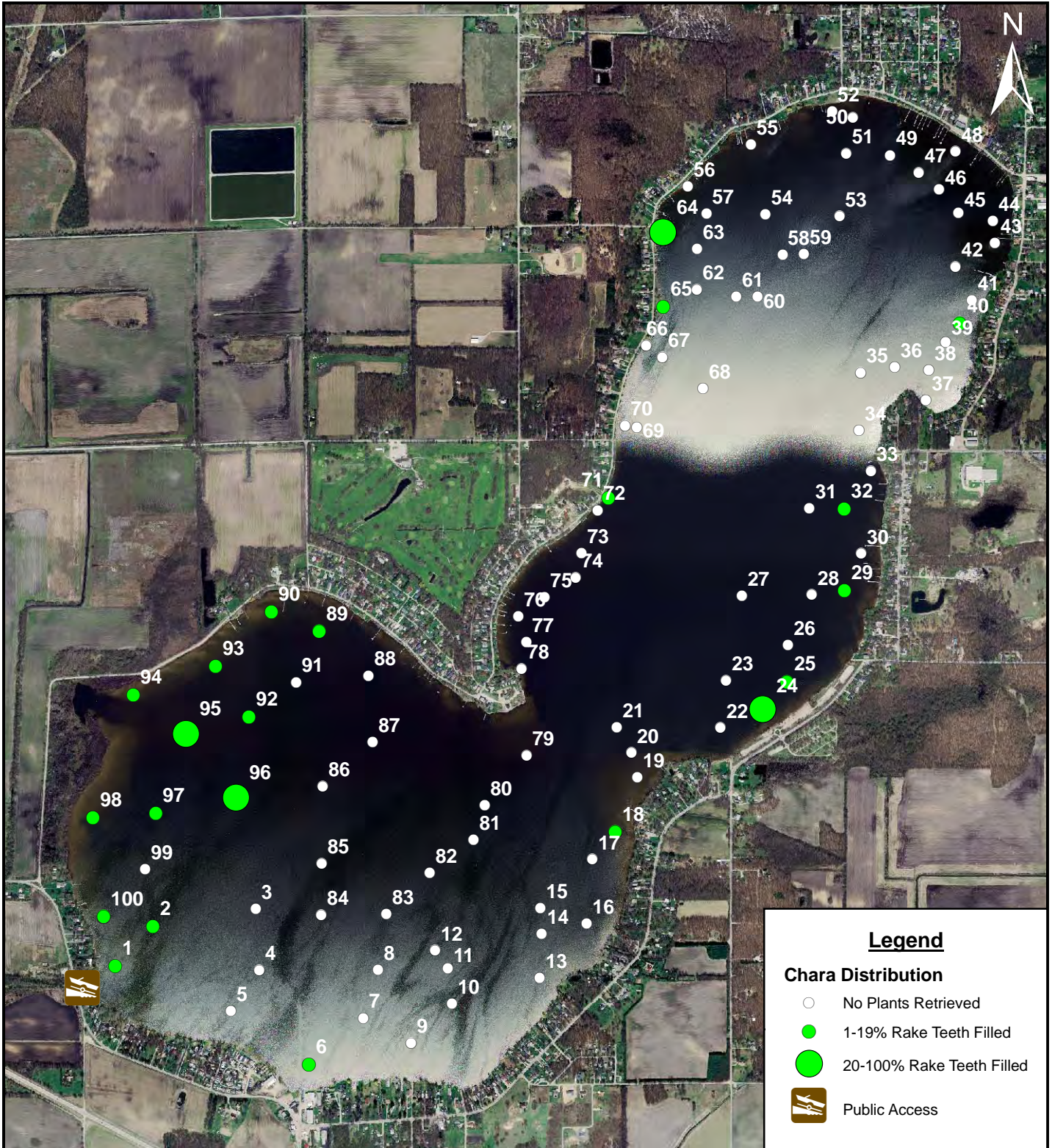
The 0 to 5 foot depth zone was the most diverse depth zone with a total of 7 species collected. The 0 to 5 foot depth zone had vegetation at 26 of the 57 sampling locations. The maximum number of species collected was 5 with an average of 0.77 species per site. The most dominant species within this depth zone was chara and occurred at 36.8% of sampling locations (Figure 4). Illinois pondweed was the second most frequently occurring species (14%) followed by Eurasian watermilfoil (10.5%). Other native species collected within this depth zone include slender naiad, sago pondweed, American pondweed, and eel grass.

Four species were collected within the 5 to 10 foot depth zone. Vegetation was present at 5 of the 33 sampling locations within this depth zone. The maximum number of species collected at a sampling location was 2 species and the average number of species collected at a sampling location was 0.21. Eurasian watermilfoil was the most dominant (5.5) and had a frequency of occurrence of 9.1% within the 5 to 10 foot depth zone. Eurasian watermilfoil was collected with a rake score of 5 at 8 feet. Eurasian watermilfoil has a lower light requirement compared to native species and can thrive in barren lake bottoms. Native species collected within the 5 to 10 foot depth zone include chara, slender naiad, and Illinois pondweed.

Threatened and Endangered Species at Bass Lake


The Indiana Natural Heritage Data Center database provides information on the presence of rare species, threatened and endangered species, and high quality natural communities and areas. The database serves as a tool for setting management priorities in areas where these species are encountered. V3 encountered the state endangered Northeastern bladderwort (*Utricularia resupinata*) during the 2008 Tier II sampling on the western flat of Bass Lake. Northeastern bladderwort, or any other threatened or endangered species, was not encountered during the 2009 Tier II sampling. No voucher specimens were collected during the efforts of this project. There are no anticipated adverse impacts to any state or federally protected or endangered species as it relates to the use of the vegetation control herbicides recommended within this plan.





Legend

Chara Distribution

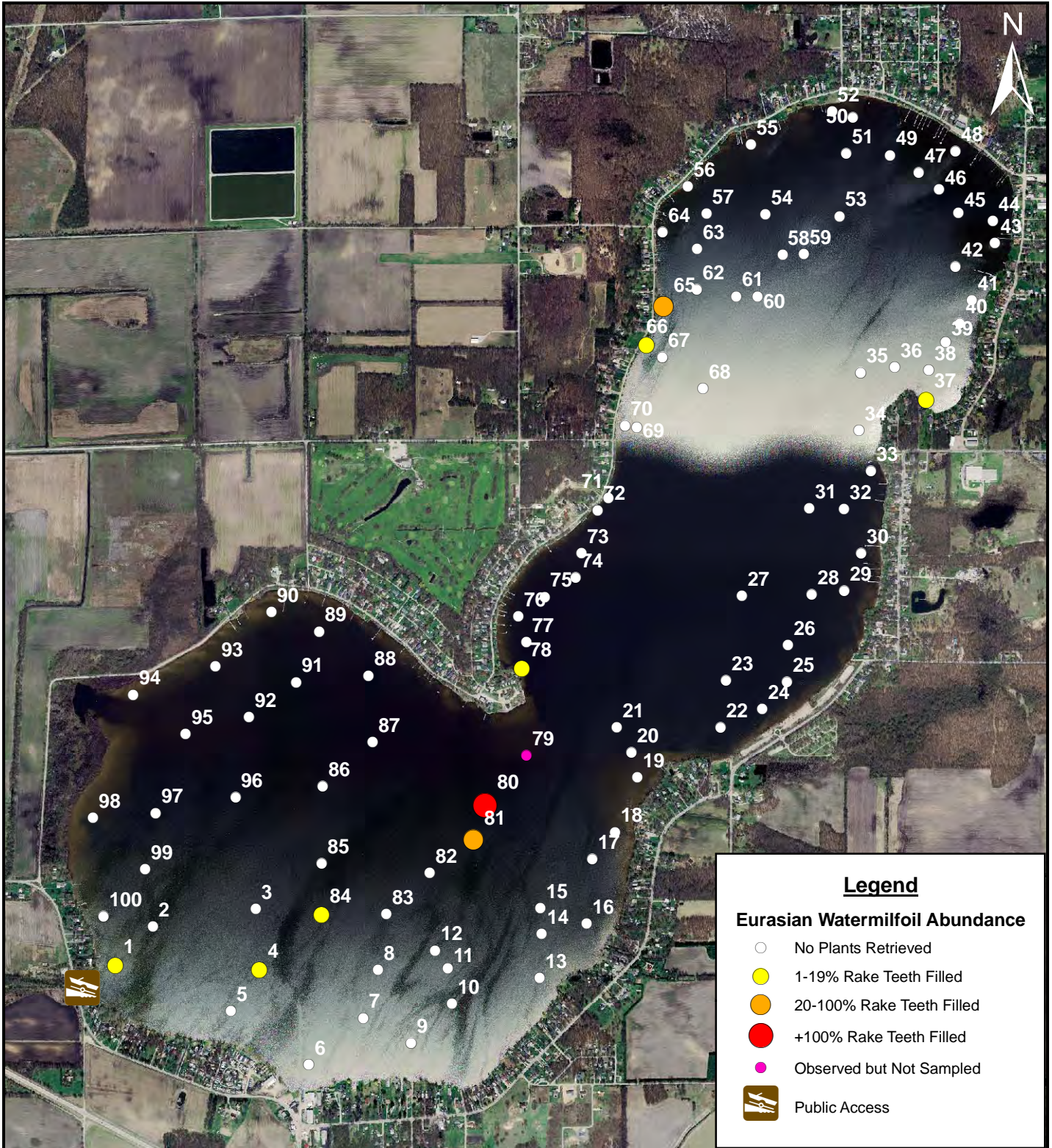
- No Plants Retrieved
- 1-19% Rake Teeth Filled
- 20-100% Rake Teeth Filled
-  Public Access



V3 Companies
 7325 Janes Avenue
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TITLE: Post treatment Distribution and Abundance of Chara
BASE LAYER: Indiana Spatial Data 2006 Orthophotography
CLIENT: Bass Lake Conservancy District 3620 South CR 210 Knox, IN 46534


PROJECT AND SITE LOCATION: Bass Lake Aquatic Plant Management Plan Update - 2009		
PROJECT No. 07122.02	FIGURE: 4	SHEET: 1 OF: 1
QUADRANGLE: N/A	DATE: 7/20/09	SCALE: 1" = 1,750'



Legend

Eurasian Watermilfoil Abundance

- No Plants Retrieved
- 1-19% Rake Teeth Filled
- 20-100% Rake Teeth Filled
- +100% Rake Teeth Filled
- Observed but Not Sampled

 Public Access



V3 Companies
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 www.v3co.com

TITLE: Post treatment Distribution and Abundance of Eurasian Watermilfoil	
BASE LAYER: Indiana Spatial Data 2006 Orthophotography	
CLIENT: Bass Lake Conservancy District 3620 South CR 210 Knoxville, IN 46534	

PROJECT AND SITE LOCATION: Bass Lake Aquatic Plant Management Plan Update - 2009			
PROJECT No. 07122.02	FIGURE: 5	SHEET: 1 OF: 1	
QUADRANGLE: N/A	DATE: 7/20/09	SCALE: 1" = 1,750'	

Comparison of Bass Lake's 2004 – 2009 Quantitative Sampling Data

Comparing the results of the species dominance and frequency of occurrence from 2004 to 2009 sampling efforts provides trends in vegetative community abundance and response to herbicide treatment. Chara remained the most frequently occurring species within Bass Lake but decreased in occurrence by 8% from 2008 to 2009. Chara had a dominance value of 11.6 within the 0-5 foot depth zone in 2008 and a dominance value of 9.5 in 2009.

The Tier II species frequency of occurrence results from 2004 to 2009 demonstrate an increase in species diversity and number of species within Bass Lake (Table 4). Chara was the most frequently occurring species throughout all studies with the exception of 2006 where Eurasian watermilfoil experienced a 50% increase in occurrence. Overall, the 2009 species results remain consistent with the 2008 results in the total number of species collected and chara dominance. A 7% increase in Eurasian watermilfoil frequency from 2008 to 2009 indicates a need for herbicide treatment in 2010.

Table 4: Tier II Survey Frequency of Occurrence Results 2004 – 2009*

Species	Frequency of Occurrence (%)				
	August 2004	August 2006	August 2007	July 2008	July 2009
Chara	37.3	25.0	13.0	31.0	23
Eurasian watermilfoil	19.0	38.0	9.0	2.0	9.0
Curlyleaf pondweed	0.6	-	5.0	5.0	-
Spiny naiad	-	2.0	-	2.0	-
Nitella sp.	-	2.0	-	-	-
Needle spikerush	-	1.0	-	-	-
Variable pondweed	-	9.0	-	-	-
Spatterdock	-	-	2.0	-	-
Small pondweed	-	-	-	1.0	-
Slender naiad	-	-	-	1.0	6.0
Northeastern bladderwort	-	-	-	1.0	-
Dwarf stonewort	-	-	-	1.0	-
Illinois pondweed	-	-	-	-	9.0
Sago pondweed	-	-	-	-	2.0
American pondweed	-	-	-	-	1.0
Eel Grass	-	-	-	-	1.0
Total Number of Species	3	6	4	8	7

*Species with greatest frequency value are shown in bold

*2005 omitted from the table as Tier II vegetation sampling did not occur.



Factors that may influence species frequencies include sampling dates, sampling techniques and number of sampling locations (Table 5). Native species diversity has increased since the fluridone treatment. The mean native species per site was greatest in 2009 (0.51). The increase in abundance of native pondweeds was evident throughout the 2009 Tier II survey. Efforts to maintain and enhance the native plant community at Bass Lake are strongly encouraged as the overall abundance of native species is low compared to other natural lakes within Indiana.

Date	Number of Sites	Sites with Plants	Sites with Native Plants	Maximum Species/Site	Mean Species/Site	SE Mean Species/Site	Mean Native Species/Site	SE Mean Native/Site	Species Diversity	Native Species Diversity
8/24/2004	161	70	-	-	0.60	-	0.27	-	0.53	0.09
8/1/2006	100	49	26	4	0.75	0.09	0.37	0.06	0.64	0.53
8/6/2007	100	25	14	4	0.33	0.06	0.13	0.03	0.62	0.0
7/30/2008	100	32	31	5	0.44	0.08	0.37	0.05	0.97	0.97
7/21/2009	100	31	26	5	0.51	0.09	0.42	0.09	0.72	0.63

A diverse native plant community provides fish habitat, stabilizes shoreline, and prevents the spread and/or establishment of invasive species. Herbicide treatments have been applied since 1985 to reduce the amount of Eurasian watermilfoil within Bass Lake. The Tier II studies conducted since 2004 show trends in Eurasian watermilfoils' frequency of occurrence in response to treatment (Figure 6).

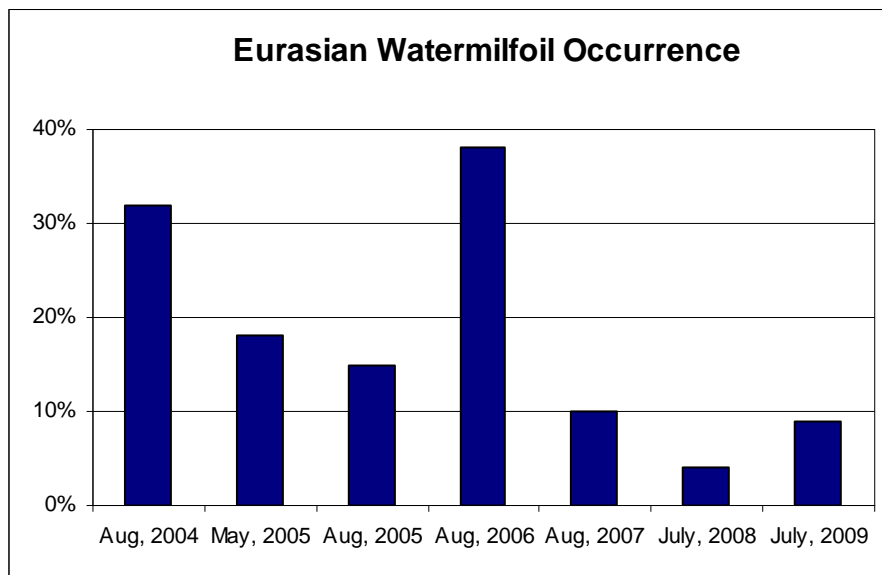


Figure 6: Bass Lake, Eurasian watermilfoil frequency of occurrence 2004 to 2009.

Eurasian watermilfoil was present at 9% of sampling locations during the 2007 sampling effort and decreased to 3% of sampling locations in 2008. Eurasian watermilfoil was collected at depths ranging from 3 to 4 feet in 2008. Eurasian watermilfoil was collected at depths ranging from 2 to 8 feet in 2009. The expansion of Eurasian watermilfoil into deeper zones of Bass Lake is especially problematic as depths greater than 8 feet lack vegetation and can quickly become colonized by Eurasian watermilfoil.



Materials become suspended in the water column during periods of heavy boat traffic which increases turbidity. Turbidity is a measure of the degree to which the water loses its transparency due to the presence of suspended particulates. The suspended material may be eroded soil, re-suspended lake sediments, or other organic material. As turbidity increases water clarity decreases. Bass Lake is characterized by turbid water and impacts the ability for native plants to establish. Exotic species such as Eurasian watermilfoil and curlyleaf pondweed have a competitive advantage in turbid water as they are able to grow in low light conditions. Secchi disk depth measurements are determined by the depth at which an 8-inch black and white disk is no longer visible in the water column. Secchi disk depth measurements indicate water clarity trends within a lake ecosystem. The 2009 secchi disk reading of 3.5 feet was approximately 1 foot greater than the average secchi disk reading (Figure 7).

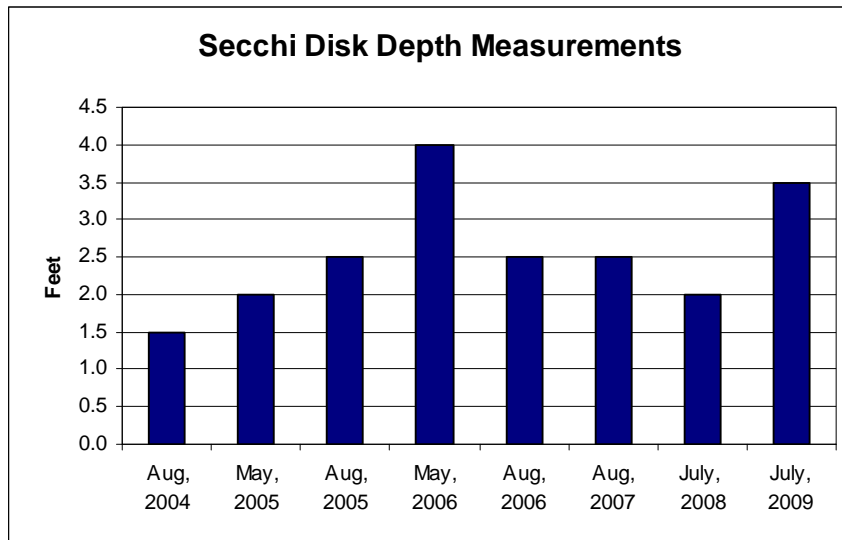


Figure 7: Bass Lake secchi disk readings 2004 to 2009.

Bass Lake has a low density and diversity of submersed aquatic vegetation. The 2009 sampling effort had vegetation present at 31% of sampling locations which is consistent with the 2008 sampling results (Figure 8).

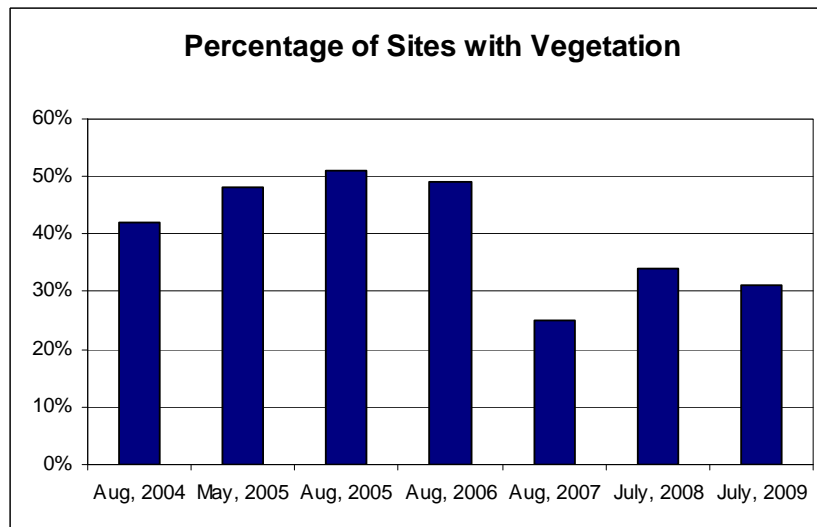


Figure 8: Bass Lake, comparison of sites with vegetation 2004 to 2009.



Diversity of aquatic vegetation at Bass Lake has increased but abundance remains low. Factors that influence the establishment of native vegetation include high turbidity, competition with exotic species, and/or wave action caused by boat traffic (Yousef et al., 1978). The amount of native species collected in 2009 remains consistent with the 2008 sampling results. Thirty-three out of thirty-four sampling locations had native vegetation (Figure 9). Native species collected during the 2008 sampling effort include chara, spiny naiad, slender naiad, small pondweed, and Northeastern bladderwort. Native species collected in 2009 include chara, Illinois pondweed, slender naiad, sago pondweed, American pondweed, and eel grass.

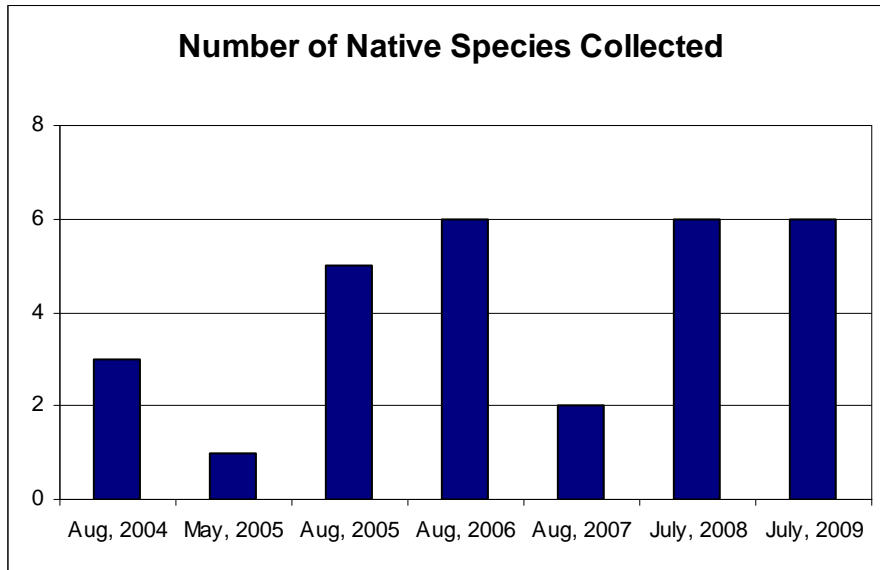


Figure 9: Bass Lake, comparison of native species collected 2004 to 2009.



Aquatic Vegetation Management Alternatives

At the present time, the health of Bass Lake's aquatic vegetative community is in recovery and requires continued management of exotic species to promote a healthy native plant community. Native plant diversity has improved but density still remains low. Eurasian watermilfoil had a frequency of occurrence of 9% in 2009 and requires a management strategy to keep from becoming the dominant species in Bass Lake. Additionally, watershed activities to improve the water quality and clarity of Bass Lake are important to encourage native plant diversity.

There are currently no proposed best management practices (BMP's) involving the establishment of native submergent or emergent aquatic plant communities within Bass Lake or along the shoreline. Different types of aquatic vegetation management alternatives are discussed below. One or more of these alternatives may be employed to meet the objectives of Bass Lake. Many management strategies have been used to control Eurasian watermilfoil in Indiana lakes. A management strategy should be chosen based on its selectivity to the target species, its long-term effectiveness, and its potential for detrimental side-effects (i.e., effects on non-target species). The foremost objective is to choose a management strategy that will effectively control the watermilfoil population with minimal negative effects on non-target plants or fish species. Aquatic vegetation management alternatives are described in detail in the Bass Lake, Starke County Aquatic Plant Management Plan Update – 2007 (V3, 2008). This report can be obtained through the LARE project report website at: <http://www.in.gov/dnr/fishwild/3303.htm>.



Public Involvement

The BLCD has been representing residents of Bass Lake for approximately 16 years. The Conservancy District has five directors which hold monthly meetings at the Bass Lake Community Center. Residents are encouraged to attend meetings and attendance typically increases as residents become dissatisfied with the abundance of aquatic vegetation, especially Eurasian watermilfoil. The property owners association publishes a spring newsletter to residents of Bass Lake and the Conservancy District uses it to provide information, such as aquatic vegetation management and exotic species.

A public meeting was held November 9, 2009, at the Bass Lake Community Center in Knox, Indiana. Ten individuals attended the meeting who collectively represented members of the Bass Lake Property Owners Association and Lake Association. The number of people in attendance was similar to past public meeting's attendance. V3 discussed current plant management activities, results of the Tier II survey, comparison of Tier II results from past studies, and future management recommendations. A lake use survey form was handed out after the meeting and eight individuals participated. Summary totals from the completed lake use survey are shown in Figure 10. One hundred percent (100%) of lake property owners have resided at Bass Lake for more than 10 years. Questions concerning lake use found that 100% of those surveyed used the lake for swimming and boating and 75% for fishing. None of the survey participants used the lake for drinking water. All participants were aware of the weed control project at Bass Lake and were in favor of continuing efforts to control exotic vegetation. All survey participants were also aware that LARE funds were limited to controlling invasive exotic species and that more work may need to be privately funded. Three of the participants identified nuisance quantities of aquatic plants at their shoreline. Aquatic vegetation interfered with five of the survey participants' enjoyment of the lake. Questions concerning problems on their lake found that six out of eight participants believed too many boats access the lake and that dredging was needed. Half of the participants felt use of jet skis and overuse by nonresidents were problems. Overall the group expressed satisfaction by the reduction of Eurasian watermilfoil through herbicide treatments from 2007 to 2009.

The 2009 lake use survey results are very similar to results of the 2008 lake use survey. The survey questions remained the same so trends could be identified. The top recreational uses at Bass Lake remain swimming, boating and fishing. The main issue concerning lake use was too many boats accessing Bass Lake which was consistent with 2007 and 2008 survey results. An increased desire for dredging was conveyed in 2009. One participant indicated a need for dredging in 2008 which increased to six participants in 2009 and was one of the main problems expressed by survey participants. The importance of native vegetation within lake ecosystems has been thoroughly discussed during public meetings held at the Bass Lake Community Center. Attendees at the public meeting requested educational materials concerning identification of native plants and their benefits to be utilized as educational outreach. Materials were provided to the Bass Lake Conservancy District as well as the Bass Lake Property Owners Association.



The reduction of Eurasian watermilfoil is most effective when lake users recognize their role in invasive and exotic species introduction. Eurasian watermilfoil fragments attached to trailers or boat motors is a major source of introduction into Indiana lakes. Signage at the public access site for Bass Lake encourages lake users to examine their boat for plant material prior to launching to reduce the introduction of exotic species such as Eurasian watermilfoil (Figure 11).

Figure 11: Signage at Bass Lake public access provides educational outreach to recreational users.





Action Plan

V3 recommends that a search and destroy survey for Eurasian watermilfoil be conducted in 2010 (Figure 12). The search and destroy area is approximately 880 acres and was created based on areas shallower than 15 feet. The search and destroy area covers where vegetation is growing as the maximum plant depth of the 2009 Tier II survey was 8 feet. A total of 50 acres are proposed for Eurasian watermilfoil treatment in 2010, using Renovate or 2,4-D (Navigate ®) as they both have been used successfully on Bass Lake. Determining whether to use Renovate or 2,4-D will depend on available funding. Liquid formulations work best at shallow depths and where the vegetation is dense, whereas granular formulations are more effective at greater depths and when vegetation is scattered. A total of 5 acres are proposed for curlyleaf pondweed treatment in 2010. Curlyleaf pondweed will be treated using Aquathol K at a rate of 1.0 ppm when water temperatures approach 50° Fahrenheit and are not higher than 57° Fahrenheit. Curlyleaf pondweed was not found during the 2009 post-treatment Tier II survey but was likely not retrieved due to the early growth cycle of this species. Priority treatment area location and acreage are described within the Application for Aquatic Vegetation Control Permit located in Appendix II. Areas surrounding the public access should be thoroughly inspected as a point of exotic species introduction.






The 2007 fluridone treatment was the first whole lake herbicide treatment at Bass Lake. Bass Lake's shallow depths and active public access site allow for Eurasian watermilfoil to establish and spread rapidly. Follow up surveys and treatments are necessary so that Eurasian watermilfoil does not reach pre-fluridone treatment levels (100+ acres). V3's post-treatment Tier II survey on July 21, 2009 had Eurasian watermilfoil at 9% of sampling locations at depths ranging from 2 to 8 feet. Clarke Aquatics treated an additional 31.5 acres of Eurasian watermilfoil in areas where Eurasian watermilfoil was collected during the post treatment survey. The additional late season treatment was a proactive measure to decrease abundance in 2010. The results of the 2009 Tier II survey anticipate that up to 4 years of Eurasian watermilfoil control may be achieved through the 2007 fluridone treatment with follow up spot treatments.

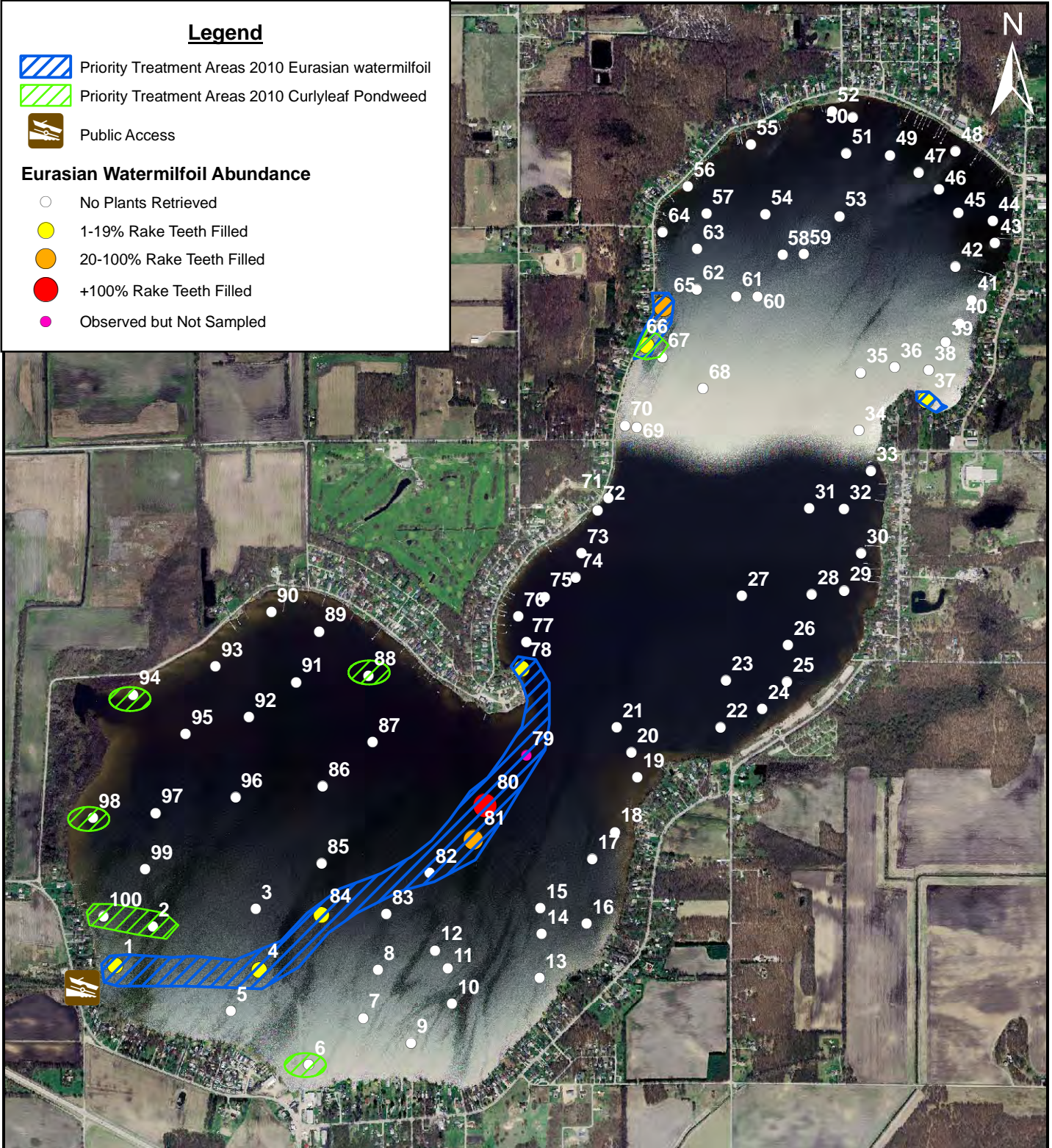


Legend

-  Priority Treatment Areas 2010 Eurasian watermilfoil
-  Priority Treatment Areas 2010 Curlyleaf Pondweed
-  Public Access

Eurasian Watermilfoil Abundance

-  No Plants Retrieved
-  1-19% Rake Teeth Filled
-  20-100% Rake Teeth Filled
-  +100% Rake Teeth Filled
-  Observed but Not Sampled



 <p>V3 Companies 7325 Janes Avenue Woodridge, IL 60517 630.724.9200 phone 630.724.9202 fax www.v3co.com</p>	<p>TITLE: Tier II Eurasian Watermilfoil Results with 2010 Priority Treatment Areas</p>		<p>PROJECT AND SITE LOCATION: Bass Lake Aquatic Plant Management Plan Update - 2009</p>		
	<p>BASE LAYER: Indiana Spatial Data 2006 Orthophotography</p>		<p>PROJECT No. 07122.02</p>	<p>FIGURE: 12</p>	<p>SHEET: 1 OF: 1</p>
	<p>CLIENT: Bass Lake Conservancy District 3620 South CR 210 Knox, IN 46534</p>		<p>QUADRANGLE: N/A</p>	<p>DATE: 7/20/09</p>	<p>SCALE: 1" = 1,750'</p>

The IDNR permitted a whole lake fluridone treatment for 2007 as a proactive response to the 100 acres of Eurasian watermilfoil that required treatment in 2006. An additional fluridone treatment is not recommended unless Eurasian watermilfoil reaches 10% of surface area of Bass Lake which indicates pre-fluridone treatment levels. A cost/benefit analysis of fluridone vs. spot treatments over a four year period is provided in Table 5. All cost estimates utilize 2010 pricing and can fluctuate with herbicide costs. The cost of fluridone is based on a whole-lake application and does not fluctuate based on Eurasian watermilfoil acreage. An herbicide application of 2,4-D or Renovate has a cost per acre and increases or decreases based on the amount of Eurasian watermilfoil present in Bass Lake. The fluridone treatment approach requires a whole-lake fluridone treatment the first year and spot treatments utilizing 2,4-D or Renovate in years following the fluridone treatment. Spot treatments are required to treat areas with Eurasian watermilfoil that established after the concentration of fluridone dissipated. The cost/benefit analysis was created based on 180 acres of Eurasian watermilfoil requiring treatment and past treatment trends in Eurasian watermilfoil abundance. The non-fluridone treatment approach estimates Eurasian watermilfoil acreage based on trends in Eurasian watermilfoil abundance in response to herbicide application.

Table 5: Cost/benefit analysis of fluridone vs. spot treatments at Bass Lake.

Year	Fluridone Treatment Approach		Non-Fluridone Treatment Approach	
	Eurasian watermilfoil Acreage following Fluridone	Fluridone Cost	Eurasian watermilfoil Acreage using 2,4-D or Renovate	2,4-D/Renovate Cost
2010	180	\$139,560	180	\$72,000
2011	11.5	\$4,317	150	\$60,000
2012	48.5	\$6,562	150	\$63,750
2013	75	\$31,875	165	\$70,125
TOTAL	240	\$182,314	645	\$265,875

The Eurasian watermilfoil acreage at which fluridone (Sonar AS) becomes the less expensive herbicide treatment is applicable if Bass Lake produces 338 acres of milfoil in two seasons. The amount of Eurasian watermilfoil requiring treatment decreases significantly in the years following a lake wide Sonar treatment. The fluridone treatment conducted in 2007 was effective in reducing Eurasian watermilfoil and is presented as an additional treatment approach for Bass Lake. Bass Lake is a shallow lake with a maximum depth of 30 feet and an average depth of 3.5 feet which makes the majority of the lake susceptible to exploitation by Eurasian watermilfoil, therefore aggressive treatments post-fluridone treatment are needed to increase long term effectiveness of Eurasian watermilfoil control.



As the action plan is implemented, aquatic plant surveys will help to monitor the effectiveness of the management strategy. The abundance and distribution of exotic species will be recorded using the current IDNR Tier II sampling protocol. After the spring 2010 Target Species Distribution Map is created, the distribution and abundance of Eurasian watermilfoil and curlyleaf pondweed will be identified and treatment maps will be prepared. The new data analysis results will be incorporated into the current lake management plan. This will provide property owners, applicators, and the IDNR with detailed records describing the changes within the plant communities of Bass Lake. They will also serve to keep the public informed about management practices at the lake so they will be motivated and educated to actively participate in management of the Bass Lake ecosystem. In years to follow, additional vegetative surveys will be conducted to determine how exotic and native aquatic species are responding to treatment.



Implementation of Action Plan

The management goal for 2010 is to reduce Eurasian watermilfoil to less than 5% of littoral zone surface area and curlyleaf pondweed to 10% of littoral zone surface area. Surface area of the littoral zone will be measured by site frequency.

Eurasian watermilfoil Action Plan

1. Prepare Spring 2010 Target Species Distribution Map, and Proposed Treatment Area Map. The site visit and investigation necessary to create these two maps will allow for the determination of the extent of follow-up chemical treatment that will be necessary to treat Eurasian watermilfoil. The Spring 2010 mapping will determine the distribution of Eurasian watermilfoil.
2. Follow-up Herbicide Treatment to Eurasian watermilfoil. An early spring (3rd week of April to mid-May) systemic herbicide application of granular 2,4-D (Navigate ®) is proposed during 2010 to treat the Eurasian watermilfoil that has established since the 2009 herbicide application.
3. Summer 2010 Tier II Aquatic Vegetation Survey. A post treatment Tier II aquatic vegetation survey should be conducted during the Summer of 2010 to document the diversity, distribution and abundance of aquatic vegetation. This data is important to evaluate the native plant community health and determine whether Eurasian watermilfoil is at a manageable level.

Curlyleaf pondweed Action Plan

1. Prepare early Spring 2010 Target Species Distribution Map, and Proposed Treatment Area Map for curlyleaf pondweed. The site visit and investigation necessary to create these two maps will allow for the determination of the extent of follow-up chemical treatment that will be necessary to treat curlyleaf pondweed. Curlyleaf pondweed was not collected during the July 2009 post treatment survey but is included in the action plan as it has an early growth cycle which may not coincide with the timing of the post treatment survey.
2. Follow-up Herbicide Treatment to curlyleaf pondweed. Curlyleaf pondweed will be treated using Aquathol K at a rate of 1.0 ppm when water temperatures approach 50° Fahrenheit and are not higher than 57° Fahrenheit.
3. Summer 2010 Tier II Aquatic Vegetation Survey. A Tier II aquatic vegetation survey should be conducted to document the diversity, distribution and abundance of aquatic vegetation.



Budget Update

The following costs are estimated based on lake size, average depth, chemical and application costs, as well as LARE survey requirements. The proposed management schedule and budgets for 2010 and 2011 are summarized below. Deviations from the budget presented in the 2007 Update include decreased treatment acreage for curlyleaf pondweed and increased treatment acreage for Eurasian watermilfoil in 2010. Herbicide treatment of Eurasian watermilfoil will require the application of either Renovate or 2,4-D and will not be used in conjunction with one another. Renovate and 2,4-D are equally effective, however, Renovate is typically more expensive.

2010

Target Species Distribution Map and Proposed Treatment Area Map	\$1,000
Early Spring Systemic Herbicide Application of granular 2,4-D (Navigate ®) (assumed 50 acres)	\$22,500
Early Spring Systemic Herbicide Application of liquid Renovate (assumed 50 acres)	\$25,000
Application of Aquathol K 1 ppm for curlyleaf pondweed (assumed 5 acres)	\$1,500
Late season post treatment aquatic vegetation survey (Tier II) and plan update	\$7,500

2011

Target Species Distribution Map and Proposed Treatment Area Map	\$1,000
Early Spring Systemic Herbicide Application of granular 2,4-D (Navigate ®) (assumed 55 acres)	\$24,750
Early Spring Systemic Herbicide Application of liquid Renovate (assumed 55 acres)	\$27,500
Application of Aquathol K 1 ppm for curlyleaf pondweed (assumed 5 acres)	\$1,500
Late season post treatment aquatic vegetation survey (Tier II) and plan update	\$7,500

Herbicide applications will depend on the results of the plant surveys.



The BLCD is grateful for LARE funding that is used to control invasive exotic species. The BLCD supports the cost share strategy and has funds prepared for the cost share.

Renovate and 2,4-D have been used successfully on Bass Lake for Eurasian watermilfoil treatment. Determining whether to use Renovate or 2,4-D will mainly depend on available funding. Navigate, with the active ingredient of 2,4-D has been effective in killing Eurasian watermilfoil within Bass Lake. Both products are systemic herbicides and effectively control Eurasian watermilfoil. Renovate is an option for future herbicide treatment as Eurasian watermilfoil has the ability to develop a resistance to 2,4-D. Liquid formulations work best at shallow depths and where the vegetation is dense, whereas granular formulations are more effective at greater depths and when vegetation is scattered.

These management activities and Tier II vegetation surveys are proposed to improve Bass Lake's ecosystem and facilitate the achievement of overall goals established by the IDNR.



Timeline for LARE Grant Applications

LARE grants are available on a competitive basis for actions that can address the ecology and management of public lakes and their watersheds. The Bass Lake Conservancy District must comply with IDNR grant deadlines to remain eligible for funding assistance with management of invasive aquatic plants such as Eurasian watermilfoil.

Associations must apply for funding assistance by January 15 and grant application forms can be obtained through the LARE website (www.in.gov/dnr/fishwild/3302.htm). Aquatic vegetation control permits should be ideally completed by January 31st and submitted to DNR Division of Fish and Wildlife commercial license clerk. Award notices are announced in March. If a lake has received funding a request for proposals that is prepared by LARE staff should ideally be submitted to contractors by the end of March. Contractor qualifications and experience should be thoroughly reviewed before a final selection is made. Contracts for a planning consultant and herbicide treatment contractor should ideally be signed by the month of April to accommodate early spring treatments and pre-treatment surveys if applicable.



Monitoring and Plan Updates

As the action plan is implemented, aquatic vegetation surveys will help to monitor the effectiveness of the management strategy. The abundance and distribution of aquatic vegetation will be recorded using the current IDNR Tier II sampling protocol.

Deviations from the original 5-year budget include the management option of native vegetative planting. Aquatic vegetation planting was included in the original plan and was estimated as a management option for 2007 and 2008. Native plantings will remain a tentative management option in the future as funding opportunities are limited. Fluridone is an aggressive treatment when Eurasian watermilfoil is present in greater than 100 acres. If a whole lake fluridone treatment was applied to Bass Lake, the native planting areas would experience low survivorship. Residents expressed a desire for educational materials related to beneficial native vegetation within emergent and submergent zones of Bass Lake during the November public meeting. The interest of lake residents in native species is attributed to the increase in native species abundance throughout Bass Lake.

The results of the 2009 post-treatment sampling reflect progress toward the goals stated in the 5-year plan. Water quality continues to be a focus in future management as species have not been collected from depths greater than 10 feet in recent vegetative surveys. The deeper contours of Bass Lake should be monitored in 2010 to determine if Eurasian watermilfoil is present. Eurasian watermilfoil has the ability to grow rapidly in low light conditions and quickly colonizes areas of bare soil which makes monitoring deeper zones of Bass Lake essential in future surveys. Dense monotypic stands of Eurasian watermilfoil could establish in depths greater than 10 feet without early detection and early aggressive treatment.

In years to follow, additional Tier II post treatment surveys will be conducted to determine how exotic and native aquatic species are reacting to treatment regimes. These surveys will provide a basis for evaluation of the management strategy and can be presented to the public should the management strategy need to be modified. They will also serve to keep the public informed about management practices at the lake so they will be motivated and educated to actively participate in conservation of the Bass Lake ecosystem.



Additional Funding Sources

Identifying additional funding sources for improvement at Bass Lake is important as state funding is limited. In addition to the LARE Program, there are many other sources of potential funding to help improve the quality of Indiana Lakes such as Bass Lake. Many government agencies assist in projects designed to improve environmental quality.

The Environmental Protection Agency, the Indiana Department of Environmental Management, and the U.S. Forest Service also have numerous programs for funding. A few of these are listed below. More information can be found at www.in.gov/idem and www.fs.fed.us/.

- U.S Environmental Protection Agency Environmental Education Program (EPA)
- Community Forestry Grant Program (U.S. Forest Service)

The USDA has many programs to assist in environmental improvement. More information on the following programs can be found at www.usda.gov.

- Watershed Protection and Flood Prevention Program
- Wetlands Reserve Program
- Grasslands Reserve Program
- Wildlife Habitat Incentive Program
- Small Watershed Rehabilitation Program

The following programs are offered by the U.S Fish and Wildlife Service. More information about the Fish and Wildlife Service can be found at www.fws.gov.

- Partners for Fish and Wildlife Program
- Bring Back the Natives Program
- Native Plant Conservation Program

The Starke County Soil and Water Conservation District (SWCD) district supervisors and staff work with both rural and urban dwelling landowners or occupiers, groups, local agencies and others to prevent resource problems, correct existing soil and water conservation problems and help utilize the county's natural resource capabilities. Through the district, local people are able to organize and coordinate their efforts in obtaining technical and financial assistance from state and federal agencies with responsibilities and expertise in natural resource use and development. More information about the Starke County SWCD can be found at: <http://www.starkeswcd.org/>.



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APPENDIX I

DATA SHEETS AND TIER II LATITUDE / LONGITUDE

Unit 02

Submersed Aquatic Vegetation Survey (Tier II) Datasheet

WATERBODY NAME: <u>Bass Lake</u>					DATE: <u>7-20-09</u>							
COUNTY: <u>Starke County</u>					SECCHI DEPTH (FT):							
SITE ID:					MAX PLANT DEPTH (FT):							
SURVEYING ORGANIZATION: <u>V3 Companies</u>					WEATHER: <u>Partly Sunny</u>							
CREW LEADER: <u>Jessica Dunn</u>					COMMENTS (Include voucher codes - V1, V2...):							
RECORDER: <u>Phil Rezin</u>												
CONTACT INFO: <u>jdunn@v3co.com</u>					Rake score (1, 3, 5). 9 = algae, emergent or species observed but not sampled.							
GPS#	Point #	R/T	Latitude	Longitude	Depth	Species Codes:					Notes	
						CHARA	POTILL	MYRSP1	NAJLE	POTNOD		
218	1	R			2	1	1					decaying / dead <u>MYR</u>
219	2	R			3	1	3		1			
220	3	R			6							no veg
221	4	R			5							
442	5	R			3							no veg
443	6	R			3	1	1		3	9		
444	7	R			4							no veg
445	8	R			9							no veg
446	9	R			2							no veg
447	10	R			3							no veg
448	11	R			8							no veg
449	12	R			15							no veg
450	13	R			2							no veg
451	14	R			7							no veg
452	15	R			14							no veg
453	16	R			3							no veg
454	17	R			6							no veg
455	18	R			2	1						little chara
456	19	R			2							no veg
457	20	R			7							no veg
458	21	R			13							no veg
459	22	R			6							no veg
460	23	R			11							no veg
461	24	R			4	3						
462	25	R			3	1						
463	26	R			3							no veg
464	27	R			6							no veg
465	28	R			8							no veg
466	29	R			2	1						tiny bit / small shells
467	30	R			2							no veg
468	31	R			7							no veg
469	32	R			4	1						little bit
470	33	R			2							no veg

Other plant species observed at lake: MYRSP1 floating @ boat launch w/ POTILL cuttings

0-5 (57)
 IIII IIII IIII IIII
 IIII IIII IIII IIII
 IIII IIII IIII "

5-10 (33)
 IIII IIII IIII
 IIII IIII IIII IIII

10-15 (10)
 IIII IIII

Submersed Aquatic Vegetation Survey (Tier II) Datasheet

WATERBODY NAME: Bass Lake	DATE: 7/20/09
COUNTY: Starke	SECCHI DEPTH (FT): 3.5
SITE ID:	MAX PLANT DEPTH (FT):
SURVEYING ORGANIZATION: V3 Companies	WEATHER: Partly cloudy
CREW LEADER: Jessica Dunn	COMMENTS (Include voucher codes - V1, V2...):
RECORDER: Phil Rezin	
CONTACT INFO: jDunn@v3co.com	Rake score (1, 3, 5). 9 = algae, emergent or species observed but not sampled.

GPS #

Point #	R/T	Latitude	Longitude	Depth	Species Codes:							Notes	
					CHARA	STUPEP	MYRSP1	TYRANG	POTIL	NAFLE			
471	34	R			6								no veg
472	35	R			11								no veg
473	36	R			7								no veg
474	37	R			4		1	1					little nit foil / dying
475	38	R			13								white lily
476	39	R			8								
477	40	R			4	1							
478	41	R			3								no veg, rocky slabs.
479	42	R			9								
480	43	R			3								
481	44	R			9								
482	45	R			10								
483	46	R			14								
484	47	R			6								
485	48	R			2								
486	49	R			5								
487	50	R			2								
488	51	R			4								
489	52	R			2								
490	53	R			6								
492	54	R			4								
493	55	R			2								
494	56	R			2				9				
495	57	R			3								
496	58	R			6								
497	59	R			14								
498	60	R			6								
499	61	R			5								
500	62	R			6								
501	63	R			4								
502	64	R			3	3				9			white water (9)
503	65	R			5	1	3			9	3		
504	66	R			3		3	1	9	9	1		dead MYRSP1 / some green

Other plant species observed at lake:

7/21

503

7688

(GPS 491 delete extra pt)
 turbidity 2.09, pH 9.92, temp 23.2°C, cond 210.4, Specific 218.0, salinity .1

Submersed Aquatic Vegetation Survey (Tier II) Datasheet

WATERBODY NAME: Bass Lake	DATE: 7/21/09
COUNTY: Starke	SECCHI DEPTH (FT): 3.5ft
SITE ID:	MAX PLANT DEPTH (FT):
SURVEYING ORGANIZATION: V3 Companies	WEATHER: Sunny
CREW LEADER: Jessica Dunn	COMMENTS (Include voucher codes - V1, V2...):
RECORDER: Phil Rezin	

CONTACT INFO: jdunn@v3co.com Rake score (1, 3, 5). 9 = algae, emergent or species observed but not sampled.

GPS#	Point #	R/T	Latitude	Longitude	Depth	Species Codes:							Notes	
						CHARA	NAJPE	MYRSP1	POTIL	STUPEC	VALAME	POTARD		
505	67	R			7									no veg
506	68	R			11									no veg
507	69	R			7									no veg
508	70	R			5									no veg
509	71	R			7	1	1							no veg
510	72	R			2				1					little bit
511	73	R			7									no veg
512	74	R			11									no veg
513	75	R			7									no veg
514	76	R			4									no veg
515	77	R			6									no veg
516	78	R			2			1						little bit
517	79	R			3			9						no veg
518	80	R			8			5						some dying
519	81	R			6			3						
520	82	R			6									no veg
522	83	R			7									no veg
523	84	R			6			1						very little dark
524	85	R			2									no veg
525	86	R			3									no veg
526	87	R			4									no veg
527	88	R			5	1			3					
528	89	R			2	1			1					
529	90	R			2									no veg
530	91	R			4	1								little
531	92	R			4	1								little
532	93	R			3	1								little
533	94	R			3	1								little
534	95	R			4	3								
535	96	R			6	3			1					
536	97	R			4	1								
537	98	R			2	1			1					
538	99	R			3									no veg
Other plant species observed at lake:														
539	100	R			3	1	1		3	9	1	1	1	

between 79 & 80 MYRSP1 beds

GPS# 521 deleted

Bass Lake Aquatic Plant Management Plan Update-2009, Tier II Sampling July 21, 2009

Tier II Sampling Location Number	Latitude	Longitude
1	41.21241	-86.61026
2	41.21375	-86.60855
3	41.21433	-86.6039
4	41.21224	-86.60375
5	41.21085	-86.60505
6	41.20902	-86.60153
7	41.2106	-86.59906
8	41.21224	-86.59839
9	41.20975	-86.59691
10	41.21107	-86.59506
11	41.21227	-86.59524
12	41.21289	-86.59581
13	41.21194	-86.5911
14	41.21344	-86.59101
15	41.21431	-86.59105
16	41.21378	-86.58897
17	41.21597	-86.5887
18	41.21688	-86.58766
19	41.21875	-86.58666
20	41.21958	-86.58692
21	41.22044	-86.58757
22	41.22042	-86.58289
23	41.22202	-86.58264
24	41.22104	-86.581
25	41.22196	-86.57988
26	41.22322	-86.57983
27	41.22491	-86.5819
28	41.22493	-86.57875
29	41.22505	-86.57727
30	41.22632	-86.5765
31	41.22787	-86.57883
32	41.22783	-86.57726
33	41.22911	-86.57604
34	41.2305	-86.57657
35	41.23247	-86.57648
36	41.23266	-86.57494
37	41.23152	-86.57354
38	41.23254	-86.5734
39	41.23349	-86.57263
40	41.23412	-86.57199
41	41.23491	-86.57145
42	41.23605	-86.57217
43	41.23685	-86.5704
44	41.23761	-86.57048
45	41.23789	-86.57203
46	41.23869	-86.5729
47	41.23926	-86.57382
48	41.23997	-86.57216
49	41.23986	-86.57511
50	41.24114	-86.57677

Tier II Sampling Location Number	Latitude	Longitude
51	41.23991	-86.57708
52	41.24136	-86.57772
53	41.23779	-86.5774
54	41.23787	-86.58075
55	41.24024	-86.58139
56	41.23883	-86.58425
57	41.2379	-86.58341
58	41.23649	-86.57998
59	41.23652	-86.57902
60	41.23507	-86.58112
61	41.23508	-86.58209
62	41.23532	-86.58387
63	41.2367	-86.58385
64	41.23728	-86.58539
65	41.23474	-86.58538
66	41.23343	-86.58616
67	41.23302	-86.58543
68	41.23195	-86.5836
69	41.23063	-86.5866
70	41.23071	-86.58713
71	41.22824	-86.5879
72	41.22783	-86.58838
73	41.22638	-86.58912
74	41.22554	-86.58939
75	41.22489	-86.5908
76	41.22424	-86.59199
77	41.22336	-86.59163
78	41.22244	-86.59185
79	41.2195	-86.59165
80	41.21781	-86.59355
81	41.21664	-86.59406
82	41.21553	-86.59604
83	41.21414	-86.598
84	41.21411	-86.60094
85	41.21586	-86.60091
86	41.21848	-86.60085
87	41.21999	-86.59859
88	41.22224	-86.59876
89	41.22375	-86.60098
90	41.22442	-86.60313
91	41.22203	-86.60203
92	41.22085	-86.60416
93	41.22258	-86.60567
94	41.22163	-86.60939
95	41.22029	-86.60703
96	41.21812	-86.60479
97	41.2176	-86.6084
98	41.21745	-86.61123
99	41.2157	-86.60888
100	41.21409	-86.61077

APPENDIX II
VEGETATION CONTROL PERMIT



APPLICATION FOR AQUATIC VEGETATION CONTROL PERMIT

State Form 26727 (R4 / 2-04)
Approved State Board of Accounts 2004

Whole Lake Multiple Treatment Areas
Check type of permit

INSTRUCTIONS: Please print or type information

FOR OFFICE USE ONLY	
License No.	
Date Issued	
Lake County	

Return to: Page 1 of 2
DEPARTMENT OF NATURAL RESOURCES
Division of Fish and Wildlife
Commercial License Clerk
402 West Washington Street, Room W273
Indianapolis, IN 46204

FEE: \$5.00

Applicant's Name Cinndi Carey		Lake Assoc. Name Bass Lake Conservancy District	
Rural Route or Street 3620 South County Road 210		Phone Number (574) 772-5794	
City and State Knox, IN		ZIP Code 46534	
Certified Applicator (if applicable)	Company or Inc. Name	Certification Number	
Rural Route or Street		Phone Number	
City and State		ZIP Code	

Lake (One application per lake) Bass Lake	Nearest Town Knox	County Starke
Does water flow into a water supply		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No

Please complete one section for EACH treatment area. Attach lake map showing treatment area and denote location of any water supply intake.

Treatment Area # (880 acres)	LAT/LONG or UTM's Lat: 41.23883 Lon: -86.58425		
Total acres to be controlled sum of 50 acres for lake	Proposed shoreline treatment length (ft) sum of 2,285 ft	Perpendicular distance from shoreline (ft)	adjacent
Maximum Depth of Treatment (ft) 15 ft	Expected date(s) of treatment(s) 03/15/10 - 08/15/10		
Treatment method: <input checked="" type="checkbox"/> Chemical <input type="checkbox"/> Physical <input type="checkbox"/> Biological Control <input type="checkbox"/> Mechanical			

Based on treatment method, describe chemical used, method of physical or mechanical control and disposal area, or the species and stocking rate for biological control. An 880-acre search and destroy area for Eurasian watermilfoil consists of depths shallower than 15 feet. Bass Lake 2010 priority treatment areas consists of locations where Eurasian watermilfoil was retrieved during the July 21, 2009 post treatment survey. 50 acres within the search and destroy area will be treated with a systemic herbicide application of granular 2,4-D or Renovate in 2010. Search and destroy area and Eurasian watermilfoil priority treatment area is shown in the attached exhibit.

Plant survey method: Rake Visual Other (specify) **Based on Tier II sampling conducted during July 2009**

Aquatic Plant Name	Check if Target Species	Relative Abundance % of Community
Chara		23.0
Eurasian watermilfoil	x	9.0
Illinois pondweed		9.0
Slender naiad		6.0
Sago pondweed		2.0
American pondweed		1.0
Eel grass		1.0

Treatment Area #	(880 acres)	LAT/LONG or UTM's	Lat: 41.23343 Lon:-86.58616
Total acres to be controlled	sum of 9 acres for lake	Proposed shoreline treatment length (ft)	sum of 2,285 ft
Maximum Depth of Treatment (ft)	15 ft	Perpendicular distance from shoreline (ft)	adjacent
Expected date(s) of treatment(s)		03/15/10 - 08/15/10	
Treatment method: <input checked="" type="checkbox"/> Chemical <input type="checkbox"/> Physical <input type="checkbox"/> Biological Control <input type="checkbox"/> Mechanical			

Based on treatment method, describe chemical used, method of physical or mechanical control and disposal area, or the species and stocking rate for biological control. A search and destroy area for curlyleaf pondweed priority treatment area for Bass Lake in 2010 consists of 880 acres based on depths below 15 feet. The 9 acres within the search and destroy area will be treated with a systemic herbicide application of 1ppm of Aquathol K in 2010. Search and destroy area for curlyleaf pondweed is shown in the attached priority treatment exhibit.

Plant survey method: Rake Visual Other (specify) Based on Tier II sampling conducted during July 2009

Aquatic Plant Name	Check if Target Species	Relative Abundance % of Community
Eurasian watermilfoil	x	9.1
Chara		6.1
Slender naiad		3.0
Illinois pondweed		3.0

INSTRUCTIONS: Whoever treats the lake fills in "Applicant's Signature" unless they are a professional. If they are a professional company who specializes in lake treatment, they should sign on the "Certified Applicant" line.

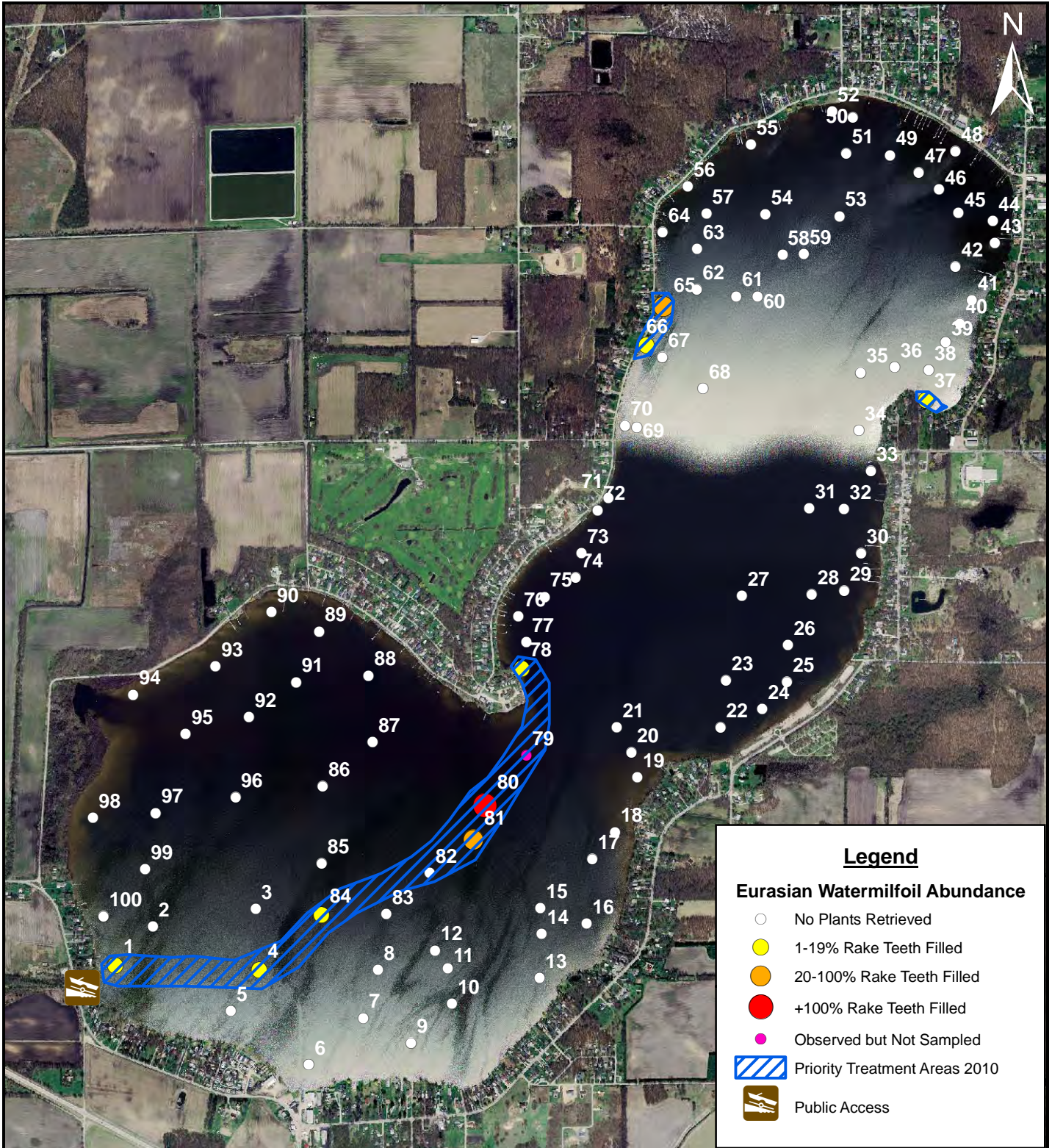
Applicant Signature	Date
Certified Applicant's Signature	Date

FOR OFFICE ONLY

<input type="checkbox"/> Approved <input type="checkbox"/> Disapproved	Fisheries Staff Specialist
<input type="checkbox"/> Approved <input type="checkbox"/> Disapproved	Environmental Staff Specialist

Mail check or money order in the amount of \$5.00 to:

DEPARTMENT OF NATURAL RESOURCES
 DIVISION OF FISH AND WILDLIFE
 COMMERCIAL LICENSE CLERK
 402 WEST WASHINGTON STREET ROOM W273
 INDIANAPOLIS, IN 46204



V3 Companies
 7325 Janes Avenue
 Woodridge, IL 60517
 630.724.9200 phone
 630.724.9202 fax
 www.v3co.com

TITLE: Tier II Eurasian Watermilfoil Results with 2010 Priority Treatment Areas	PROJECT AND SITE LOCATION: Bass Lake Aquatic Plant Management Plan Update - 2009			
	BASE LAYER: Indiana Spatial Data 2006 Orthophotography	PROJECT No. 07122.02	FIGURE: 13	SHEET: 1 OF: 1
	CLIENT: Bass Lake Conservancy District 3620 South CR 210 Knoxville, IN 46534	QUADRANGLE: N/A	DATE: 7/20/09	SCALE: 1" = 1,750'

