AQUATIC VEGETATION MANAGEMENT PLAN

FOR HUDSON LAKE, LAPORTE COUNTY, IN,

ADDRESSING THE YEARS 2007-2011

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EXECUTIVE SUMMARY

Hudson Lake, historically at 432 surface acres, is the second largest natural inland lake in LaPorte County, IN where it is located in the town of New Carlisle. The original surface acreage of the lake has been significantly reduced during the last decade presumably due to a substantial decrease in precipitation. Currently, the population of Eurasian water-milfoil (EWM) is not at nuisance status, but has the potential to interfere with recreational activities on the lake if it is left unchecked. This potential can negatively affect fish and wildlife by altering the ecological balance of the plant community and the associated trophic dynamics. The primary purpose of this plan is to assist the IDNR and the Hudson Lake Conservation Association in achieving the following goals: 1) a reduction in the abundance of EWM to improve the quality of native aquatic plant communities and recreational activities; 2) the development of conservation strategies for state-listed aquatic plant species; 3) the education of area residents on the fundamentals of lake ecology and best lake management practices. This Aquatic Plant Management Plan for Hudson Lake summarizes first year data collected in 2007 and proposed plant management activities.

Reconnaissance mapping for non-native species and a Tier II aquatic plant survey were conducted in early June 2007. Results from the Tier II aquatic plant survey completed on June 21, 2007, identified a total of 17 species of aquatic plants, two of which are state-listed: 1) purple bladderwort (*Utricularia purpurea*); 2) Fries' pondweed (*Potamogeton freisii*). Two non-native species, EWM and curly-leaved pondweed (*Potamogeton crispus),* were observed. Curly-leaved pondweed was located at 12 sites, but never had a rake score >1 (i.e. abundance value), and therefore, it is not considered to be of concern. In contrast, five significant beds of EWM were identified. This species was found at a frequency of 40.5%. Coontail (*Ceratophyllum demersum*), EWM, and eel-grass (*Vallisneria americana*) were the most frequently encountered native species and were found at >30% of the sampling sites. SDI and NDI values suggest high species diversity, indicating evenness in the abundance of species across the aquatic plant community.

The mapping of EWM discussed above, supplemented with information from the Tier II survey, targeted 13.5 acres of this species for treatment with 2, 4-D. This area was treated on July 18, 2007 by Aquatic Weed Control, Syracuse, IN. A second Tier II survey and mapping was completed on August 17, 2007. An additional state-listed species, water-marigold (*Bidens beckii*), was observed during the reconnaissance mapping of EWM. Overall, species distributions and frequencies of occurrence were similar to those observed in the previous survey. However, based on these results and mapping, an additional 9.5 acres of EWM were targeted for a second treatment. Herbicide was applied on August 24, 2007 by the aforementioned company.

Based on these results, three alternate management options are presented: 1) the annual application of the herbicide 2, 4-D; 2) a whole-lake herbicide treatment, using Sonar®, with the installation of enclosures around the population of water-marigold; 3) the stocking of 20,000 milfoil weevils. We highly recommend that the Hudson Lake Conservation Association seek funding to explore these alternative management options. Our recommendation is to pursue alternative III because it provides both a short- and long-term integrated solution to control EWM. If this alternative is not feasible or satisfactory by the LARE program, we recommend the use of Alternative II.

ACKNOWLEDGEMENTS

Funding for this project has been provided by a grant obtained from the Indiana Department of Natural Resources, Lake and River Enhancement (LARE) Program and cost-share assistance from the Hudson Lake Conservation Association. We acknowledge Gwen White and Angela Sturdevant of the Indiana Department of Natural Resources, Division of Fish and Wildlife, for their assistance during the course of this project. Special thanks are also given to Jim Donahoe of Aquatic Weed Control (Syracuse, IN) for his recommendations on herbicide options and assistance with permit applications. We also thank the members of the Hudson Lake Conservation Association for their courtesy and their participation during the public informational meeting held on August 11, 2007. Special thanks are also given to Bob Robertson and Robin Longenbaugh of the Indiana Department of Natural Resources, Division of Fish and Wildlife, for providing copies of past fisheries management reports and herbicide applications, respectively. We also thank Gwen White and Bob Robertson for critical comments on an earlier version of this report.

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INTRODUCTION

The Hudson Lake Conservation Association (HLCA) received an $18,000 grant in April, 2007 from the Indiana Department of Natural Resources (IDNR), Lake and River Enhancement Program (LARE). Aquatic Restoration Systems, LLC received $8,575 to prepare an aquatic plant management plan for Hudson Lake with a 10% match from the HLCA. The remaining funds were available for herbicide treatment of Eurasian water-milfoil (*Myriophyllum spicatum*).

The overall purpose of the LARE program as stated in the LARE brochure (INDR 2005):

> "… is to ensure the continued viability of Indiana's publicly accessible lakes, streams, and reservoirs. Program goals include (a) controlling inflows of eroded soil and associated nutrients to lakes, streams, and reservoirs and (b) where appropriate, forestalling or reversing degradation from these inflows through remedial actions. To accomplish these goals, the LARE Section of the IDNR Division of Fish and Wildlife provides technical and financial assistance to qualified projects. These include: (a) studies, management plans, sediment removal and design and construction activities involving specific lakes or 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."

1.1. Problem Statement

Eurasian water-milfoil (EWM) has become more of a problem on Hudson Lake over the last decade. Declining water levels have likely contributed to this problem because of an increase in the shallowness of the littoral zone. Although EWM has not reached nuisance infestation levels at the current time, concerns center on controlling this species before it diminishes the ecological integrity of the lake and begins to more dramatically impact recreational activities. At the current time, recreational uses of the lake have not been significantly impaired by EWM; however, low water levels have negatively impacted boating and fishing at the far west end of the lake because the channels leading to this area are too shallow for navigation via watercraft. If water levels remain as is or continue to recede, the population of EWM is more likely to reach nuisance status in the near future. If an increase in the density or abundance of EWM occurs, there is additional concern that there will be a decline in the population size of water-marigold *(Bidens beckii*), a state-threatened aquatic vascular plant species commonly known as the.

1.2. Management History and Goals

Currently, there is only one state-initiated study, providing management options, that is publicly available for Hudson Lake. Harza (1991) suggested that the following actions needed to be initiated: 1) the conservation of existing wetlands; 2) aquatic plant harvesting; 3) herbicidal plant control. Currently, it is unknown whether the HLCA and Hudson Lake residents have been notified and informed about best management practices (BMPs) as outlined in the report by Harza (1991). If they have been apprised of these BMPs, it appears that minimal levels of participation or action have since taken place.

A search for herbicide application permits through IDNR, Division of Fish and Wildlife yielded only two such articles on file (R. Longenbaugh, IDNR, pers. comm.). These permits were issued in 1990 and 2000 for the control of milfoil, coontail, water-weed, naiads, and pondweeds with no specific details on target species. The gamut of herbicides to be used for the control of the aforementioned groups included Reward®, Clearigate®, Hydrothol® 191, copper sulfate, and Nautique®. The herbicide 2, 4-D (dichlorophenoxyacetic acid) was also listed on the 2000 application. Although these permits were issued,

the application of herbicide was not preformed by the company that was granted these permits (T. Cunningham, Weed Patrol, Elkhart, IN, pers. comm.).

The aquatic plant management plan for Hudson Lake should meet the following goals as specified by the LARE program: 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; 3) provide reasonable public recreational access while minimizing the negative impacts on plant and wildlife resources. Specific management objectives can be found in Section 6.0.

1.3. Watershed and Water body Characteristics

Hudson Lake, historically at 432 surface acres, is the second largest natural inland lake in LaPorte County, IN where it is located in the town of New Carlisle. The original surface acreage of the lake has been significantly reduced during the last decade presumably due to a substantial decrease in precipitation (Figure 1.0). According to Harza (1991) the watershed area is 5,455 acres and approximately 790 acres of this watershed is a closed wetland that does not contribute to the water budget of Hudson Lake. Nearby Saugany Lake flows into Hudson Lake and is approximately 1.7 mi to the North. Storm water run-off enters into the southwest corner of Little Hudson Lake and is responsible for extensive siltation in this portion of the water body (Figure 2.0). Besides surface run-off and direct precipitation, the major source of water to the lake is ground water. The legal lake level is 763 ft and is controlled by a 24" water control structure located along the eastern shore. The present lake level is approximately 759.8 ft, giving it a surface area of 366 acres and a volume of 4281.9 ac-ft (E. Belmonte, V_3, pers. comm.). Residence time has not currently been calculated for these values.

Hudson Lake has extensive areas of development except on the southern shoreline where it has been limited by the South Shore rail line (Figure 3.0). There is some development along the southwest portion of Little Hudson Lake (Figure 2.0), but low water levels have likely saved it from further development.

In addition to the present study, a diagnostic study of Hudson Lake has been funded by the LARE program for 2007-2008. These funds were awarded to the HLCA who have contracted with the Illinois branch of the V_3 consulting firm to conduct the study.

1.4. Present Water Body Uses

Popular activities on the lake include swimming, boating, water-skiing, SCUBA diving, and fishing. Ice-fishing has been popular in the past; however, mild winters have apparently precluded this activity with estimates of only 15 fishermen on the ice per day (W. Companik, HCLA, pers. comm.). Fishing is not limited to any one area of the lake. The presence of dilapidated duck blinds along the west end of Little Hudson Lake suggests that waterfowl hunting has taken place.

The lake has a small local beach along the northern shoreline. Swimming is often limited to the waters adjacent to the beach area (see Figure 1.0B). Buoys are present along much of the northern shoreline; however, they do not delimit the swimming area or the boundary of a no-wake zone (W. Companik, HCLA, pers. comm.). As such, high-speed boating is allowed since there are no restrictions in place prohibiting this activity.

Currently, no official public boat launch exists on the lake; however, two private boat ramps are located on the southwestern and southeastern corners of the lake (see Figure 1.0B). The latter ramp is maintained by a private party and can be used for access to the lake for a nominal parking-fee. Boating, water-skiing, and SCUBA diving typically take place in the deeper, open-water areas of the lake. During the summer months, there is an average of 40 boats on the lake per day (W. Companik, HCLA, pers. comm.).

1.5. Fisheries

Fisheries studies have been conducted by the IDNR at Hudson Lake in 1972, 1978, 1981, and 1990. Table 1.0 summarizes the percent relative abundance of fish species by weight and by total number collected during these surveys. The most recent of theses surveys resulted in the collection of 785 fish, which weighed 937 lbs and represented 15 species (IDNR, unpubl. data). The most abundant fishes by number were bluegill (*Lepomis macrochirus*) 329, yellow perch (*Perca flavescens*) 94, and redear sunfish (*Lepomis microlophus*) 88, whereas the most abundant fishes by weight were bluegill, (*Lepomis macrochirus*) 55.6 lb, bowfin (*Amia calva*) 36.9 lb, and northern pike (*Esox lucius*) 26.0 lb (IDNR, unpubl. data). In comparison with survey data from other Indiana lakes, weights of three of the primary game fish (bluegill, yellow perch, and redear sunfish) collected from Hudson Lake during the 1990 survey were considered average, whereas weights for largemouth bass (*Micropterus salmoides*) were determined to be below average. Estimates of growth rates of game fish, which were based on back calculated lengths of fishes and age classes, indicate that yellow perch and redear sunfish were average and bluegill and largemouth bass were slightly below average (IDNR, unpubl. data).

Recommendations based on the 1990 fishery survey included 1) the establishment of a state owned public access site, 2) the protection of wetlands directly associated with the Hudson Lake watershed, and 3) the establishment of a harvesting program to remove submersed aquatic vegetation. Subsequently, the IDNR ceased to conduct fishery surveys on Hudson Lake after 1990 due to changes in policy that no longer provided for fisheries surveys of lakes without an IDNR public access site. (B. Robertson, IDNR, pers. com.). However, based on general trends in the aforementioned data sets, Hudson Lake has appeared to have supported relatively stable populations of game fish.

It is well-documented that aquatic plants have an integral role in the structure, function, and stability of lake ecosystems (Sculthorpe 1967; Hutchinson 1975; Carpenter and Lodge 1986; Jeppesen et al. 1998; Scheffer 1998; Wetzel 2001). They provide spawning sites, refuge, and a food source for a variety of foraging macroinvertebrates and fish (Scheffer 1998), the very attributes of which are most commonly used to gauge the biotic integrity of aquatic habitats. Thus, it should be of no surprise that the quality and health of game fish populations are directly or indirectly associated with the architecture and abundance of aquatic vegetation. Unfortunately, questions, such as “what kinds” and “in what quantities”, are not easily answered because the relationship between aquatic plants and game fish is often highly complex and can vary among different types of aquatic habitats as well as among different fish species (Dibble et al. 1996; Weaver et al. 1996; Diehl and Kornijów 1998). Thus, it is difficult to prescribe an optimal aquatic plant coverage for a given lake. Much of the information on this subject that is often found in LARE reports, suggests that fish communities are adversely affected when aquatic plant coverage is reduced to <10% of the total surface area, or increased to >60% of the total surface area. This optimal range appears to have been obtained from studies of lakes and reservoirs from the southern United States (see Valley et al. 2004). As correctly stated by Valley et al. (2004), very few studies of this type have been conducted in north-temperate lakes to date. However, one such study conducted on 45 thermally stratified lakes in Michigan provided little evidence to support a correlation between an optimal intermediate range of aquatic plant coverage and fish growth (see Cheruvelil et al. 2005).

2.0. METHODS

2.1. Sampling Design

Non-native species were mapped with a Trimble GeoXT™ global positioning system (GPS) unit outfitted with a Trimble Beacon-on-a-Belt (BoB™) real-time differential corrected receiver on June 4, 2007 andAugust 11, 2007 to determine the extent of their coverage and to locate beds to serve as potential candidates for control measures (i.e. herbicide application). Mapping efforts conducted in early June were hampered by the nature of the season, thus it was difficult to visually determine the exact extent of the beds of invasive species, such as EWM, since many of these plants were observed in moderately deep water and

had shown only limited growth. To resolve this issue, short rake pulls were carried out at increasing depths to determine the approximate locations where Eurasian water-milfoil was replaced by other species as light level diminished. This problem was not encountered during mapping efforts conducted in August.

Pre- and post-treatment floristic surveys designed to inventory and determine the frequency of occurrence, abundance, and plant dominance of aquatic macrophytes within Hudson Lake were conducted during the months of June and August 2007, respectively. Sampling methodology follows the Tier II aquatic vegetation survey protocol modified in May 2007 (IDNR, unpubl. manual). To utilize current geographical information system (GIS) and global positioning system (GPS) technologies in the sampling scheme, a polygon theme was created and saved as a shapefile for each depth contour by digitizing, aligning, and georeferencing bathymetric map of Hudson Lake over an associated digital orthophoto quadrangle (DOQ), using the Image Analysis extension in ArcView™ version 3.2a GIS software (Environmental Systems Research Institute Inc. 2000). Depth contour themes were combined into one shapefile, which was used to designate sampling boundaries for the generation of waypoints (i.e. sampling points). The recommended number of waypoints for each depth contour (Table 2.0) was generated in a semi-systematic fashion using TerrsSync™ version 2.2 software (Trimble Navigation Ltd. 2000) to selectively place waypoints inside each contour zone at relatively equal intervals to obtain uniform coverage throughout these areas. Waypoints were recorded in the Universal Trans Mercator (UTM) coordinate system, North American Datum 1983 (NAD 83). In an attempt to provide a more even distribution of waypoints throughout the littoral zone, four extra waypoints were generated for the 0-5 ft contour. Waypoints (hereafter referred to as sites) were transferred onto the Trimble GeoXT™, which was used to navigate from one site to another and to record data (Figure 4.0). The same sites were sampled during both surveys (i.e. pre- and post-treatment). The number of sites partitioned by depth contour varied between the pre- and post-treatment surveys (see Table 3.0). The number of sites sampled by depth contour were 23 (0-5 ft), 18 (5-10 ft), 17 10-15 ft), 16 (15-20 ft), and 10 (20-25 ft) for the pre-treatment survey and 23, 18, 16, 15, and 12, respectively, for the post-treatment survey. The most likely explanation for this variation is that position of sites marginally within a depth contour may have shifted to an adjacent contour due to fluctuations in lake water levels and/or positioning of the boat relative to the waypoint.

2.2. Physical Parameters

At each site, a depth measurement was recorded by dropping a detachable, weighted, double-headed, straight-toothed garden rake attached to a braided polyester line calibrated in 0.1 m increments from the side of the boat, thus each measurement represents the depth of water from the water's surface to the sediment. Each measurement was converted to a standard scale of feet and rounded to the nearest 0.1 ft.

A single measurement of Secchi disk transparency was recorded at the deepest point in the lake from the boat using the same aforementioned line during both the pre-treatment and post-treatment surveys. These measurements were also converted to a standard scale of feet and rounded to the nearest 0.1 ft.

2.3. Vegetation Sampling

At each site, the rake was lowered and allowed to settle on the lake bottom. The boat was then maneuvered parallel to the shore during which 10 feet of line was released from the bow. With the motor in reverse to hold the boat in a steady position, the line was retrieved, thus resulting in an aquatic vegetation sample from the given site. Plants were removed from the rake and grouped by species. Each species of submersed plants was separately and evenly spread on one side of the rake across the complete row of tines. Abundance scores were recorded for each submersed species and represent the amount of plant material gauged by tine length, where each tine of the rake is divided into five evenly spaced increments (i.e. 2nd, 4th, 6th, 8th, and 10th deciles). Abundance scores follow the designations outlined in the tier II aquatic vegetation survey protocol modified in May 2007 (IDNR, unpubl. manual) which are defined as follows: 5 = species abundance >100% at a given site; 3 = species abundance ≥20%, but ≤100% at a given

site; 1 = species abundance <20% at a given site. When a submersed species was observed at a given site, but not sampled by the rake, its presence was recorded.

2.4. Systematics

Taxonomy and nomenclature of vascular aquatic macrophytes follow familial treatments of the Flora of North America Editorial Committee (1997, 2000, 2002a, 2002b, 2002c, 2006) with the following exceptions: Acanthaceae and Lythraceae (Gleason & Cronquist 1991), Haloragaceae (Aiken 1981), and Lentibulariaceae (Taylor 1989). Taxonomic treatment of the Characeae follows Daily (1953) with nomenclatural revisions where necessary (e.g., see Wood 1965). Voucher specimens have been collected and upon processing will be deposited in the Aquatic Plant Herbarium of Purdue University North Central.

2.5. Vegetation Parameters

Vegetation parameters used in this study are based on a variety of standard metrics and indices. Calculations were made using the Aquatic Vegetation Calculator (AquaVeC) version 2.1 provided by the IDNR. Standard metrics used here include: 1) total (i.e. native + non-native species) and native species richness; 2) maximum and mean numbers of species $\cdot$ site^{-1}; 3) frequency of occurrence. Species richness metrics represent the total number of species within a given group (e.g., native and non-native) collected during a survey. The maximum number of species $\cdot$ site^{-1} represents the largest number of species collected from any given site. Means reported here are the arithmetic averages of a set of values. The frequency of occurrence was calculated for each species and represents the percentage of sites from which a given species was present. This metric has been calculated by using 0-25 ft depth contour as the survey unit and by using 5 ft depth contours as discrete survey units. This metric has been calculated by using 0-25 ft depth contour as the survey unit and by using 5 ft depth contours as discrete survey units.

Indices used here include: 1) native and non-native species diversity index (i.e. SDI and NDI, respectively); 2) plant dominance index. The SDI is calculated as follows:

$$\text{SDI} = 1 - \sum R^2$$

where $\sum R^2$ is the sum of the squared relative frequency of each species. The equation for the NDI is exactly the same as that used for the SDI, but unlike the SDI, only data on the occurrences of native species are incorporated in the calculation. Both the SDI and the NDI are modified versions of the complement of Simpson's (1949) diversity index (see Washington 1984), substituting relativized frequencies for measures of abundance values (i.e. biomass or density). Simpson's (1949) diversity index ranges between 0 and 1 and measures the probability that two individuals randomly selected from a sample will belong to the same species, as such values approaching 1 indicate low diversity. In contrast, the modified versions used here represent the probability that two individuals randomly selected from a sample will belong to different species. Although values obtained from the use of the modified indices also range between 0 and 1, values approaching 1 indicate greater diversity (Magurran 1988).

The plant dominance index (PDI) is used to characterize the dominance of each species within the aquatic plant community by combining the frequency of occurrence metric for a given species and its associated rake scores. The PDI is calculated as follows:

$$\text{PDI} = 100(\Sigma r_i)/(N \cdot r_{max})$$

where r_i is the rake score for a species from the ith site, N is the total number of survey sites, and r_{max} is the theoretical maximum rake score, which is 5. This index has been calculated by using 0-25 ft depth contour as the community unit and by using 5 ft depth contours as discrete community units.

3.0. RESULTS

3.1. Tier II Pre-treatment Surveys

3.1.1 *Mapping Non-native Species*

Curly-leaved pondweed (*Potamogeton crispus*) and EWM were observed during a reconnaissance survey conducted on June 4th. Five beds of EWM were identified and mapped (Figure 4.0), whereas no definable beds of curly-leaved pondweed were located. At this time of the year, curly-leaved pondweed appears to be a subordinate member of the aquatic plant flora intermixed with other desirable species. In contrast, total coverage of EWM was estimated at 13.5 acres, with sites A and E contributing to over 85% of this estimate (Figure 5.0). We recommended the application of herbicide to these beds since further growth of this species will most likely interfere with recreational activities.

3.1.2. *Quantitative Survey*

Data was collected from a total of 84 sampling points on June 4th, 12th, and 21st. . The depth distribution of these sampling points is shown in Table 3.0. Eighty-five percent of sample sites were vegetated although only 38% of the total number of sites contained native species. Eleven of the 26 points sampled from areas having a depth >15 ft yielded no plants. A single collection of Coontail (*Ceratophyllum demersum*) from a depth of 22 ft recorded at point 77 represents the maximum plant depth for this survey (see Appendix 11.2). The total number of species declined with increasing depth contour (Table 3.0). Although the maximum number of species was greatest at the 0-5 ft contour, the mean number of species was higher at the 5-10 ft contour (Table 3.0). A maximum of 6 species were identified from any one site with a mean of 2.4 across all sites (Table 4.0).

The pre-treatment survey indicates that Hudson Lake has a relatively small number of total species (17). Coontail, EWM, and eel-grass (*Vallisneria americana*) were found at frequencies >30% (Table 5.0). Two species, opposite stonewort (*Chara contraria*) and Fries' pondweed (*Potamogeton friesii*, state-listed as threatened), were found at 28.6 and 23.8, respectively (Table 5.0.). Although the aforementioned species had relatively intermediate frequencies, they were not abundant at each site, predominantly represented by a rake score of 1 (Table 5.0). The distributions of rake scores by site for EWM, curly-leaved pondweed, and Fries' pondweed are shown in Figures 6.0A, 7.0A, and 8.0A, respectively. All other species had frequencies <15% and at least 90% of their rake scores was 1 (Table 5.0).

Analysis of species distribution by depth contour indicates that opposite stonewort is predominantly a shallow water species, where it had frequencies of 69.6%, 38.9%, 0.0%, 6.3%, and 0.0% at the 0-5 ft, 5-10 ft, 10-15 ft, 15-20 ft, and 20-25 ft depth contours, respectively (Table 5.0). In contrast, the frequency of coontail increased dramatically with depth contour (Table 5.0). Opposite stonewort and coontail were co-dominant (PDI = 10.0), whereas EWM was most abundant between 5-15 ft (Figure 6A) and the most dominant species (13.8) across all depth contours (Table 5.0). Values of the SDI and NDI, 0.90 and 0.88 (Table 4.0), respectively, suggest high species diversity, which indirectly indicates that on any given rake toss one would collect 2-3 different species and that one species does not dominant the aquatic plant community (Table 3.0).

3.2. Tier II Post-treatment Surveys

3.2.1 *Mapping Non-native Species*

Based on the coverage map of EWM, 2,4-D was applied to 13.5 acres on July 18, 2007 by Aquatic Weed Control, Syracuse, Indiana. A three week window was recommended prior to the next survey to allow the effects of herbicide to become manifested (J. Donahoe, Aquatic Weed Control, pers. comm.). Thus, the first available date to conduct the post-treatment survey was August 8, 2007.

EWM was mapped during a reconnaissance survey conducted on August 11th . Nine beds of EWM were identified and mapped (Figure 6.0). Again, no definable beds of curly-leaved pondweed were located. A total coverage of EWM was estimated at 9.5 acres, with site A contributing to approximately 50% of this estimate (Figure 6.0). Since HLCA was funded for treatment up to 25 acres and the initial application covered only 13.5 acres, we recommended the application of herbicide to these beds.

3.2.2. *Quantitative Survey*

Data was collected from a total of 84 sampling points on August 11th, 14th, and 17th. The depth distribution of these sampling points is shown in Table 3.0. Changes in the depth distributions of these points likely resulted from fluctuations in water levels. Eighty-three percent of sample sites were vegetated although only 38% of the total number of sites contained native species. Eleven of the 27 points sampled from areas having a depth >15 ft yielded no plants. A single collection of coontail from a depth of 23 ft recorded at point 79 represents the maximum plant depth for this survey (see Appendix 11.5). The percentage of unvegetated sites and the value of maximum plant depth are similar to those calculated from data collected during the pre-treatment survey. These data indicate that it will likely be unnecessary to shift the sampling regime for future surveys covered by this plan.

The total number of species declined with increasing depth contour (Table 3.0). Although the maximum number of species was greatest at the 0-5 ft contour, the mean number of species was higher at the 5-10 ft contour (Table 3.0). A maximum of 9 species were identified from any one site with a mean of 2.5 across all sites (Table 4.0). These trends are also similar to those observed during the pre-treatment survey.

A greater number of species was observed during the post-treatment survey (21) than in the previous survey (Table 4.0). These species were fragile stonewort (*Chara globularis*), Ceylonian stonewort (*Chara zeylanica*), and Compact stonewort (*Nitella tenuissima*), three macrophytic algal species and humped bladderwort (*Utricularia gibba*), a vascular plant (Tables 5.0, 6.0 and 7.0). This increase in richness is likely a reflection of temporal changes in the structure of the aquatic plant community.

In regard to frequency of occurrence, similar results were obtained for coontail, EWM, and eel-grass (Table 6.0). Other species previously mentioned also had similar frequencies and patterns of distribution. Fries' pondweed showed a substantial difference in frequency after the second survey, where it dropped to 3.6% (Table 6.0) from 23.8% (Table 5.0). Common Naiad (*Najas flexilis*) showed a san increase in frequency from 3.6% (Table 5.0) to 17.9% (Table 6.0). Smooth stonewort (*Nitella flexilis*) was found at 8.3% of sites at the 20-25 ft depth contour (Table 6.0), but not recorded from this contour during the pre- treatment survey (Table 5.0). Although the frequency of occurrence of most species was similar, mean rake scores per depth contour slightly increased and are likely a result of greater productivity in the month of August (Table 3.0). The distributions of rake scores by site for EWM, curly-leaved pondweed, and Fries' pondweed are shown in Figures 6.0B, 7.0B, and 8.0B, respectively. All other species had frequencies <15% and at least 90% of their rake scores was 1 (Table 6.0).

PDI values mirrored trends observed in frequency of occurrence values in both pre- and post-treatment surveys (Tables 5.0 and 6.0). PDI values were similar for most species in both surveys with the exception of those calculated for opposite stonewort, which showed a marginal increase from 10.0 (Table 5.0) to 14.0 (Table 6.0). This increase is a reflection of the life-history strategy of this species, which tends to greatly increase its abundance during the latter part of the growing season (Scribailo and Alix, pers. obs.) SDI and NDI values were virtually identical to those calculated from data collected during the pre-treatment survey (Table 4.0). It is likely that the minor fluctuations observed in the values of these indices and metrics reflect the seasonal stochasticity of shallow lake ecosystems and/or differences in life history strategies among aquatic plants rather than significant effects due to herbicide treatment. Comparisons among datasets generated from the same sampling window across years are likely to be more meaningful in elucidating significant trends in the alteration of biodiversity that are attributable to herbicide treatments.

3.3. Threatened and Endangered Species

Three state-listed aquatic plant species, purple bladderwort, Fries' pondweed, and water-marigold were identified during the course of the survey work. Purple bladderwort, which is state-listed as rare (IDNR 2004), was collected from the shallow water of Little Hudson Lake at four sites during the pre-treatment survey and at two sites during the post-treatment survey (Figure 9.0). Fries' pondweed and water-marigold are state-listed as threatened (IDNR 2004), and though the former species has a fairly broad distribution across Hudson Lake during the early portion of the growing season (Figure 8.0A), the latter species appears to be isolated in a small bed along the southwest corner of Big Hudson Lake (Figure 10.0)

Fries' pondweed is a species that is probably often misidentified during aquatic plant surveys because of its similarity to other linear-leaved pondweed species. Fries' Pondweed is most easily identified by the presence of condensed over-wintering shoots (turions) that the plant begins to produce as early as June. The turions are very distinctive with bract-like outer leaves turned at right-angles to the leaves in the condensed shoots (Figure 11.0A). Fries' Pondweed is most easily confused with stiff pondweed (*Potamogeton strictifolius*) but can be distinguished most readily by turion morphology since bracts in the latter species are in the same plane as the inner leaves (Figure 11.0B). The species has a very early-season phenology and plants begins to senesce by mid-July. By early August few to no plants are left as indicated by our survey data, which shows this species as being present at 23.8% of sites in June but at only 3.6% in mid-August. The species is very common at Hudson Lake and there are concerns over whether it will be adversely affected by a whole lake herbicide application. Currently, it is unknown whether the turions or plants of this species will be negatively affected by a whole lake application of fluridone. Scientists at SePro Corporation (Carmel, IN) expect little damage to Fries' pondweed based on the fact that they typically recommend 40-45 ppb of fluridone to control *Potamogeton pusillus* (a similar linear-leaved pondweed), but only 6 ppb of fluridone to control EWM in a whole lake herbicide application.

Water-marigold is a submersed aquatic plant that has a habit similar to EWM (Figure 12.0A), as such concerns over the proper identification of this species warrants some discussion. When in bud, water-marigold is distinctively recognized by the presence of emergent entire leaves (Figure 12.0B). At Hudson Lake, water-marigold grows in relatively shallow water (≈3 ft) and appears to be associated with water lilies (Figure 12.0C). Water-marigold can be readily distinguished from the whorled feather-like leaves of water-milfoil because the leaves of the former species lack a central axis and are divided into multiple unequal segments (Figure 13.0). Unfortunately, the population size of water-marigold has dramatically declined over the years. In 1998, this species filled the entire bay directly west of it current location, where its density was very high (Scribailo and Alix, unpubl. data). In 2003, this species was recorded from only two out of 134 sites (Alix 2006). The reduction in lake water level coupled with the extensive encroachment of water lilies and EWM may have impacted this species over the last decade.

Several additional points are noteworthy when comparing past report data with Alix (2006) to those collected from the current study. Fisheries management reports list only a total of 11 taxa in 1972 and 11 taxa in 1978 (Table7.0). Harza (1991) recorded only 19 taxa, whereas Scribailo and Alix (unpub. data) recorded 25 taxa (Table 7.0). All of the aforementioned reports were based on qualitative information. With the exception of the latter study, data collected on aquatic plants was not the primary focus of the study. In 2003, Alix (2006) conducted quantitative in-water sampling from 134 quadrats compared with 84 in-boat rake tosses used here. Twenty-eight submersed and free-floating species and an additional 15 species of emergents (N = 43) were recorded in 2003, whereas 21 species of the former group were found in the current study (Table 4.0). These differences suggest that current protocol for determining the number of samples and the strategy for data collection will underestimate species richness. This problem underscores the importance of a lake reconnaissance that gives an accurate assessment of species richness of the aquatic plant community. In this regard, it should be noted that water-marigold was not recorded from rake tosses during the Tier II survey and was only detected by a complete lake reconnaissance. An unfortunate outcome of the exclusive use of the Tier II method is that rare species are unlikely to be collected. Thus, we are likely to unconsciously promote the eradication of those species that are in the greatest need of conservation.

4.0. AQUATIC PLANT MANAGEMENT ALTERNATIVES

The narrative that follows identifies the primary aquatic plant control option possibilities for Hudson Lake. The benefits and shortcomings of each option are discussed. Following this discussion is a section that outlines our views as to the best strategy for management of aquatic plants in Hudson Lake.

4.1. No Action

The aquatic plant surveys performed during the course of this study indicate that Hudson Lake possesses a diverse aquatic plant community, having a relatively low abundance EWM. At 90% of the sites where EWM occurred, rake scores were less than or equal to 1 in both surveys. Nevertheless, a very real concern is that the current moderate extent of EWM not lull residents and managers into a state of complacency over the potential magnitude of the problem. Hudson Lake has the opportunity to control this invasive species before it gets out of control and significantly damages the ecology of the lake. A no-action strategy would likely result in an increase in the extent of EWM over time. As the biomass of this invasive species increases well documented effects on the ecology of the lake include increasing nutrients in the water column followed by more extensive algal blooms and a decline in the quality of game-fish populations to name a few (Grace and Wetzel 1978).

4.2. Mechanical Harvesting

Mechanical harvesting of problem aquatic plants was a particularly attractive control method through the 1980's. It is still a useful method for species that do not reproduce from fragments. EWM tends to be spread through the use of aquatic plant harvesters (Kimbel and Carpenter, 1981). Although large volumes of biomass can be cut and collected with a harvester it is only a temporary solution since the machine only cuts the aquatic plants off near the root crowns which can then re-grow within the same or the following season. Harvesters are advantageous because the harvested material does not stay in the water and decay as it does with chemical methods. The water is also immediately available for recreation unlike the situation with chemical treatments.

4.3. Manual Harvesting

Residents of the lake should routinely attempt to harvest aquatic plants that have washed up onto the shoreline or near the shore. This will reduce the nutrient loading to the lake from the eventual decay of these plants. It also provides for a more aesthetically pleasing shoreline and easier access for swimming and boating.

Residents can manually harvest plants from the littoral zone in front of their property using a standard steel garden rake or by purchasing one of several commercially available "lake rakes" (Figure 14.0). These vary from being a simple landscape rake design with a float and retrieval line to products like the aquatic weed eradicator (AWE) which has a serrated blade that cuts the plants as opposed to pulling them out.

The concern with residents harvesting plants on their own from the littoral zone is that many desirable lake plants look similar to EWM and should not be harvested. This is particularly true on Hudson Lake where the state endangered water-marigold occurs in shallow areas on the southwest side of the lake and may he found inter-mixed with EWM in other, as yet unknown locations. Aquatic plants in the littoral zone help to stabilize sediments and decrease turbidity of the water. These shallow beds of vegetation are also important for sheltering "young of the year" game fish from predation.

Our recommendation would be if residents want to remove EWM they need to learn the difference between similar species and then simply hand-pull the young EWM plants out by grasping them at their base leaving the other species intact.

4.4. Nutrient Reduction

Eurasian water-milfoil and other nuisance aquatic plants, including algae, thrive on the availability of excess nutrients, in the form of nitrogen and phosphorus, in the lake. Thus any practices that reduce this impact are highly desirable since they will assist in the control of species like EWM. All lake residents can participate in practices that reduce nutrient loading to their lake. One of the best practices that can curtail this problem is to reduce the amount of fertilizer applied to lawns since residents tend to over-fertilize their lawns. Application time is also important (i.e. fertilizer should not be applied prior to heavy rains).

The planting of buffer strips along the lake margins are a good practice that should be encouraged. The use of drain tiles that rapidly remove water into the lake are also not desirable since nutrients have no time to absorb into the ground the way they do over natural surfaces. Although residents tend to like manicured lawns right down to the waters edge they should try to maintain at least parts of their property near the lakeshore in a natural state through the planting of emergent wetland species. These plants act as a barrier to the movement of sediment and nutrient runoff into the lake and also uptake the nutrients before they reach the lake. The presence of taller vegetation near the shoreline has also been shown to dissuade the nesting of Canada Geese since they do not frequent areas where there isn't a clear view for possible predators. Canada Geese are one of the worst culprits in Indiana in terms of their contributions to nitrogen loading into water bodies. There are many small grant sources available to pay for the cost of emergent aquatic plants for buffer strips if residents are willing to do the labor. It should be noted that many of these emergent aquatic plant species such as arrowheads, irises, lizards-tail, bur-reeds, and even the sedges, rushes, and grasses have attractive foliage and floral or fruit displays. Emphasis on these planting should be towards the use of native species and not horticultural varieties.

4.5. Biological Control Methods

Biological control methods are highly desirable for lakes because they offer the possibility of controlling aquatic vegetation without the need of dumping large amounts of herbicides into the water. If effective, they offer a long-term natural control solution that typically does not harm the ecology of the lake.

4.5.1 *Grass Carp*

Grass Carp were originally thought of as a panacea for the EWM problem in the United States. Unfortunately, their ability to rapidly multiply quickly made them become a nuisance species that destroyed the ecology of the water bodies they were originally meant to protect. Triploid sterile grass carp were then marketed so that the numbers introduced for control of nuisance vegetation could not increase. Control was limited because grass carp have a low feeding preference for EWM and would thus consume other desirable aquatic plant species before feeding on EWM. Grass carp also tend to disturb the bottom, uprooting plants, and greatly increasing turbidity. They are not a desirable solution for control of EWM.

4.5.2. *EWM Weevils*

The water-milfoil weevil (*Euhrychiopsis lecontei*) is a native North American insect that consumes EWM and northern milfoil. The weevil was discovered after a decline in the EWM population was observed in Brownington Pond, Vermont (see Creed and Sheldon 1991; 1992a, b, c; 1993a, b, c; 1994). It was

subsequently proposed that much of the EWM decline that was observed throughout the 1980's (Carpenter 1980) to the present in North American lakes might have been associated with the natural spread of the weevils (Creed and Sheldon 1995; 1998). The water-milfoil weevil was subsequently proposed as a good biological control agent for EWM (Creed and Sheldon 1994; Sheldon 1997).

The water-milfoil weevil larvae burrows down into the stem of the plant and disrupt transport of metabolites and nutrients to the shoot apex. Release of the plants' gases which reduces buoyancy and causes the plant to sink (Creed et. al. 1992c). Once the plants drop out of the water column they can no longer compete for light and die off, particularly in deeper water.

The water-milfoil weevil has been marketed in North America by the EnviroScience Company Inc. (Stow, Ohio). Although there have been claims of success when stocking lakes with the weevils in Indiana a lack of quantifiable data has made it difficult to evaluate the efficacy of this treatment method. In 2003, Scribailo and Alix evaluated weevil stockings in Round, Little Turkey, and Griffy Lakes in Indiana and the subsequent damage to associated populations of EWM. Scribailo and Alix (unpubl. data) found no conclusive evidence to support a significant decline in EWM populations. In addition, very few weevils were collected from each of the three study sites following the summer after their initial release. However, since the assessment of weevil populations only occurred over a two year period, it is possible that the weevil populations increased in subsequent years. There have been well documented declines in EWM in many other states, but these declines have been attributed to the natural spread of the weevils and are not the result of introductions from stockings (see Newman 2004).

The first discovery of a native population of the water-milfoil weevils in Indiana was at Saugany Lake in La Porte County (Waltz, White, and Scribailo 1998). At this location the weevils greatly reduced the EWM population and allowed white-stem pondweed to become one of the predominant species in the lake. Many native aquatic plant species flourished with the reduction in biomass of the EWM. Studies have shown that the weevils are adversely affected by many environmental factors. Adult weevils can suffer high predation rates since they are readily visible and are poor swimmers (Ward and Newman 2006) although other studies have shown little effects of game fish on weevil densities (Creed 2000).

The weevils over-winter in leaf litter on the shore so that areas of natural shoreline are a necessity for survival of a weevil colony. An IDNR permit is required for the stocking of the water-milfoil weevil. A problem associated with the use of this method for control of EWM is that it may take several years for a colony to become large enough to significantly reduce the biomass of the former species. Most lake residents expect reductions in EWM populations within the same growing season immediately after treatment.

4.6. Chemical Control Methods

There are a variety of chemicals used to control EWM. Aquatic herbicides can be divided into two broad categories. Contact herbicides are in pellet form and kill aquatic plants by being directly applied to the surfaces of the plant. The most commonly used contact aquatic herbicide is Reward® (diquat). The problem with contact herbicides is that it is difficult to get the kind of specificity that is possible with systemic herbicides. Contact herbicides work more effectively on emergent or floating type species, such as water lilies, where direct contact is possible. In the case of EWM, there is also the concern that the herbicide is not taken up by the roots and that the above-ground biomass will be killed, but the roots will allow re-growth and further infestation. Some selectivity can be achieved by varying dosage rates since EWM is adversely affected at concentrations much lower than most other aquatic plants.

Systemic herbicides are absorbed through the leaves and roots of aquatic plants where they travel through the vascular tissue to all parts of the plant body. Examples of systemic herbicides are Sonar® and Avast™ (active ingredient: fluridone); Navigate®, Aqua-Kleen®, DMA® 4 (active ingredient: 2, 4-D), and

Renovate® (active ingredient: triclopyr). Whole-lake treatments of fluridone can be used to control severe infestations of EWM because the dosage level required typically does not adversely affect many other aquatic plants most of which are monocots like pondweeds, water naiads, and eel grass. The most commonly used formulations for EWM are DMA® 4 and Renovate®. Renovate® is more expensive, but offers control over a greater period of time.

4.7. Best Management Options

A number of alternative management options have been discussed in the previous section. Several of these are not considered suitable for Hudson Lake. Control of EWM on Hudson Lake would likely not benefit from the use of an aquatic plant harvester. Besides the problem with fragmentation discussed above this method of aquatic plant control would not be effective because of the rapid depth drop-off in the littoral zone of Hudson Lake. Harvesters tend to work best in lakes with very shallow littoral zones since the harvester can only cut plants down to a depth of about five feet. Harvesters are also very expensive to operate and maintenance costs are prohibitive.

Based on the information collected during this study, as well as historical information, the best management options are now presented. There are several alternative options for the control of EWM on Hudson Lake that could be used effectively.

4.7.1. *Herbicide Control of EWM*

Herbicide application will provide the most immediate solution to the EWM problem on Hudson Lake. Two options are possible: 1) yearly spot applications with 2,4-D to existing beds of EWM; 2) whole-lake treatment of Hudson Lake in 2008 with possible minor spot applications in subsequent years. Triclopyr was not considered as an alternate herbicide because the abundance of EWM is the greatest between 5 and 15 ft (Tables 5.0 and 6.0) and the use of triclopyr is not cost effective in deeper water (J. Donohoe, Aquatic Weed Control, pers. comm.). Yearly spot applications would involve continuing the same practice that is currently being used at Hudson Lake to control EWM. This method will require the same amount of funding outlay in perpetuity each year.

Estimates from data collected in 2007 indicate that approximately 55 acres of EWM should be treated in 2008. Whole-lake herbicide applications are potentially attractive because they offer the possibility of near-eradication of EWM in a short time-span. The biggest problem with this alternate solution is that it would likely result in severe damage to the water-marigold population in the lake which is already restricted to only one shallow bay. An attractive option if this treatment method were to be used would be to enclose the water-marigold bed and hydrologically isolate it from the rest of the lake during the treatment period. This possibility exists because the water-marigold bed is actually not much more than 12 feet wide by 20 feet long. The enclosure would be put in place by divers. Barrier curtains of this type have been used in a number of applications in Washington (see http://www.aquatechnex.com/res_shoecraft.html). In this instance, the barrier curtain was use to enclose the treatment area, but the method would work equally well for enclosing the aquatic plant bed of interest for conservation. Standard turbidity or silt barriers are available from geotextile companies that would work for this purpose (see http://www.silt-barriers.com/Type_1_Silt_Barrier.html).

We recommend the establishment of an ecozone in the aforementioned bay to protect the integrity of the water-marigold population. As previously stated, this population is located in shallow bay, which somewhat precludes the use of high speed watercraft. Designation of this area as an ecozone would prohibit consultants and lakefront property owners from applying herbicide within the bay.

4.7.2. *Milfoil-weevil Control of EWM*

The introduction of water-milfoil weevils offers a possible long-term solution to the control of EWM in Hudson Lake. The fact that there is a viable natural population of the weevils in Saugany Lake (see above) which greatly reduced the extent of EWM and that Saugany Lake drains into Hudson Lake would seem likely reasons for confidence in the ability of the weevils to flourish in Hudson Lake. Hudson Lake also has an extensive area of natural shoreline on which the weevils could over-winter.

Milfoil weevils could be introduced from Saugany Lake into Hudson Lake by transferring stems of EWM from the former to the latter and tying them to plants in existing EWM stands. Stocking rates in this case would be low and it would take considerable time for the weevils to reach appreciable numbers. An alternative would be to purchase milfoil weevils from EnviroScience, Inc. (Stow, OH) for stocking purposes. If this method is to be effective, it requires either an initial outlay of funds for 10-15,000 weevils for each of at least two years or lower stocking rates that will take a longer time period to have an appreciable impact. Nevertheless, given the success of weevils in Saugany Lake, it offers an attractive long-term natural solution to the problem. It compares favorable with the cost of herbicide application particularly if a breeding population of weevils becomes established.

5.0. PUBLIC INVOLVEMENT

It is critical that the public be involved in the decision making process when considering management options for Hudson Lake. This is particularly important so that residents can express their concerns with lake quality and also subsequently express their views on any proposed management plans. A standard public lake-use survey was sent to William Companik (HLCA president) for review prior to public distribution. Mr. Companik's view was that the survey needed major revisions and that it did not serve the interest of the HLCA, as such it was not distributed to the public.

A public meeting was held on August 11, 2007 during which Robin W. Scribailo (Aquatic Restoration Systems, LLC, Porter, IN) and Jim Donahoe (Aquatic Weed Control, Syracuse, IN) presented information discussing, fundamentals of lake ecology, management issues facing Hudson lake, and possible control options available. Fifty-eight people attended this meeting. In addition to the representatives of consulting firms and a reporter from a local news agency, the majority of people in attendance were HLCA members and lake residents. Although questions related to lake ecology and management options were fielded and answered, these were not recorded by the HLCA or consultants. Once the draft report for the Aquatic Plant Management Plan has been circulated a second meeting will be held in March 2008 to discuss proposed management plans that potential funding will be solicited for from LARE.

The HLCA does not hold regularly scheduled public meetings, but does maintain a website at http://home.comcast.net/~hudsonlake/ to keep its 300 members and the general public up-to-date on current issues and topics related to the lake. According to executive members of the HLCA, the organization is project-driven and only conducts meetings as necessary for project planning, initiation, and the dissemination of information.

6.0. MANAGEMENT IMPLEMENTATION STRATEGY

As previously outlined, the primary objectives of the aquatic plant management strategy are to: 1) reduce the abundance of EWM to improve the quality of native aquatic plant communities and recreational activities; 2) develop conservation strategies for state-listed aquatic plant species; 3) educate area residents on the fundamentals of lake ecology and best lake management practices. These represent long-term (i.e. 5-10 yrs) goals for the HLCA. The actions needed to achieve these goals are determined by the management strategy adopted by the HCLA. Continued efforts toward the treatment of EWM coupled with ongoing education of lake residents will contribute to the long-term ecosystem health of Hudson Lake.

Although different forms of treatment have been discussed as separate options in the section above, we present several alternative options with timelines for aquatic plant management that in some cases involve an integration of several methods to achieve a more long-term EWM control.

6.1. Alternative I

Conduct a Tier II survey in July 2008. Apply 2, 4-D to 55 acres of EWM in early August 2008. Continue this sequence each year over the next four years. This acreage was chosen because it keeps total cost of herbicide under the LARE funding-cap of $20000 and minimizes cost to the HLCA. The primary objective is to obtain a 50% reduction in the abundance of EWM during every growing season included in this plan. This reduction is reflected in cost estimates in Table 8.0. This approach will reduce EWM in a growing season, but unfortunately not from year to year. A short-coming of this method is that funds will likely have to be expended on control of EWM each year in perpetuity. An advantage of this alternative is that it does not require a large initial cost share by the HCLA.

6.2. Alternative II

Enclose the population of water-marigold with silt barriers to prevent damage to this species and conduct a whole-lake treatment with Sonar® in July 2008, respectively. Conduct a Tier II survey in August 2008. Conduct a Tier II survey in July 2009 to assess the remaining quantity of EWM. Spot touch-up any remaining EWM with 2, 4-D in August 2009. Continue the latter sequence over the next few years. The desired outcome is that the whole-lake herbicide will eradicate 80% of the EWM and leave little remaining in subsequent years. The cost estimates in Table 8.0 project 10% of the original cost of 2, 4-D from Alternative I. Additional costs associated with this alternative include funds for the purchase of silt barriers ($650), the installation of these barriers ($1500), and the assessment of the water-marigold population ($1000). The die-off of aquatic plants may cause extensive algal blooms.

6.3. Alternative III

Conduct a Tier II Survey in June 2008. Stock with 20,000 weevils in mid-August in EWM beds. Conduct a Tier II Survey in June 2009. Stock with additional weevils if EWM still appears as abundant in 2009. Continue this sequence over the next few years. Table 8.0 projects the cost of stocking Hudson Lake with an additional 5000 weevils/year for two years. Overall, it is the most cost-effective approach over the duration of this plan. The desired outcome is that the weevil population will establish and keep the EWM at a low level in perpetuity. The disadvantage is that residents may have to accept that it may take several years before extensive control is exhibited.

7.0. PUBLIC EDUCATION

In order to properly manage the ecology of Hudson Lake it is important that all stakeholders understand the impact that various actions can have on lake quality. The Hudson lake Conservation Association has been very active for many years in trying to solicit funds for the management of the lake. Lake residents can also be involved in initiating “best management practices” to help in the maintenance of lake quality. Manuals such as “Lakesmarts” (McComas 1993) offer many excellent suggestions as to how lake residents can ensure that they are not contributing to problems as opposed to solutions on the lake. Some of these practices include:

1. Reduce the frequency and amount of fertilizer, herbicide, or pesticide used for lawn care. Make sure timing of application is appropriate and not just prior to heavy rains.

2. Use only phosphorus-free fertilizer.

3. Plant buffer strips along the lake edge and shallow littoral zone to slow-down runoff and trap sediment and nutrients. Buffer strips also discourage goose activity and nesting.

4. Place rip-rap limestone in front of seawalls to dampen wave energy.

5. Keep lawn clipping, leaves, and animal waste out of the water.

6. Properly maintain septic systems. Systems should be pumped regularly and leach fields should be properly cared for.

7. Clean all plant fragments and sediment from boats, propellers, and trailers after lake use and refrain from dumping bait buckets into the lake to prevent the spread of exotic species.

8. Exercise care in filling boat motors with gas and oil to avoid spillage into the lake.

9. Use oars or paddles to push boats out into deeper water before lowering motors to avoid damage to the bottom and the creation of excess turbidity.

10. Rake floating vegetation off the shoreline to avoid excess nutrient loading to the lake.

An important issue concerning the education of lake residents in Indiana centers on the discovery of *Hydrilla vertcillatum* (commonly known as hydrilla or water thyme) from Lake Manitou, Rochester, IN. This species is notoriously aggressive and has the potential to become the worst exotic weed in Indiana. We strongly encourage lake residents to learn how to distinguish this species from other similar native species, such as naiads and Canadian water-weed. Brazilian elodea (*Egeria densa*), another exotic species to Indiana, is also similar to the aforementioned species. Information at http://plants.ifas.ufl.edu/seagrant/hydver2.html provides the most up-to-date information on how to distinguish these species. If you feel that you have identified either of these exotic species from Hudson Lake, please contact the Aquatic Invasive Species Coordinator, Indiana Department of Natural Resources at 317-234-3883.

8.0. PROJECT BUDGET

Since a number of alternative management scenarios have been identified, the costs are presented here for each treatment as opposed to a description by years. Plan updates for each year would be $5000 or more depending upon the desired level of monitoring for water-marigold.

Treatment Type:	Cost:
2,4 D liquid ($360.00 per acre) x 77 acres	$27,720
Weevil stocking ($1.00 each) x 15,000	$15,000
Whole-lake herbicide with Sonar®	$46,500
100 feet of floating silt barrier $633	

9.0. MONITORING AND EVALUATION PLAN

We have presented several alternative aquatic plant management options. In all cases monitoring of the effectiveness of any treatment method will involve comparisons of the frequency of aquatic plants relative to EWM at the same sample points each year. Mapping of the extent of EWM beds and curly-leaved

pondweed with GPS each year will also allow comparisons of the extent of this species and give a measure of the success of the aquatic plant management strategy. Water-marigold will be independently assessed to ensure that the population size does not continue to dwindle. Analysis of the data will provide information for yearly updates to the Aquatic Plant Management Plan and allow modifications to the proposed plan if certain management actions are found not to be successful.

Table 1.0. Summary of relative abundance of fish collected in 1972, 1978, 1981, and 1990 from fishery surveys conducted on Hudson Lake (modified from IDNR, unpubl. data). D = datum not available; N = species not present in survey. Parenthetical values represent number of individuals collected during the 1990 survey.

		Relative Abundance (%)								
		Weight				Number				
Species	Common Name	1972	1978	1981	1990	1972	1978	1981	1990	
Ameiurus nebulosus	Brown bullhead	D	7.8	7.3	10.4	4.3	5.1	3.3	3.8	(30)
Ameiurus melas	Black bullhead	N	N	N	2.0	N	N	N	1.0	(8)
Ameiurus natalis	Yellow bullhead	D	<0.1	11.3	7.8	1.9	<0.1	7.0	6.4	(50)
Amia calva	Bowfin	D	17.5	16.6	15.2	1.3	1.2	1.0	1.5	(12)
Catostomus commersoni	White sucker	N	2.2	7.8	1.6	N	2.6	1.4	0.3	(2)
Erimyzon tenuis	Lake chubsucker	D	4.1	15.1	3.5	2.4	6.3	20.8	5.1	(40)
Esox americanus	Grass pickerel	D	1.1	2.4	0.4	0.6	1.2	3.1	0.4	(3)
Esox lucius	Northern pike	D	20.7	6.9	10.7	7.1	1.6	1.0	0.8	(6)
Lepomis gibbosus	Pumpkinseed	D	<0.1	0.4	N	0.4	<0.1	1.1	N	(0)
Lepomis gulosus	Warmouth	D	3.7	4.0	2.5	1.5	4.7	7.3	4.6	(36)
Lepomis macrochirus	Bluegill	D	24.5	6.9	22.9	43.1	45.7	24.5	41.9	(329)
Lepomis microlophus	Redear sunfish	D	4.9	4.5	9.2	5.4	5.6	4.8	11.2	(88)
Micropterus salmoides	Largemouth bass	D	5.7	8.8	5.3	1.9	3.2	4.7	4.3	(34)
Notemigonus crysoleucas	Golden shiner	D	<0.1	1.7	2.6	6.4	0.1	6.2	5.7	(45)
Perca flavescens	Yellow perch	D	6.1	1.7	5.3	13.1	20.0	8.0	12.0	(94)
Pomoxis nigromaculatus	Black crappie	D	1.0	4.5	0.9	10.5	1.4	5.6	1.0	(8)

Table 2.0. Protocol for the number of random samples required for the determination of aquatic vegetation abundance. The number of samples is based on lake surface area and trophic state, in which samples are distributed by depth class (modified from IDNR, unpubl. data). Highlighted values correspond to sampling regime for Hudson Lake.

	Number of Random Samples												
		Eutrophic Contours			Mesotrophic Contours				Oligotrophic Contours				
Lake Surface Area (Acres)	Total	0-5	5-10	10-15	0-5	5-10	10-15	15-20	0-5	5-10	10-15	15-20	20-25
<10	20	10	7	3	10	5	3	2	10	4	3	2	1
10-49	30	10	10	10	10	10	7	3	10	10	5	3	2
50-99	40	17	13	10	10	10	10	10	10	10	10	7	3
100-199	50	23	17	10	14	14	12	10	10	10	10	10	10
200-299	60	30	20	10	18	16	16	10	14	12	12	12	10
300-399	70	37	23	10	22	20	18	10	17	15	14	14	10
400-499	80	43	27	10	25	25	22	10	19	18	17	16	10
500-799	90	50	30	10	29	27	24	10	22	21	19	18	10
≥800	100	57	33	10	33	31	26	10	25	23	22	20	10

Table 3.0. Summary of species richness values and mean rake scores apportioned by survey. Parenthetical values represent standard error.

Depth Contour (ft)	Number of Sites: Total	Number of Sites: w/Plants	Number of Sites: w/Native Plants	Number of Species: Total	Number of Species: Natives	Species · Site^{-1}: Maximum	Species · Site^{-1}: Mean	Species · Site^{-1}: Mean Natives	Mean rake Score
Pre-treatment Survey (June 2007)									
0-5	23	21	12	14	13	5	2.48 (0.29)	2.09 (0.25)	1.7
5-10	18	18	8	12	10	5	3.44 (0.29)	2.83 (0.32)	2.0
10-15	17	17	3	8	6	6	3.18 (0.37)	2.06 (0.30)	2.1
15-20	16	11	5	8	6	6	1.63 (0.45)	1.19 (0.33)	1.0
20-25	10	4	4	1	1	1	0.40 (0.16)	0.40 (0.16)	0.4
Post-treatment Survey (August 2007)									
0-5	23	20	14	17	16	9	2.91 (0.51)	2.65 (0.48)	2.0
5-10	18	18	7	15	13	7	3.89 (0.43)	3.22 (0.42)	2.8
10-15	16	16	6	12	10	5	2.69 (0.31)	1.81 (0.23)	2.8
15-20	15	13	9	7	6	5	1.73 (0.38)	1.53 (0.34)	1.3
20-25	12	3	2	2	2	2	0.33 (0.19)	0.33 (0.19)	0.3

Table 4.0. Summary of richness metrics and diversity indices. SDI = species diversity index (i.e. total taxa); NDI = native species diversity index (i.e. excluding non-native taxa).

	Taxon Richness and Diversity						
			Number of Taxa · Site^{-1}				
	Number of Taxa			Mean			
Lake	Total	Native	Maximum	Total	Native	SDI	NDI
2003*	43	41	11	4.0	3.5	0.94	0.94
2007†	17	15	6	2.4	1.9	0.90	0.88
2007‡	21	19	9	2.5	2.1	0.91	0.90

*Alix (2006)
†First tier II survey (pre-treatment)
‡Second tier II survey (post-treatment)

Table 5.0. Summary of frequency and dominance values of aquatic macrophytes partitioned by depth and calculated from data collected during the pre-treatment survey (June 2007). Species preceded by an asterisk are considered to be non-native. Common names provided in parentheses.

Depth contour: 0-25 ft.

Species	Frequency of Occurrence (%)	Rake Score Frequency per Species (%)				Plant Dominance Index
		0	1	3	5	
Ceratophyllum demersum (Coontail)	33.3	67.7	26.2	6.0	1.2	10.0
Chara contraria (Opposite stonewort)	28.6	71.4	20.2	6.0	2.4	10.0
Heteranthera dubia (Water star grass)	8.3	91.7	8.3	0.0	0.0	1.7
**Myriophyllum spicatum* (Eurasian Water-milfoil)	40.5	59.5	31.0	4.8	4.8	13.8
Najas flexilis (Common naiad)	3.6	96.4	3.6	0.0	0.0	0.7
Najas marina (Spiny naiad)	1.2	98.8	1.2	0.0	0.0	0.2
Nitella flexilis (Smooth stonewort)	4.8	95.2	4.8	0.0	0.0	1.0
Potamogeton amplifolius (Broad-leaved pondweed)	7.1	92.9	6.0	1.2	0.0	1.9
**Potamogeton crispus* (Curly-leaved pondweed)	14.3	85.7	14.3	0.0	0.0	2.9
Potamogeton friesii (Fries' pondweed)	23.8	76.2	21.4	1.2	1.2	6.2
Potamogeton gramineus (Grass-leaved pondweed)	2.4	97.6	2.4	0.0	0.0	0.5
Potamogeton illinoensis (Illinois pondweed)	10.7	89.3	10.7	0.0	0.0	2.1
Potamogeton zosteriformis (Flat-stem pondweed)	13.1	86.9	13.1	0.0	0.0	2.6
Stuckenia pectinata (Sago pondweed)	9.5	90.5	9.5	0.0	0.0	1.9
Utricularia macrorhiza (Common bladderwort)	2.4	97.6	2.4	0.0	0.0	0.5
Utricularia purpurea (Purple bladderwort)	4.8	95.2	4.8	0.0	0.0	1.0
Vallisneria americana (Eel-grass)	33.3	66.7	33.3	0.0	0.0	6.7

Depth contour: 0-5 ft.

Ceratophyllum demersum (Coontail)	8.7	91.3	8.7	0.0	0.0	1.7
Chara contraria (Opposite stonewort)	69.6	30.4	43.5	17.4	8.7	27.8

Table 5.0. –Continued.

Species	Frequency of Occurrence (%)	Rake Score Frequency per Species (%)				Plant Dominance Index
		0	1	3	5	
**Myriophyllum spicatum* (Eurasian Water-milfoil)	39.1	60.9	39.1	0.0	0.0	7.8
Najas flexilis (Common naiad)	4.3	95.7	4.3	0.0	0.0	0.9
Najas marina (Spiny naiad)	4.3	95.7	4.3	0.0	0.0	0.9
Potamogeton amplifolius (Broad-leaved pondweed)	4.3	95.7	4.3	0.0	0.0	0.9
Potamogeton friesii (Fries' pondweed)	8.7	91.3	4.3	4.3	0.0	3.5
Potamogeton gramineus (Grass-leaved pondweed)	8.7	91.3	8.7	0.0	0.0	1.7
Potamogeton illinoensis (Illinois pondweed)	21.7	78.3	21.7	0.0	0.0	4.3
Potamogeton zosteriformis (Flat-stem pondweed)	4.3	95.7	4.3	0.0	0.0	0.9
Stuckenia pectinata (Sago pondweed)	26.1	73.9	26.1	0.0	0.0	5.2
Utricularia macrorhiza (Common bladderwort)	8.7	91.3	8.7	0.0	0.0	1.7
Utricularia purpurea (Purple bladderwort)	17.4	82.6	17.4	0.0	0.0	3.5
Vallisneria americana (Eel-grass)	21.7	78.3	21.7	0.0	0.0	4.3
Depth contour: 5-10 ft.						
Ceratophyllum demersum (Coontail)	11.1	88.9	5.6	5.6	0.0	4.4
Chara contraria (Opposite stonewort)	38.9	61.1	33.3	5.6	0.0	10.0
Heteranthera dubia (Water star grass)	5.6	94.4	5.6	0.0	0.0	1.1
**Myriophyllum spicatum* (Eurasian Water-milfoil)	55.6	44.4	44.4	0.0	11.1	20.0
Najas flexilis (Common naiad)	11.1	88.9	11.1	0.0	0.0	2.2
Potamogeton amplifolius (Broad-leaved pondweed)	27.8	72.2	22.2	5.6	0.0	7.8
**Potamogeton crispus* (Curly-leaved pondweed)	5.6	94.4	5.6	0.0	0.0	1.1
Potamogeton friesii (Fries' pondweed)	61.1	38.9	55.6	0.0	5.6	16.7
Potamogeton illinoensis (Illinois pondweed)	22.2	78.8	22.2	0.0	0.0	4.4
Potamogeton zosteriformis (Flat-stem pondweed)	22.2	78.8	22.2	0.0	0.0	4.4

Table 5.0. –Continued

Species	Frequency of Occurrence (%)	Rake Score Frequency per Species (%)				Plant Dominance Index
		0	1	3	5	
Stuckenia pectinata (Sago pondweed)	11.1	88.9	11.1	0.0	0.0	2.2
Vallisneria americana (Eel-grass)	72.2	27.8	72.2	0.0	0.0	4.4
Depth contour: 10-15 ft.						
Ceratophyllum demersum (Coontail)	58.8	41.2	57.1	5.9	5.9	18.8
Heteranthera dubia (Water star grass)	5.9	94.1	5.9	0.0	0.0	1.2
**Myriophyllum spicatum* (Eurasian Water-milfoil)	64.7	35.3	29.4	23.5	11.8	31.8
Najas flexilis (Common naiad)	17.6	82.4	17.6	0.0	0.0	3.5
**Potamogeton crispus* (Curly-leaved pondweed)	47.1	52.9	47.1	0.0	0.0	9.4
Potamogeton friesii (Fries' pondweed)	35.3	64.7	35.3	0.0	0.0	7.1
Potamogeton zosteriformis (Flat-stem pondweed)	35.3	64.7	35.3	0.0	0.0	7.1
Vallisneria americana (Eel-grass)	52.9	47.1	52.9	0.0	0.0	10.6
Depth contour: 15-20 ft.						
Ceratophyllum demersum (Coontail)	62.5	37.5	43.8	18.8	0.0	20.0
Chara contraria (Opposite stonewort)	6.3	93.8	6.3	0.0	0.0	1.3
Heteranthera dubia (Water star grass)	31.3	68.8	31.3	0.0	0.0	6.3
**Myriophyllum spicatum* (Eurasian Water-milfoil)	25.0	75.0	25.0	0.0	0.0	5.0
Nitella flexilis (Smooth stonewort)	6.3	93.8	6.3	0.0	0.0	1.3
**Potamogeton crispus* (Curly-leaved pondweed)	18.8	81.3	18.8	0.0	0.0	3.8
Potamogeton friesii (Fries' pondweed)	6.3	93.8	6.3	0.0	0.0	1.3
Vallisneria americana (Eel-grass)	6.3	93.8	6.3	0.0	0.0	1.3
Depth contour: 20-25 ft.						
Ceratophyllum demersum (Common Coontail)	40.0	60.0	40.0	0.0	0.0	8.

Table 6.0. Summary of frequency and dominance values of aquatic macrophytes apportioned by depth and calculated from data collected during the post-treatment survey (August 2007). Species preceded by an asterisk are considered to be non-native. Common names provided in parentheses.

Depth contour: 0-25 ft.

Species	Frequency of Occurrence (%)	Rake Score Frequency per Species (%)				Plant Dominance Index
		0	1	3	5	
Ceratophyllum demersum (Coontail)	32.1	67.9	26.2	2.4	3.6	10.2
Chara contraria (Opposite stonewort)	32.1	67.9	17.9	9.5	4.8	14.0
Chara globularis (Fragile stonewort)	4.8	95.2	4.8	0.0	0.0	1.0
Chara zeylanica (Ceylonian stonewort)	2.4	97.6	2.4	0.0	0.0	0.5
Heteranthera dubia (Water star grass)	11.9	88.1	11.9	0.0	0.0	0.2
**Myriophyllum spicatum* (Eurasian Water-milfoil)	38.1	61.9	28.6	6.0	3.6	12.9
Najas flexilis (Common naiad)	17.9	82.1	15.5	2.4	0.0	4.5
Najas marina (Spiny naiad)	4.8	95.2	4.8	0.0	0.0	1.0
Nitella flexilis (Smooth stonewort)	4.8	95.2	4.8	0.0	0.0	1.0
Nitella tenuissima (Compact stonewort)	2.4	97.6	2.4	0.0	0.0	0.5
Potamogeton amplifolius (Broad-leaved pondweed)	6.0	94.0	4.8	0.0	1.2	2.1
**Potamogeton crispus* (Curly-leaved pondweed)	3.6	96.4	3.6	0.0	0.0	0.7
Potamogeton friesii (Fries' pondweed)	3.6	96.4	8.3	1.2	0.0	2.4
Potamogeton gramineus (Grass-leaved pondweed)	9.5	90.5	2.4	0.0	0.0	0.5
Potamogeton illinoensis (Illinois pondweed)	14.3	85.7	11.9	2.4	0.0	3.8
Potamogeton zosteriformis (Flat-stem pondweed)	10.7	89.3	10.7	0.0	0.0	2.1
Stuckenia pectinata (Sago pondweed)	8.3	91.7	8.3	0.0	0.0	1.7
Utricularia gibba (Humped bladderwort)	1.2	98.8	1.2	0.0	0.0	0.2
Utricularia macrorhiza (Common bladderwort)	4.8	95.2	4.8	0.0	0.0	1.0
Utricularia purpurea (Purple bladderwort)	2.4	97.6	1.2	1.2	0.0	1.0

Table 6.0. –Continued.

Species	Frequency of Occurrence (%)	Rake Score Frequency per Species (%)				Plant Dominance Index
		0	1	3	5	
Vallisneria americana (Eel-grass)	34.5	65.5	29.8	3.6	1.2	9.3
Depth contour: 0-5 ft.						
Ceratophyllum demersum (Coontail)	8.7	91.3	8.7	0.0	0.0	1.7
Chara contraria (Opposite stonewort)	69.6	30.4	34.8	21.7	13.0	33.0
Chara globularis (Fragile stonewort)	4.3	95.7	4.3	0.0	0.0	0.9
Chara zeylanica (Ceylonian stonewort)	8.7	91.3	8.7	0.0	0.0	1.7
**Myriophyllum spicatum* (Eurasian Water-milfoil)	26.1	73.9	26.1	0.0	0.0	5.2
Najas flexilis (Common naiad)	26.1	73.9	26.1	0.0	0.0	5.2
Nitella tenuissima (Compact stonewort)	8.7	91.3	8.7	0.0	0.0	1.7
Potamogeton amplifolius (Broad-leaved pondweed)	17.4	82.6	17.4	0.0	0.0	3.5
Potamogeton friesii (Fries' pondweed)	4.3	95.7	4.3	0.0	0.0	0.9
Potamogeton gramineus (Grass-leaved pondweed)	30.4	69.6	26.1	4.3	0.0	7.8
Potamogeton illinoensis (Illinois pondweed)	13.0	87.0	13.0	0.0	0.0	2.6
Potamogeton zosteriformis (Flat-stem pondweed)	4.3	95.7	4.3	0.0	0.0	0.9
Stuckenia pectinata (Sago pondweed)	21.7	78.3	21.7	0.0	0.0	4.3
Utricularia gibba (Humped bladderwort)	4.3	95.7	4.3	0.0	0.0	0.9
Utricularia macrorhiza (Common bladderwort)	17.4	82.6	17.4	0.0	0.0	3.5
Utricularia purpurea (Purple bladderwort)	7.4	92.6	3.7	3.7	0.0	3.5
Vallisneria americana (Eel-grass)	17.4	82.6	17.4	0.0	0.0	3.5
Depth contour: 5-10 ft.						
Ceratophyllum demersum (Coontail)	16.7	83.3	11.1	0.0	5.6	7.8
Chara contraria (Opposite stonewort)	50.0	50.0	27.8	16.7	5.6	21.1

Table 6.0. –Continued.

Species	Frequency of Occurrence (%)	Rake Score Frequency per Species (%)				Plant Dominance Index
		0	1	3	5	
Chara globularis (Fragile stonewort)	16.7	83.3	16.7	0.0	0.0	3.3
Heteranthera dubia (Water star grass)	11.1	88.9	11.1	0.0	0.0	2.2
**Myriophyllum spicatum* (Eurasian Water-milfoil)	61.1	38.9	50.0	5.6	5.6	18.9
Najas flexilis (Common naiad)	44.4	55.6	33.3	11.1	0.0	13.3
Najas marina (Spiny naiad)	16.7	83.3	16.7	0.0	0.0	3.3
Potamogeton amplifolius (Broad-leaved pondweed)	5.6	94.4	0.0	0.0	5.6	5.6
**Potamogeton crispus* (Curly-leaved pondweed)	5.6	94.4	5.6	0.0	0.0	1.1
Potamogeton friesii (Fries' pondweed)	5.6	94.4	5.6	0.0	0.0	1.1
Potamogeton gramineus (Grass-leaved pondweed)	5.6	94.4	5.6	0.0	0.0	1.1
Potamogeton illinoensis (Illinois pondweed)	44.4	55.6	33.3	11.1	0.0	13.3
Potamogeton zosteriformis (Flat-stem pondweed)	11.1	88.9	11.1	0.0	0.0	2.2
Stuckenia pectinata (Sago pondweed)	11.1	88.9	11.1	0.0	0.0	2.2
Vallisneria americana (Eel-grass)	83.3	16.7	77.8	5.6	0.0	18.9
Depth contour: 10-15 ft.						
Ceratophyllum demersum (Coontail)	48.3	56.3	31.3	12.5	0.0	13.8
Chara contraria (Opposite stonewort)	6.3	93.8	6.3	0.0	0.0	1.3
Heteranthera dubia (Water star grass)	31.3	68.8	31.3	0.0	0.0	6.3
**Myriophyllum spicatum* (Eurasian Water-milfoil)	75.0	25.0	37.5	25.0	12.5	36.0
Najas flexilis (Common naiad)	6.3	93.8	6.3	0.0	0.0	1.3
Najas marina (Spiny naiad)	6.3	93.8	6.3	0.0	0.0	1.3
Nitella flexilis (Smooth stonewort)	6.3	93.8	6.3	0.0	0.0	1.3
**Potamogeton crispus* (Curly-leaved pondweed)	12.5	87.5	12.5	0.0	0.0	2.5

Table 6.0. –Continued.

Species	Frequency of Occurrence (%)	Rake Score Frequency per Species (%)				Plant Dominance Index
		0	1	3	5	
Potamogeton friesii (Fries' pondweed)	6.3	93.8	6.3	0.0	0.0	1.3
Potamogeton illinoensis (Illinois pondweed)	6.3	93.8	6.3	0.0	0.0	1.3
Potamogeton zosteriformis (Flat-stem pondweed)	18.8	81.3	18.8	0.0	0.0	3.8
Vallisneria americana (Eel-grass)	50.0	50.0	31.3	12.5	6.3	20.0
Depth contour: 15-20 ft.						
Ceratophyllum demersum (Coontail)	80.0	20.0	66.7	0.0	13.3	26.7
Chara contraria (Opposite stonewort)	6.7	93.3	6.7	0.0	0.0	1.3
Heteranthera dubia (Water star grass)	20.0	80.0	20.0	0.0	0.0	4.0
**Myriophyllum spicatum* (Eurasian Water-milfoil)	20.0	80.0	20.0	0.0	0.0	4.0
Nitella flexilis (Smooth stonewort)	13.3	86.7	13.3	0.0	0.0	2.7
Potamogeton zosteriformis (Flat-stem pondweed)	20.0	80.0	20.0	0.0	0.0	4.0
Vallisneria americana (Eel-grass)	13.3	86.7	13.3	0.0	0.0	2.7
Depth contour: 20-25 ft.						
Ceratophyllum demersum (Coontail)	25.0	75.0	25.0	0.0	0.0	5.0
Nitella flexilis (Smooth stonewort)	8.3	91.7	8.3	0.0	0.0	1.7

Table 7.0. Summary of aquatic macrophyte surveys conducted on Hudson Lake over the last thirty-five years. Synonyms provided in parentheses.

		Survey Year						
Taxon	Common Name	1972*	1978**	1991§	1998¥	2003Ɨ	2007†	2007‡
Bidens beckii	Water-marigold				X	X		X
Brasenia schreberi	Watershield				X	X		
Carex comosa	Bristly sedge					X		
Ceratophyllum sp.	Hornwort	X						
Ceratophyllum demersum	Coontail		X	X	X	X	X	X
Chara sp.	Stonewort	X	X	X				
Chara aspera	Rough stonewort					X		
Chara contraria	Opposite stonewort				X	X	X	X
Chara globularis	Fragile stonewort					X		X
Chara haitensis	Haitian stonewort					X	X	X
Chara vulgaris	Common stonewort					X		
Chara zeylanica	Ceylonian stonewort							X
Cyperus sp.	Sedge							X
Cyperus strigosus	Long-scaled nut sedge					X		
Decodon verticillatus	Swamp loosestrife				X			
Eleocharis obtusa	Blunt spike rush					X		
Elodea sp.	Water-weed	X						
Elodea canadensis	Common water-weed		X	X	X	X	X	X
Heteranthera dubia	Water star grass				X	X	X	X
Juncus sp.	Rush						X	X
Juncus nodosus	Joint rush					X		
Justicia americana (*Dianthera americana*)	Water-willow			X				
Lemna minor	Small duckweed					X		
Myriophyllum sp.	Water-milfoil	X	X	X				
Myriophyllum heterophyllum	Various-leaved water-milfoil				X			
Myriophyllum spicatum	Eurasian water-milfoil				X	X	X	X
Najas sp.	Naiad			X				
Najas flexilis	Common naiad					X	X	X
Najas marina L.	Spiny naiad					X	X	X

Table 7.0.–Continued

Taxon	Common Name	Survey Year						
		1972*	1978**	1991§	1998¥	2003	2007†	2007‡
Nitella flexilis	Smooth stonewort					X	X	X
Nitella tenuissima	Compact stonewort						X	
Nuphar sp.	Spatterdock		X					
Nuphar advena (*N. luteum*)	Common Spatterdock			X	X	X	X	X
Nymphaea sp.	Water-lily		X					
Nymphaea odorata subsp. tuberosa (*N. tuberosa*)	Fragrant water-lily			X	X	X	X	X
Phragmites australis	Common reed						X	X
Pontederia cordata	Pickerel weed				X	X	X	
Potamogeton amplifolius	Large-leaved pondweed				X	X	X	X
Potamogeton crispus	Curly-leaved pondweed	X	X	X	X	X	X	X
Potamogeton foliosus subsp. foliosus	Leafy pondweed					X		
Potamogeton friesii	Fries' pondweed				X	X	X	X
Potamogeton gramineus	Grass-leaved pondweed				X	X	X	X
Potamogeton illinoensis	Illinois pondweed	X	X	X	X	X	X	X
Potamogeton natans	Common pondweed			X	X	X	X	X
Potamogeton nodosus	Long-leaf pondweed			X				
Potamogeton pusillus subsp. tenuissimus	Broad-leaved small pondweed					X		
Potamogeton zosteriformis	Flat-stem pondweed				X	X	X	X
Sagittaria sp.	Arrowhead			X				
Sagittaria latifolia	Common arrowhead					X		
Sagittaria rigida	Stiff arrowhead				X	X		
Schoenoplectus acutus var. acutus	Hard-stem bulrush					X		
Schoenoplectus pungens	Three-square bulrush						X	
Schoenoplectus tabernaemontani	Great bulrush					X	X	X
Scirpus sp.	Bulrush	X	X	X	X			
Sparganium emersum	Dwarf bur-reed					X		
Spirodela polyrrhiza	Great duckweed					X		

Table 7.0.–Continued

Taxon	Common Name	Survey Year						
		1972*	1978**	1991§	1998¥	2003	2007†	2007‡
Stuckenia filiformis (*Potamogeton filiformis*)	Threadleaf-pondweed			X				
Stuckenia pectinata (*Potamogeton pectinatus*)	Sago pondweed	X	X	X	X	X	X	X
Typha sp.	Cat-tail	X	X	X				
Typha latifolia	Broad-leaved cat-tail					X	X	
Utricularia gibba	Humped bladderwort					X	X	
Utricularia macrorhiza (*U. foliosa*; *U. vulgaris*)	Common bladderwort			X	X	X	X	X
Utricularia minor	Small bladderwort					X		
Utricularia purpurea	Purple bladderwort				X	X	X	X
Vallisneria americana	Eel-grass			X	X	X	X	X
Wolffia columbiana	Columbian water-meal					X		

*IDNR (Report)
**IDNR (Report)
§Harza Engineering Co. (1991)
¥Scribailo and Alix (unpubl. data)
И Alix (2006)
†Pre-treatment survey
‡Post-treatment survey

Table 8.0. Estimated costs of alternative treatments based on the above prices for 2008.

	Alternative I			Alternative II					Alternative III		
Year	Plan Update	Herbicide	Total	Plan Update	Herbicide	Barrier	Monitoring	Total	Plan Update	Weevils	Total
2008	5000	19800	24800	5000	46500	2150	1000	54650	5000	20000	25000
2009	5000	19800	24800	5000	4000	0	1000	10000	5000	5000	10000
2010	5000	19800	24800	5000	4000	0	1000	10000	5000	5000	10000
2011	5000	19800	24800	5000	4000	0	1000	10000	5000	0	5000
Grand Total	20000	79200	99200	20000	58500	2150	4000	84650	20000	30000	50000

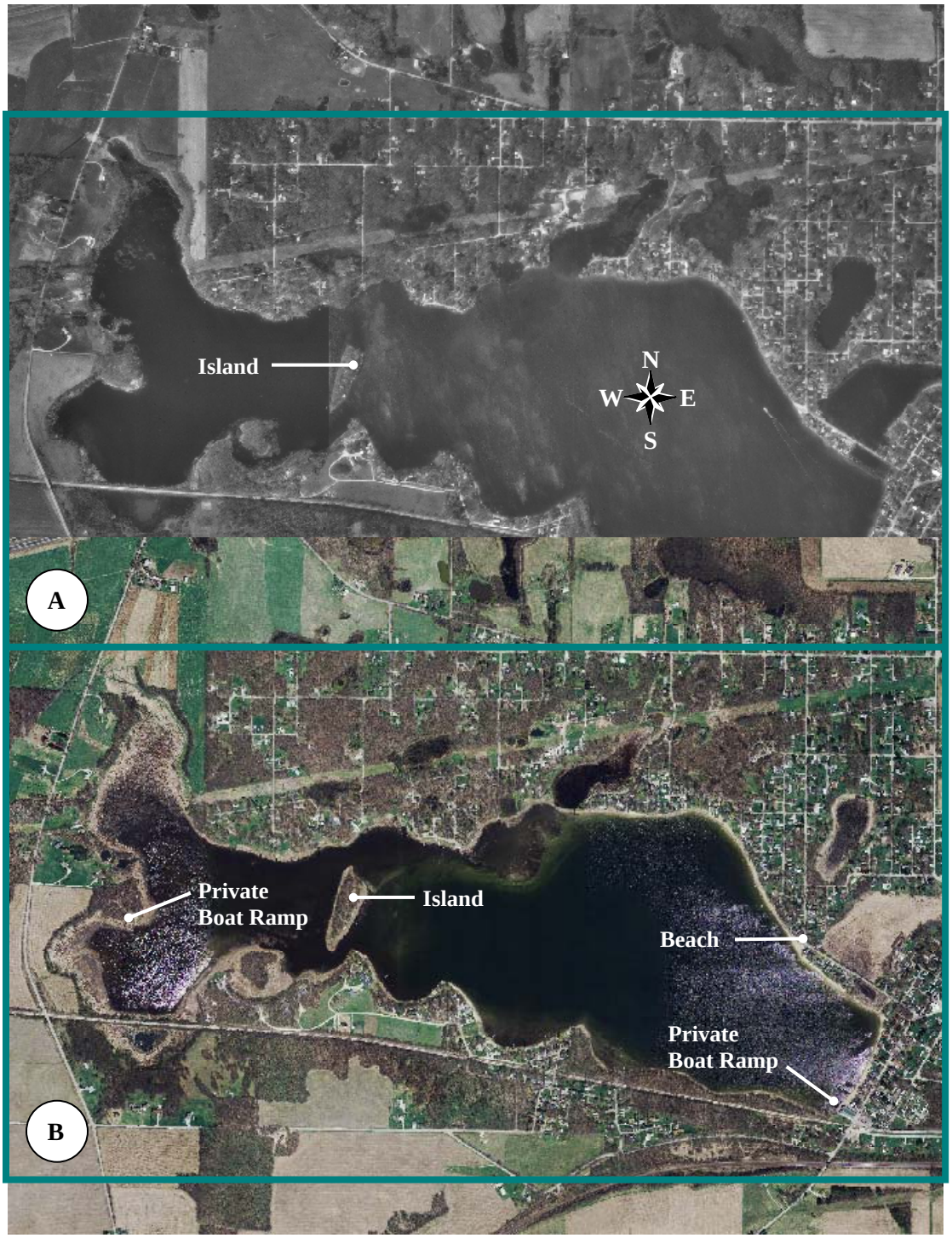

Figure 1.0. Aerial photographs of Hudson Lake, LaPorte County, Indiana. A. 1999 overhead view of the lake. B. 2006 overhead view of the lake. (Orthophotographs courtesy of the United States Geological Survey.)

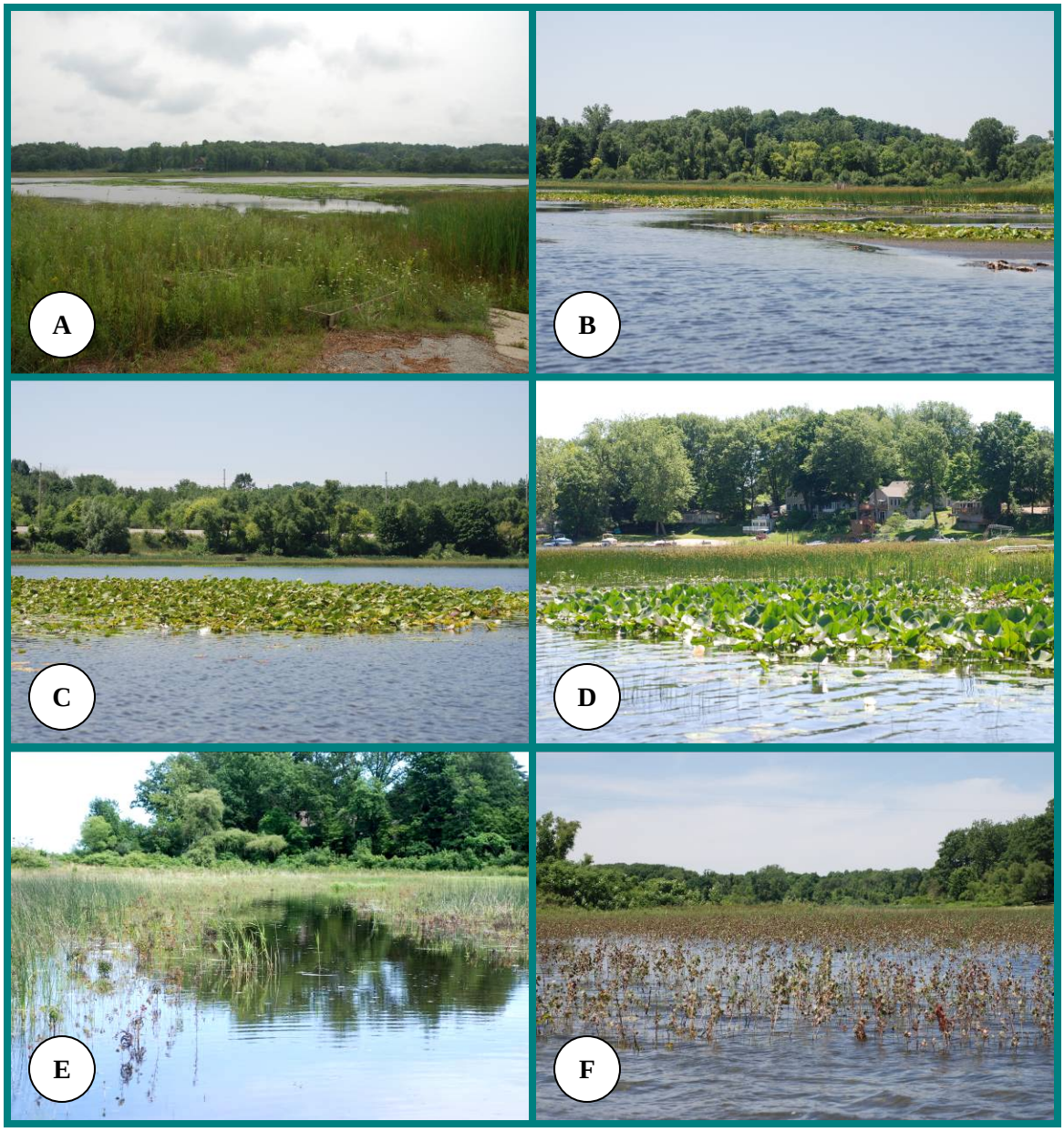

Figure 2.0. Little Hudson Lake in June 2007. A. Looking east from the west shoreline. Note the extensive cattails in front of the boat launch and lack of significant development. B. Looking south towards the boat launch in A from the north. Extensive drawdown of water levels is visible by the mudflats. C. Looking north towards the South Shore line. Note the yellow water lily beds in the middle of the lake where the water is less than two feet deep. D. Looking northwest towards the houses along East Tulip Lane. E. Southwest channel leading to Little Hudson Lake. The channel is too shallow for boat traffic and is overgrown with sedges. F. The northwest channel to Little Hudson Lake. Note the extensive poplar seedlings that germinated prior to a slight increase in water level. This channel is also impassable.

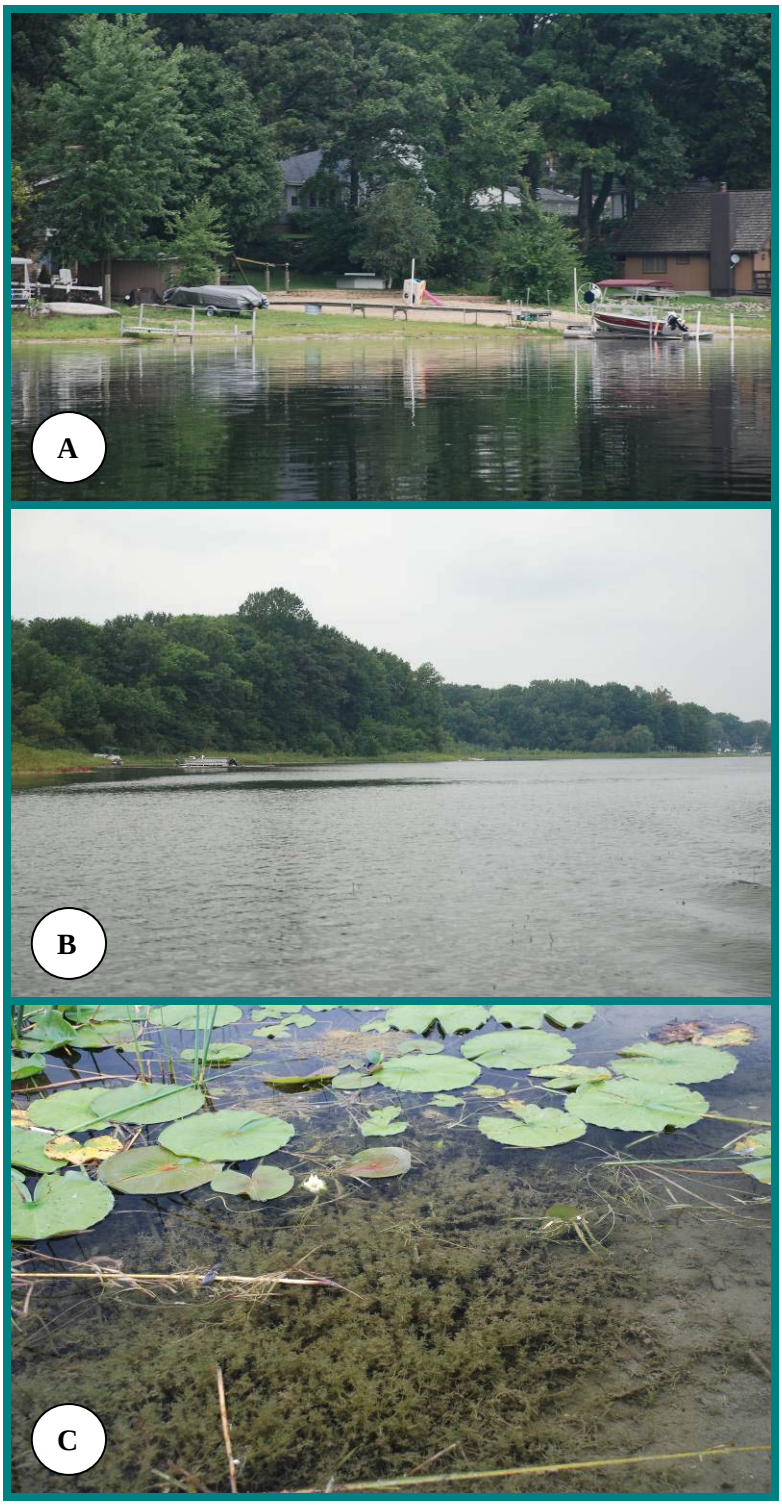

Figure 3.0. Big Hudson Lake in August 2007. A. View of the developed north shore. Note the extended dock to reach dropping water levels. B. View of the relatively undeveloped south shoreline (looking west). C. A bed of opposite stonewort (*Chara contraria*) and white water lilies (*Nymphaea odorata* subsp. *tuberosa*).

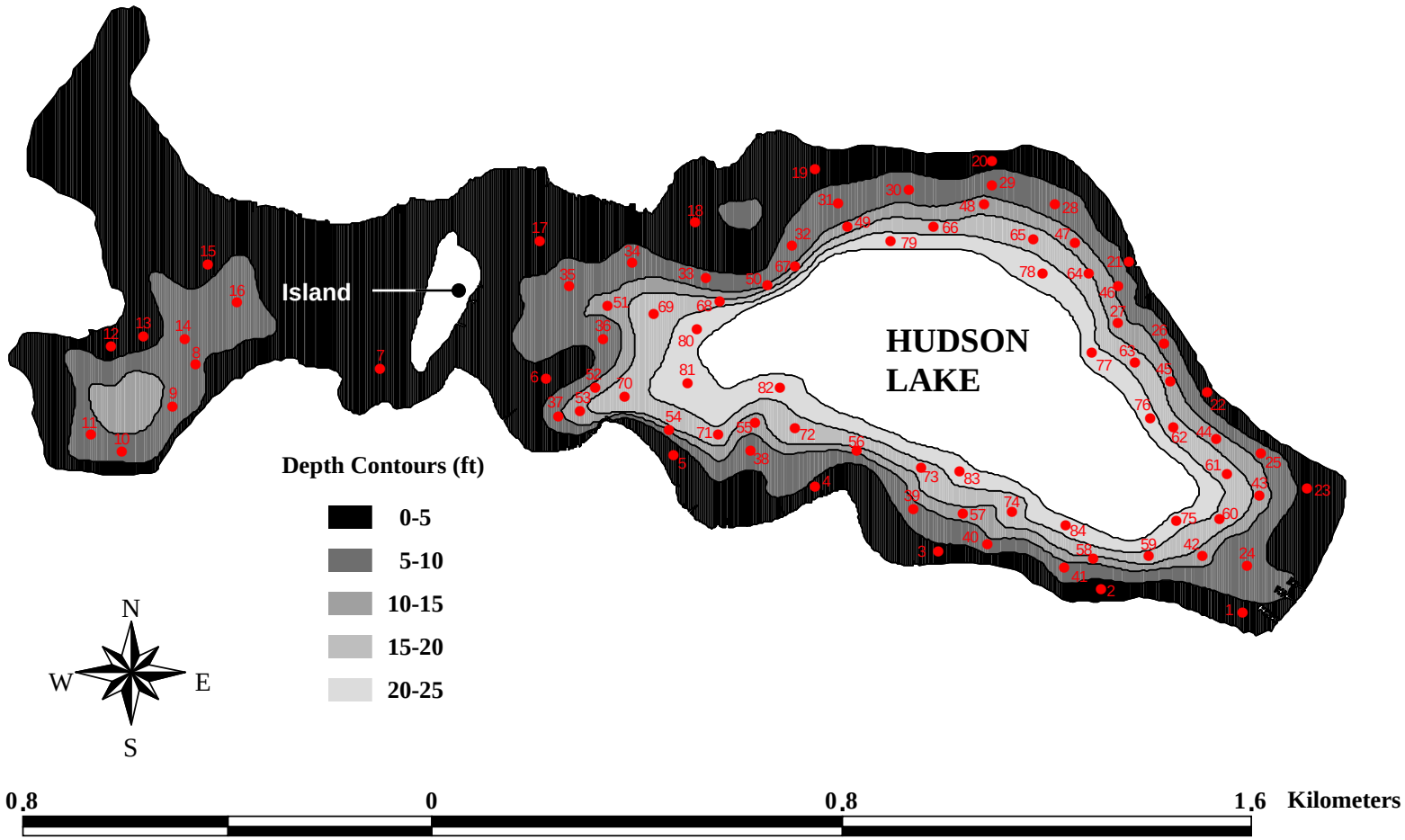

Figure 4.0. Distribution of sample locations in Hudson Lake.

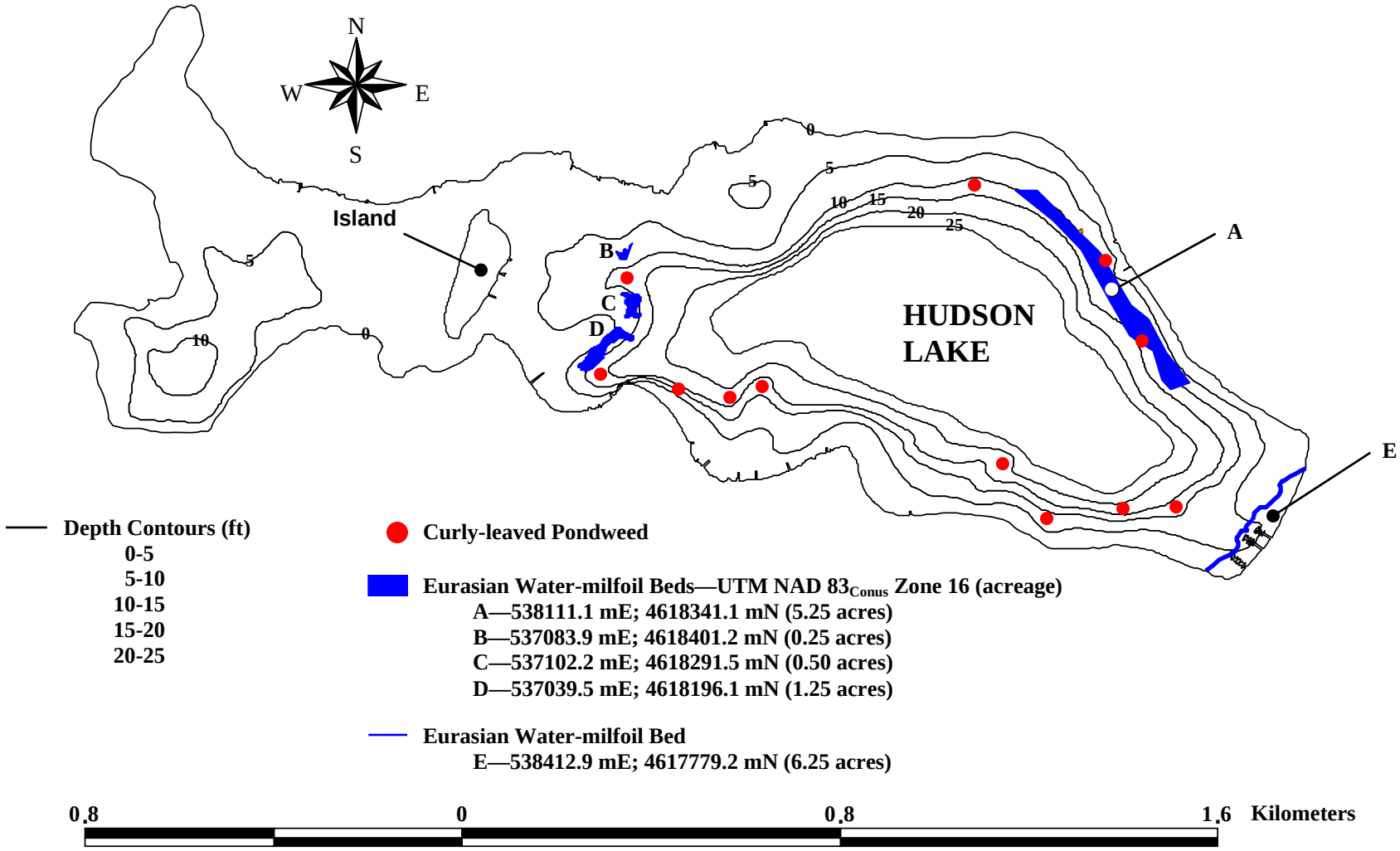

Figure 5.0. Pre-treatment survey map of invasive species, showing the occurrence of curly-leaved pondweed (*Potamogeton crispus*) and the extent of Eurasian water-milfoil (*Myriophyllum spicatum*).

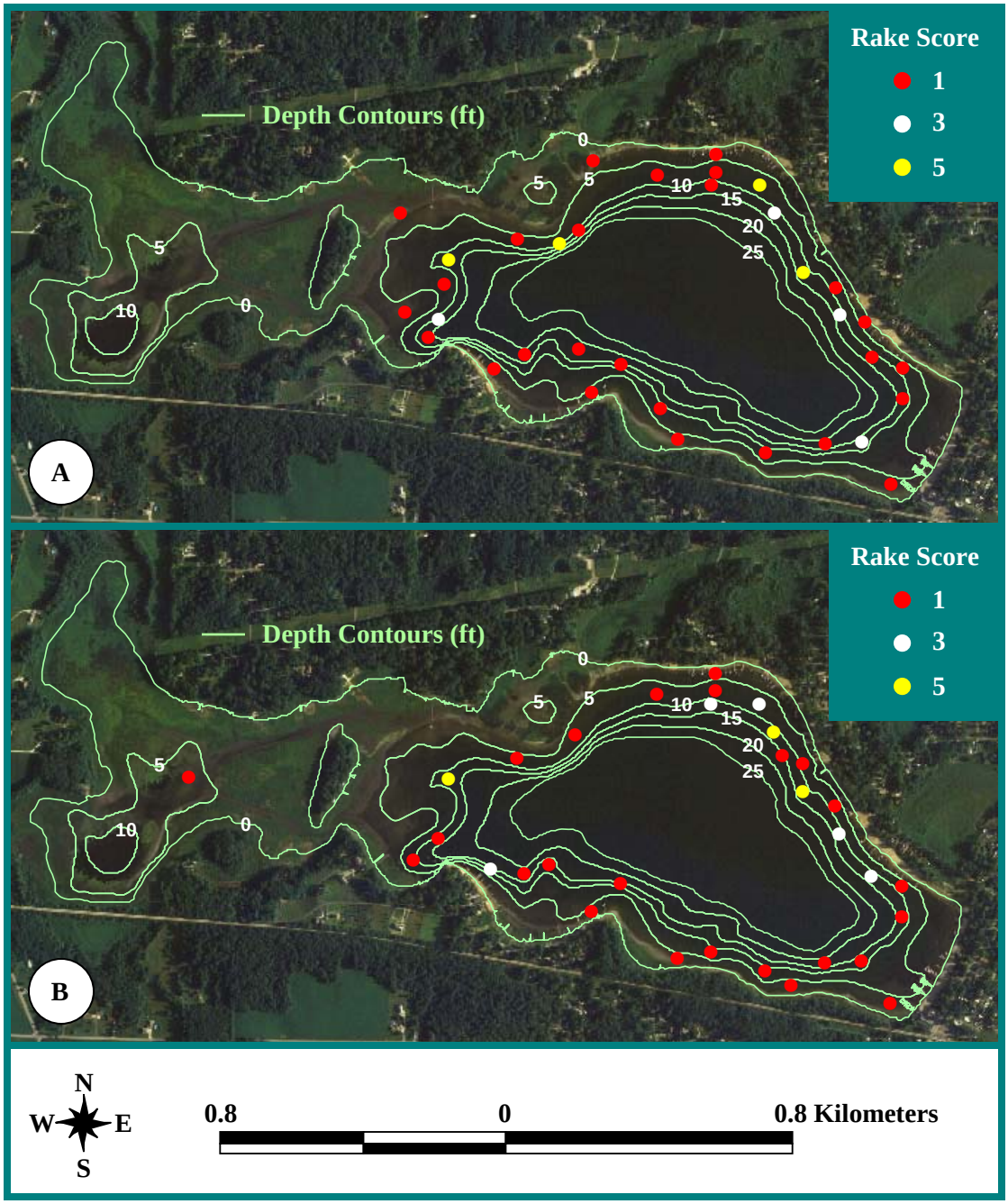

Figure 6.0. Distribution and abundance of Eurasian water-milfoil (*Myriophyllum spicatum*). A. Pre-treatment survey. B. Post-treatment survey. (Orthophotographs courtesy of the United States Geological Survey.)

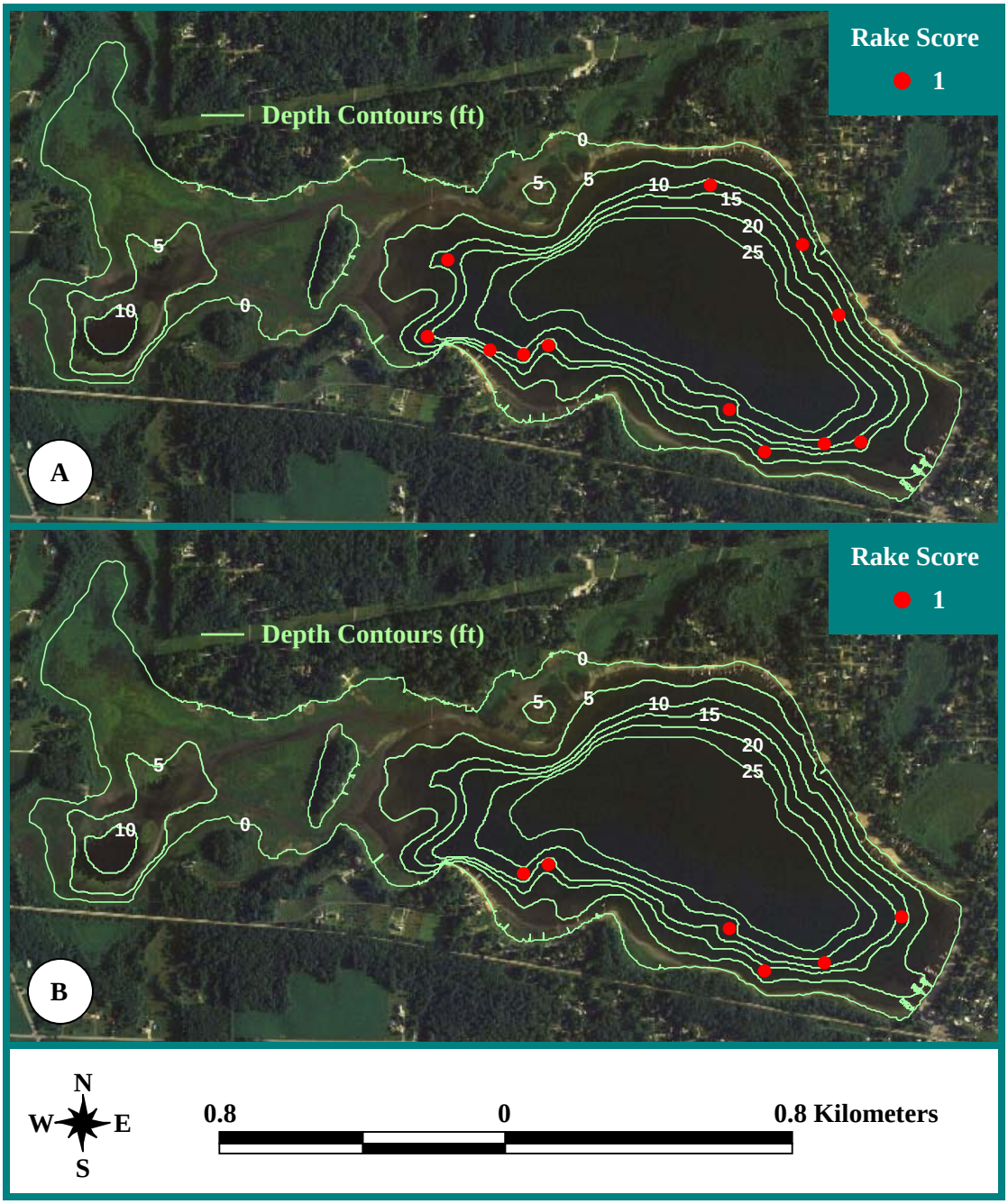

Figure 7.0. Distribution and abundance of curly-leaved pondweed (*Potamogeton crispus*). A. Pre-treatment survey. B. Post-treatment survey. (Orthophotographs courtesy of the United States Geological Survey.)

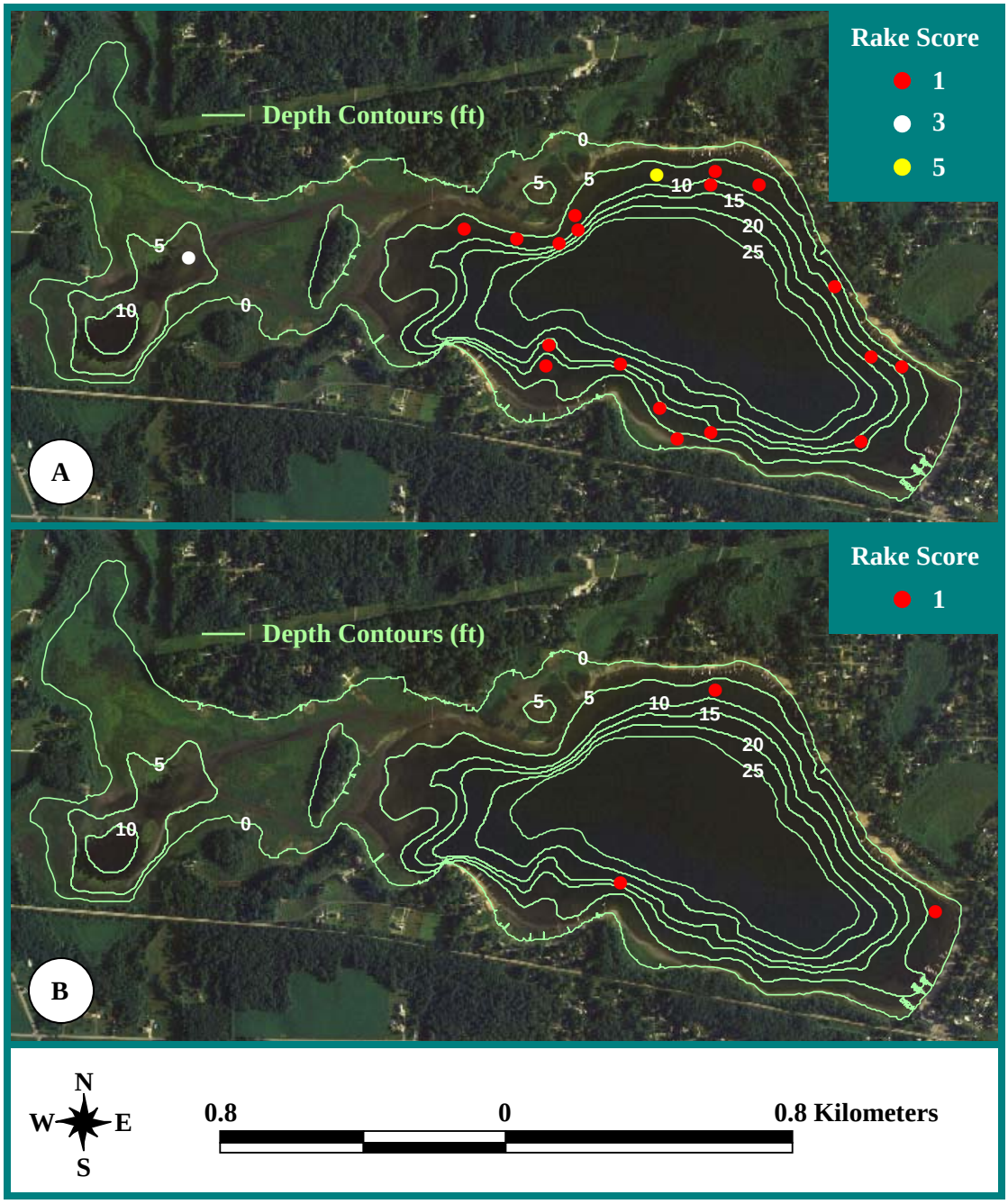

Figure 8.0. Distribution and abundance of Fries' pondweed (*Potamogeton friesii*). A. Pre-treatment survey. B. Post-treatment survey. (Orthophotographs courtesy of the United States Geological Survey.)

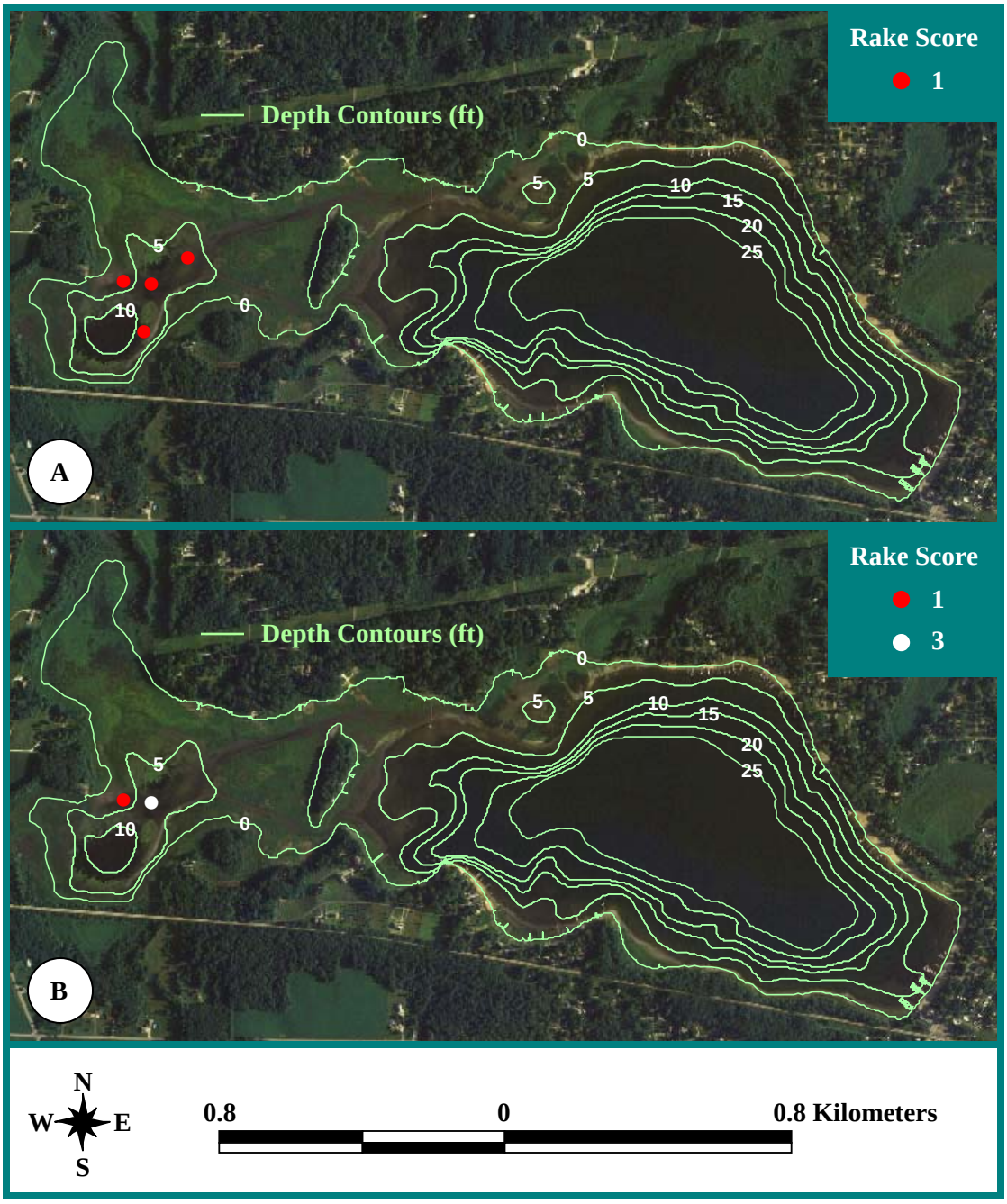

Figure 9.0. Distribution and abundance of purple bladderwort (*Utricularia purpurea*). A. Pre-treatment survey. B. Post-treatment survey. (Orthophotographs courtesy of the United States Geological Survey.)

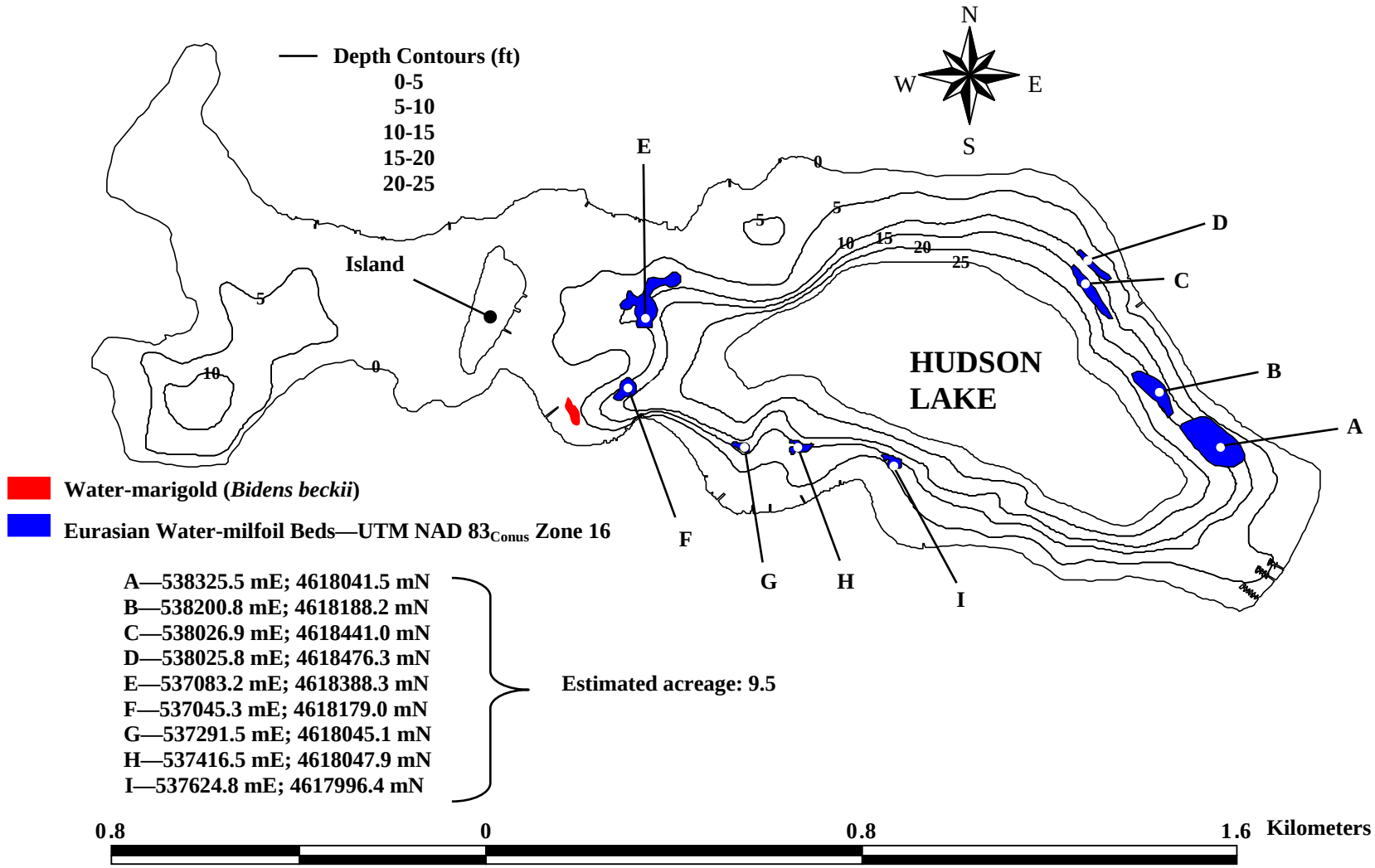

Figure 10.0. Post-treatment extent of Eurasian water-milfoil (*Myriophyllum spicatum*) and location of water-marigold (*Bidens beckii*).

Figure 11. Pondweed turions. A. Turion of Fries' pondweed (*Potamogeton friesii*). Note transparent bracts at right angle to leaves. B. Turion of stiff pondweed (*Potamogeton strictifolius*) with leaves of turion in same plane as regular leaves.

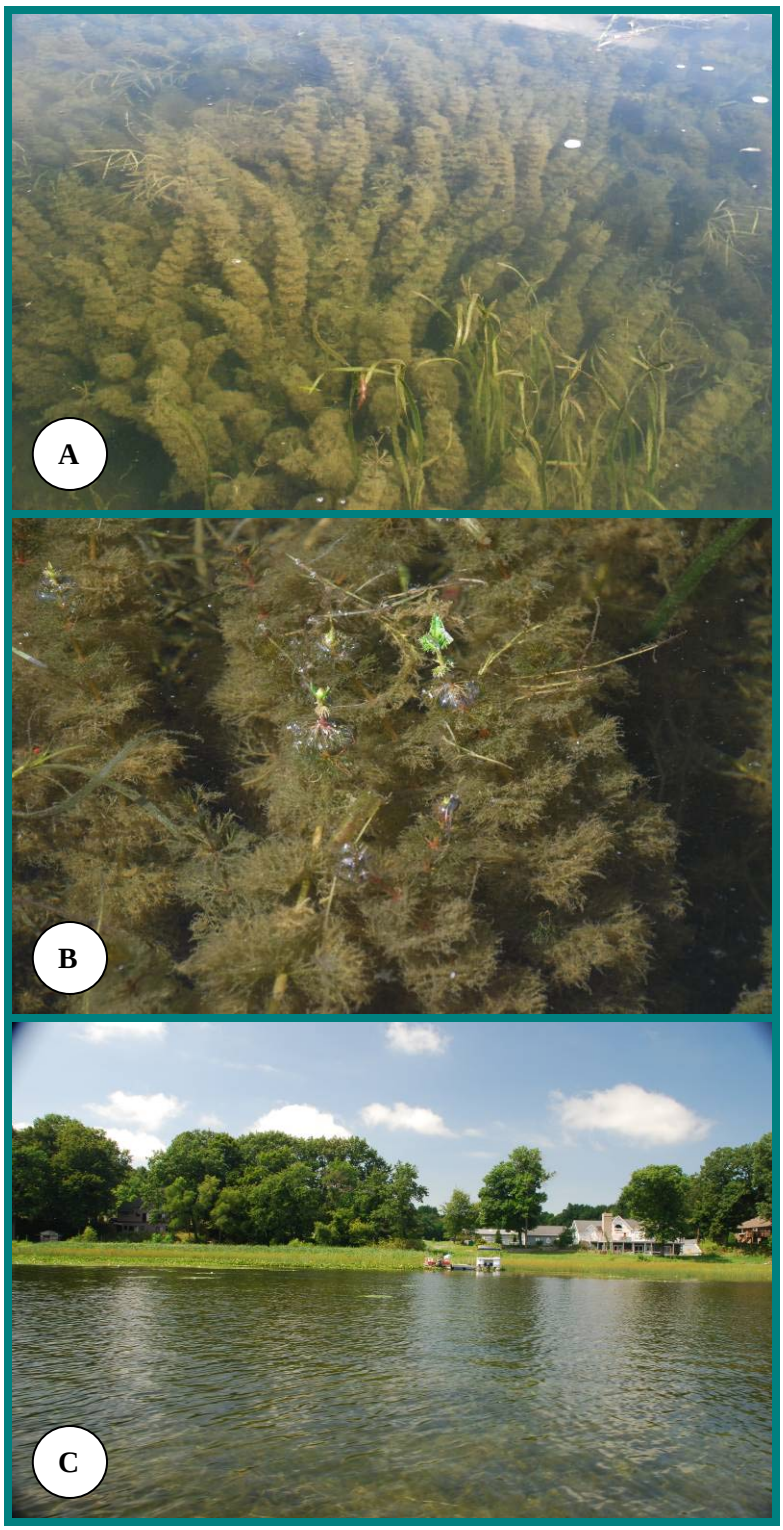

Figure 12.0. Water-marigold (*Bidens beckii*). A. Overview of the growth habit of water-marigold. B. Close-up of water-marigold showing the emergent leaves. C. The water-marigold bed in the southwest bay on Hudson Lake. The bed is located to the left of the pontoon boat in front of the water lilies.

Figure 13.0. Distinguishing characters between Eurasian water-milfoil (*Myriophyllum spicatum*) and the water-marigold (*Bidens beckii*). A. Eurasian water-milfoil. Note the feather-like whorled leaves. B. Water-marigold. Note the highly dissected leaves without a central axis. (Images courtesy of Susan Knight, University of Wisconsin, Trout Lake Station.)

Figure 14.0. Manual harvesting rakes. A. Standard Lake Rake. B. Typical Cutting Rake. (Images courtesy of Midwest Rake Company, LLC.).

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11.0. APPENDICES

11.1. Pre-treatment Water Body Cover Sheet.

Aquatic Vegetation Random Sampling (Tier 2)

Waterbody Cover Sheet Pre-Treatment

Surveying Organization: AQUATIC RESTORATION SYSTEMS, LLC

Contact Information: ROBIN W. SCRIBAILO (rscribailo@bnc.edu)

Waterbody Name: HUDSON LAKE

Lake ID: ——

County(s): LAPORTE

Date: JUNE 4, 12, 21, 2007

Habitat Stratum: IL

Avg. Lake Depth (ft): 10 ft.

Lake Level: 758 ft.

GPS Metadata

Datum: NAD 83

Zone: 16

Accuracy: 1.9

Crew Leader: ROBIN W. SCRIBAILO

Recorder: ROBIN W. SCRIBAILO

Method: D

Secchi Depth (ft): 15.1

Total # of Points Surveyed: 84

Total # of Species: 17

Littoral Zone Size (acres): 330

- ☐ Measured
- ☒ Estimated

Littoral Zone Max. Depth (ft): 24 ft.

- ☐ Measured
- ☒ Estimate (historical Secchi)
- ☐ Estimated (current Secchi)

Notable Conditions:

11.2. Tier II Data Sheets (Pre-treatment Survey)

WATERBODY NAME: Hudson Lake	DATE: June 4, 12, & 21, 2007
COUNTY: LaPorte	SECCHI DEPTH (ft): 15.1
SITE ID:	MAXIMUM PLANT DEPTH (ft): 22.0
SURVEYING ORGANIZATION: Aquatic Restoration	WEATHER: clear & sunny
CREW LEADER: Robin W. Scribailo	COMMENTS (Include voucher codes – V1, V2…):
RECORDER: Robin W. Scribailo	
CONTACT INFO: rscribailo@pnc.edu	*Rake score (1, 3, or 5). 9 = algae, emergent, or species observed but not sampled.*

Aquatic Restoration Systems AQRS, LLC

Species Codes:

Point ID	R/T	Easting	Northing	Depth (ft)	CHACON	POTILL	MYRSPI	NYMODT	POTFRI	STUPEC	ALGA	VALAME	CERDEM	POTZOS	POTAMP	UTRPUR	NAJMAR	UTRMAC							NOTES
1	T	538334.3	4617716.5	1.5	3	1	1	9																	
2	T	538055.0	4617765.2	2.5	3	1																			
3	T	537736.8	4617843.2	1.5	5		1		1	1															
4	T	537496.5	4617976.3	1.5	5		1			1	9														50%
5	T	537218.8	4618041.3	2.5	3		1					1													
6	T	536970.4	4618198.8	4.0			1					1	1	1	1										
7	T	536645.7	4618218.3	0.5																					0
8	T	536284.4	4618227.0	0.8	1						9														25%
9	T	536239.6	4618141.8	1.5						1						1	1								
10	T	536139.9	4618047.4	1.5				9		1															
11	T	536080.4	4618082.6	2.5									1												
12	T	536119.6	4618265.3	1.0				9			9														75%
13	T	536181.9	4618284.8	1.2	1											1		1							
14	T	536261.9	4618278.9	0.5	3						9					1									25%

Other plant species observed at lake: *Phragmites australis*, *Schoenoplectus pungens*, *Nuphar advena* subsp. *advena*

Tier II Data Sheets (Pre-treatment Survey) continued.

WATERBODY NAME: Hudson Lake	DATE: June 4, 12, & 21, 2007
COUNTY: LaPorte	SECCHI DEPTH (ft): 15.1
SITE ID:	MAXIMUM PLANT DEPTH (ft): 22.0
SURVEYING ORGANIZATION: Aquatic Restoration	WEATHER: clear & sunny
CREW LEADER: Robin W. Scribailo	COMMENTS (Include voucher codes – V1, V2…):
RECORDER: Robin W. Scribailo	
CONTACT INFO: rscribailo@pnc.edu	*Rake score (1, 3, or 5). 9 = algae, emergent, or species observed but not sampled.*

Aquatic Restoration Systems AQRS, LLC

Species Codes:

Point ID	R/T	Easting	Northing	Depth (ft)	CHACON	STUPEC	NYMODT	ALGA	NUPADV	POTFRI	UTRPUR	UTRMAC	SCHTAB	POTGRA	MYRSPI	VALAME	POTILL	NAJFLE	POTAMP						NOTES
15	T	536309.3	4618433.7	0.5	1	1	9	9	9																50%
16	T	536365.6	4618352.9	0.5	1		9			3	1	1	9												
17	T	536958.4	4618480.0	1.0	1									1	1										
18	T	537261.0	4618518.6	1.0	1		9						9												
19	T	537498.1	4618627.4	1.0	1										1	1									
20	T	537842.3	4618645.3	3.0	1	1									1	1	1								
21	T	538110.2	4618439.1	2.5	1									1											
22	T	538262.9	4618171.2	3.5				9							1		1								25%
23	T	538460.9	4617973.1	2.5	1											1	1	1							
24	T	538343.3	4617812.2	5.1	1	1										1		1	1						
25	T	538369.3	4618045.5	6.5	1					1					1		1								
26	T	538180.4	4618271.4	7.5	1					1					1	1									
27	T	538090.4	4618388.5	8.0											5										
28	T	537965.6	4618556.6	7.5						1					5	1									

Other plant species observed at lake:

Tier II Data Sheets (Pre-treatment Survey) continued.

WATERBODY NAME: Hudson Lake	DATE: June 4, 12, & 21, 2007
COUNTY: LaPorte	SECCHI DEPTH (ft): 15.1
SITE ID:	MAXIMUM PLANT DEPTH (ft): 22.0
SURVEYING ORGANIZATION: Aquatic Restoration	WEATHER: clear & sunny
CREW LEADER: Robin W. Scribailo	COMMENTS (Include voucher codes – V1, V2…): 41-MYRSPI-V1, V2; 41-CHACON-V1.42-CERDEM-V1; 42-MYRSPI-V1, V2;
RECORDER: Robin W. Scribailo	
CONTACT INFO: rscribailo@pnc.edu	*Rake score (1, 3, or 5). 9 = algae, emergent, or species observed but not sampled.*

Aquatic Restoration Systems AQRS, LLC

Species Codes:

Point ID	R/T	Easting	Northing	Depth (ft)	VALAME	POTFRI	POTZOS	MYRSPI	CERDEM	CHACON	POTAMP	NAJFLE	ALGA	HETDUB	STUPEC	POTILL	POTCRI								NOTES
29	T	537841.9	4618595.6	9.0	1	1	1	1																	
30	T	537680.4	4618586.3	8.0	1	5	1	1																	
31	T	537543.3	4618559.4	6.0	1		1																		
32	T	537450.8	4618471.4	5.2	1	1			1	1															
33	T	537284.1	4618404.8	9.0	1	1		1		1															
34	T	537139.6	4618434.4	5.5	1	1	1				1														
35	T	537013.7	4618386.3	5.5	1						1	1													
36	T	537080.4	4618278.9	6.5				1			3														
37	T	536995.2	4618119.6	9.0					3				9												10%
38	T	537369.3	4618049.2	5.1	1	1								1	1	1									
39	T	537687.8	4617930.7	6.0	1	1		1		1	1		9												10%
40	T	537832.7	4617859.3	7.0	1	1										1									
41	T	537984.1	4617808.5	8.0				1		3						1	1								
42	T	538253.5	4617835.1	10.1	1	1	1	3	1								1								

Other plant species observed at lake: *Pontederia cordata*, *Nuphar advena* subsp. *advena*

Tier II Data Sheets (Pre-treatment Survey) continued.

WATERBODY NAME: Hudson Lake	DATE: June 4, 12, & 21, 2007
COUNTY: LaPorte	SECCHI DEPTH (ft): 15.1
SITE ID:	MAXIMUM PLANT DEPTH (ft): 22.0
SURVEYING ORGANIZATION: Aquatic Restoration	WEATHER: clear & sunny
CREW LEADER: Robin W. Scribailo	COMMENTS (Include voucher codes – V1, V2…):44-POTFRI-V1, V2, & V3; 48-POTZOS-V1, V2; 51-POTCRI-V1; 54-NITFLE-V1
RECORDER: Robin W. Scribailo	
CONTACT INFO: rscribailo@pnc.edu	*Rake score (1, 3, or 5). 9 = algae, emergent, or species observed but not sampled.*

Aquatic Restoration Systems AQRS, LLC

Species Codes:

Point ID	R/T	Easting	Northing	Depth (ft)	MYRSPI	POTCRI	CERDEM	POTFRI	POTZOS	VALAME	NITFLE	ALGA													NOTES
43	T	538367.4	4617957.9	11.0	1		1		1																
44	T	538282.6	4618074.1	11.0	1			1		1															
45	T	538191.0	4618192.5	12.0	3	1																			
46	T	538090.4	4618310.9	12.0		1					1														
47	T	538005.5	4618478.4	11.5	3		1		1																
48	T	537829.1	4618556.6	13.0	1	1	1	1	1	1															
49	T	537558.7	4618509.7	15.0						1															
50	T	537404.6	4618391.3	12.5	5		5	1																	
51	T	537091.8	4618348.9	10.2	5	1																			
52	T	537065.0	4618179.1	13.0	3		3		1																
53	T	537036.0	4618132.2	12.0	1	1	1			1															
54	T	537212.1	4618093.1	13.0		1	1			1	1	9													
55	T	537377.8	4618107.6	12.5		1	1	1	1		1														10%
56	T	537578.9	4618051.8	12.0	1		1	1		1															

Other plant species observed at lake: *Potamogeton natans*, *Juncus* sp., *Elodea canadensis*, *Chara haitensis*

Tier II Data Sheets (Pre-treatment Survey) continued.

WATERBODY NAME: Hudson Lake	DATE: June 4, 12, & 21, 2007
COUNTY: LaPorte	SECCHI DEPTH (ft): 15.1
SITE ID:	MAXIMUM PLANT DEPTH (ft): 22.0
SURVEYING ORGANIZATION: Aquatic Restoration	WEATHER: clear & sunny
CREW LEADER: Robin W. Scribailo	COMMENTS (Include voucher codes – V1, V2…):64-CERDEM-V1.
RECORDER: Robin W. Scribailo	
CONTACT INFO: rscribailo@pnc.edu	*Rake score (1, 3, or 5). 9 = algae, emergent, or species observed but not sampled.*

Aquatic Restoration Systems AQRS, LLC

Species Codes:

Point ID	R/T	Easting	Northing	Depth (ft)	VALAME	ALGA	HETDUB	MYRSPI	POTCRI	CERDEM	NITFLE	POTFRI	CHACON												NOTES
57	T	537786.6	4617922.2	11.0	1	9	1																		10%
58	T	538041.3	4617828.4	14.5	1	9																			10%
59	T	538150.8	4617832.8	15.2		9		1	1	1	1														10%
60	T	538289.3	4617908.8	15.1						3															
61	T	538302.7	4618002.6	15.2			1			3															
62	T	538197.7	4618098.7	17.0						1															
63	T	538123.9	4618230.5	16.0																					0
64	T	538030.9	4618413.5	15.1			1			3															
65	T	537922.9	4618485.1	16.0						1															
66	T	537728.5	4618509.7	20.0																					0
67	T	537458.6	4618430.6	19.0	1		1	1		1		1	1												
68	T	537311.2	4618358.0	20.0						1															
69	T	537179.7	4618329.4	15.1																					0
70	T	537124.4	4618161.7	15.3																					0

Other plant species observed at lake:

Tier II Data Sheets (Pre-treatment Survey) continued.

WATERBODY NAME: Hudson Lake	DATE: June 4, 12, & 21, 2007
COUNTY: LaPorte	SECCHI DEPTH (ft): 15.1
SITE ID:	MAXIMUM PLANT DEPTH (ft): 22.0
SURVEYING ORGANIZATION: Aquatic Restoration	WEATHER: clear & sunny
CREW LEADER: Robin W. Scribailo	COMMENTS (Include voucher codes – V1, V2…):
RECORDER: Robin W. Scribailo	
CONTACT INFO: rscribailo@pnc.edu	*Rake score (1, 3, or 5). 9 = algae, emergent, or species observed but not sampled.*

Aquatic Restoration Systems AQRS, LLC

Species Codes:

Point ID	R/T	Easting	Northing	Depth (ft)	HETDUB	MYRSPI	POTCRI	CERDEM																	NOTES
71	T	537307.4	4618083.5	15.2	1	1	1	1																	
72	T	537456.1	4618096.9	15.1		1																			
73	T	537703.9	4618014.9	16.0																					0
74	T	537883.0	4617925.3	15.5	1		1	1																	
75	T	538203.2	4617906.3	20.2																					0
76	T	538153.7	4618117.8	20.1				1																	
77	T	538037.4	4618251.3	22.0				1																	
78	T	537942.1	4618413.3	20.5				1																	
79	T	537644.8	4618481.9	22.0																					0
80	T	537265.5	4618300.8	20.3																					0
81	T	537248.3	4618188.4	21.0																					0
82	T	537427.5	4618180.7	20.2																					0
83	T	537778.2	4618009.2	20.1																					0
84	T	537985.9	4617896.7	20.1				1																	

Other plant species observed at lake:

11.3. Tier II Standard Data Summary Sheet (Pre-treatment Survey).

Occurrence and abundance of submersed aquatic plants in Hudson Lake.

County:	LaPorte	Sites with plants:	71	Mean species/site:	2.42
Date:	JUN 4, 12, & 21, 2007	Sites with native plants:	32	Standard error (ms/s):	0.18
Secchi (ft):	15.1	Number of species:	17	Mean native species/site:	1.87
Maximum plant depth (ft):	22	Number of native species:	15	Standard error (mns/s):	0.16
Trophic status:	Oligotrophic	Maximum species/site:	6	Species diversity:	0.90
Total sites:	84			Native species diversity:	0.88

All depths (0 to 25 ft)	**Frequency of**	**Rake score frequency per species**				**Plant Dominance**
Species	**Occurrence**	**0**	**1**	**3**	**5**	
CERDEM (*Ceratophyllum demersum*)	33.3	67.7	26.2	6.0	1.2	10.0
CHACON (*Chara contraria*)	28.6	71.4	20.2	6.0	2.4	10.0
HETDUB (*Heteranthera dubia*)	8.3	91.7	8.3	0.0	0.0	1.7
MYRSPI (*Myriophyllum spicatum*)	40.5	59.5	31.0	4.8	4.8	13.8
NAJFLE (*Najas flexilis*)	3.6	96.4	3.6	0.0	0.0	0.7
NAJMAR (*Najas marina*)	1.2	98.8	1.2	0.0	0.0	0.2
NITFLE (*Nitella flexilis*)	4.8	95.2	4.8	0.0	0.0	1.0
POTAMP (*Potamogeton amplifolius*)	7.1	92.9	6.0	1.2	0.0	1.9
POTCRI (*Potamogeton crispus*)	14.3	85.7	14.3	0.0	0.0	2.9
POTFRI (*Potamogeton friesii*)	23.8	76.2	21.4	1.2	1.2	6.2
POTGRA (*Potamogeton gramineus*)	2.4	97.6	2.4	0.0	0.0	0.5
POTILL (*Potamogeton illinoensis*)	10.7	89.3	10.7	0.0	0.0	2.1
POTZOS (*Potamogeton zosteriformis*)	13.1	86.9	13.1	0.0	0.0	2.6
STUPEC (*Stuckenia pectinata*)	9.5	90.5	9.5	0.0	0.0	1.9
UTRMAC (*Utricularia macrorhiza*)	2.4	97.6	2.4	0.0	0.0	0.5
UTRPUR (*Utricularia purpurea*)	4.8	95.2	4.8	0.0	0.0	1.0
VALAME (*Vallisneria americana*)	33.3	66.7	33.3	0.0	0.0	6.7

Depth: 0 to 5 ft	**Frequency of**	**Rake score frequency per species**				**Plant Dominance**
Species	**Occurrence**	**0**	**1**	**3**	**5**	
CERDEM (*Ceratophyllum demersum*)	8.7	91.3	8.7	0.0	0.0	1.7
CHACON (*Chara contraria*)	69.6	30.4	43.5	17.4	8.7	27.8
MYRSPI (*Myriophyllum spicatum*)	39.1	60.9	39.1	0.0	0.0	7.8
NAJFLE (*Najas flexilis*)	4.3	95.7	4.3	0.0	0.0	0.9
NAJMAR (*Najas marina*)	4.3	95.7	4.3	0.0	0.0	0.9
POTAMP (*Potamogeton amplifolius*)	4.3	95.7	4.3	0.0	0.0	0.9
POTFRI (*Potamogeton friesii*)	8.7	91.3	4.3	4.3	0.0	3.5
POTGRA (*Potamogeton gramineus*)	8.7	91.3	8.7	0.0	0.0	1.7
POTILL (*Potamogeton illinoensis*)	21.7	78.3	21.7	0.0	0.0	4.3
POTZOS (*Potamogeton zosteriformis*)	4.3	96.7	4.3	0.0	0.0	0.9
STUPEC (*Stuckenia pectinata*)	26.1	73.9	26.1	0.0	0.0	5.2
UTRMAC (*Utricularia macrorhiza*)	8.7	91.3	8.7	0.0	0.0	1.7
UTRPUR (*Utricularia purpurea*)	17.4	82.6	17.4	0.0	0.0	3.5
VALAME (*Vallisneria americana*)	21.7	78.3	21.7	0.0	0.0	4.3

Depth: 5 to 10 ft	**Frequency of**	**Rake score frequency per species**				**Plant Dominance**
Species	**Occurrence**	**0**	**1**	**3**	**5**	
CERDEM (*Ceratophyllum demersum*)	11.1	88.9	5.6		[illegible]	4.4
CHACON (*Chara contraria*)	38.9	61.1	33.3		[illegible]	10.0
HETDUB (*Heteranthera dubia*)	5.6	94.4	5.6		[illegible]	1.1
MYRSPI (*Myriophyllum spicatum*)	55.6	44.4	44		1	20.0
NAJFLE (*Najas flexilis*)	11.1	88.9	11		0.0	2.2
POTAMP (*Potamogeton amplifolius*)	27.8	72.2	22		0.0	7.8
POTCRI (*Potamogeton crispus*)	5.6	94.4	5		0.0	1.1
POTFRI (*Potamogeton friesii*)	61.1	38.9	55.6	0.0	5.6	16.7
POTILL (*Potamogeton illinoensis*)	22.2	78.8	22.2	0.0	0.0	4.4
POTZOS (*Potamogeton zosteriformis*)	22.2	78.8	22.2	0.0	0.0	4.4
STUPEC (*Stuckenia pectinata*)	11.1	88.9	11.1	0.0	0.0	2.2
VALAME (*Vallisneria americana*)	72.2	27.8	72.2	0.0	0.0	4.4

Tier II Standard Data Summary Sheet (Pre-treatment Survey) continued.

Depth: 10 to 15 ft	Frequency of	Rake score frequency per species				Plant Dominance
Species	Occurrence	0	1	3	5	
CERDEM (*Ceratophyllum demersum*)	58.8	41.2	57.1	5.9	5.9	18.8
HETDUB (*Heteranthera dubia*)	5.9	94.1	5.9	0.0	0.0	1.2
MYRSPI (*Myriophyllum spicatum*)	64.7	35.3	29.4	23.5	11.8	31.8
NAJFLE (*Najas flexilis*)	17.6	82.4	17.6	0.0	0.0	3.5
POTCRI (*Potamogeton crispus*)	47.1	52.9	47.1	0.0	0.0	9.4
POTFRI (*Potamogeton friesii*)	35.3	64.7	35.3	0.0	0.0	7.1
POTZOS (*Potamogeton zosteriformis*)	35.3	64.7	35.3	0.0	0.0	7.1
VALAME (*Vallisneria americana*)	52.9	47.1	52.9	0.0	0.0	10.6

Depth: 15 to 20 ft	Frequency of	Rake score frequency per species				Plant Dominance
Species	Occurrence	0	1	3	5	
CERDEM (*Ceratophyllum demersum*)	62.5	37.5	43.8	18.8	0.0	20.0
CHACON (*Chara contraria*)	6.3	93.8	6.3	0.0	0.0	1.3
HETDUB (*Heteranthera dubia*)	31.3	68.8	31.3	0.0	0.0	6.3
MYRSPI (*Myriophyllum spicatum*)	25.0	75.0	25.0	0.0	0.0	5.0
NITFLE (*Nitella flexilis*)	6.3	93.8	6.3	0.0	0.0	1.3
POTCRI (*Potamogeton crispus*)	18.8	81.3	18.8	0.0	0.0	3.8
POTFRI (*Potamogeton friesii*)	6.3	93.8	6.3	0.0	0.0	1.3
VALAME (*Vallisneria americana*)	6.3	93.8	6.3	0.0	0.0	1.3

Depth: 20 to 25 ft	Frequency of	Rake score frequency per species				Plant Dominance
Species	Occurrence	0	1	3	5	
CERDEM (*Ceratophyllum demersum*)	40.0	60.0	40.0	0.0	0.0	8.0

11.4. Post-treatment Water Body Cover Sheet.

Aquatic Vegetation Random Sampling (Tier 2)

Waterbody Cover Sheet POST-TREATMENT

Surveying Organization: AQUATIC RESTORATION SYSTEMS, LLC

Contact Information: ROBIN W. SCRIBAILO (rscribailo@ars.cc)

Waterbody Name: HUDSON LAKE

Lake ID: ——

County(s): LAPORTE

Date: AUGUST 10, 14, 17, 2007

Habitat Stratum: IL

Avg. Lake Depth (ft): 10 ft.

Lake Level: 758 ft.

Crew Leader: ROBIN W. SCRIBAILO

GPS Metadata

Datum: NAD 83

Zone: 16

Accuracy: 2.2

Recorder: MITCHELL S. ALEX

Method: D

Secchi Depth (ft): 14.3

Total # of Points Surveyed: 84

Total # of Species: 21

Littoral Zone Size (acres): 330

- ☐ Measured
- ☒ Estimated

Littoral Zone Max. Depth (ft): 24 ft

- ☐ Measured
- ☒ Estimate (historical Secchi)
- ☐ Estimated (current Secchi)

Notable Conditions:

11.5. Tier II Data Sheets (Post-treatment Survey)

WATERBODY NAME: Hudson Lake	DATE: August 11, 14, & 17, 2007
COUNTY: LaPorte	SECCHI DEPTH (ft): 14.3
SITE ID:	MAXIMUM PLANT DEPTH (ft): 23.0
SURVEYING ORGANIZATION: Aquatic Restoration	WEATHER: Cloudy
CREW LEADER: Robin W. Scribailo	COMMENTS (Include voucher codes – V1, V2…):
RECORDER: Mitchell S. Alix	
CONTACT INFO: rscribailo@pnc.edu	*Rake score (1, 3, or 5). 9 = algae, emergent, or species observed but not sampled.*

Aquatic Restoration Systems AQRS, LLC

Species Codes:

Point ID	R/T	Easting	Northing	Depth (ft)	CHACON	MYRSPI	NYMODT	ALGA	POTGRA	STUPEC	POTAMP	CHAGLO	CERDEM	POTILL	VALAME	NAJFLE	SCHTAB	UTRMAC	UTRPUR						NOTES
1	T	538334.3	4617716.5	1.5	5	1	9	9																	20%
2	T	538055.0	4617765.2	2.7	1	1			3																
3	T	537736.8	4617843.2	1.8	3	1	9			1															
4	T	537496.5	4617976.3	1.7	5	1	9				1														
5	T	537218.8	4618041.3	2.5	5							1													
6	T	536970.4	4618198.8	4.5	1				1	1			1	1	1										
7	T	536645.7	4618218.3	1.0																					0
8	T	536284.4	4618227.0	1.5																					0
9	T	536239.6	4618141.8	1.6																					0
10	T	536139.9	4618047.4	1.8			9						1				9								
11	T	536080.4	4618082.6	2.8														1							
12	T	536119.6	4618265.3	1.5			9											1							
13	T	536181.9	4618284.8	1.7	3		9											1	1						
14	T	536261.9	4618278.9	1.5	1														3						

Other plant species observed at lake: *Cyperus* sp., *Phragmites australis*, *Potamogeton natans*, *Typha latifolia*

Tier II Data Sheets (Post-treatment Survey) continued.

WATERBODY NAME: Hudson Lake	DATE: August 11, 14, & 17, 2007
COUNTY: LaPorte	SECCHI DEPTH (ft): 14.3
SITE ID:	MAXIMUM PLANT DEPTH (ft): 23.0
SURVEYING ORGANIZATION: Aquatic Restoration	WEATHER: Cloudy
CREW LEADER: Robin W. Scribailo	COMMENTS (Include voucher codes – V1, V2…):
RECORDER: Mitchell S. Alix	
CONTACT INFO: rscribailo@pnc.edu	*Rake score (1, 3, or 5). 9 = algae, emergent, or species observed but not sampled.*

Species Codes:

Point ID	R/T	Easting	Northing	Depth (ft)	UTRMAC	NYMODT	CHACON	POTGRA	STUPEC	POTAMP	POTILL	VALAME	NAJFLE	MYRSPI	UTRGIB	ALGA	NUPADV	CHAZEY	NITTEN	POTFRI	POTZOS	CERDEM			NOTES
15	T	536309.3	4618433.7	1.5	1	9																			
16	T	536365.6	4618352.9	1.5			3	1	1	1	1	1	1	1	1										
17	T	536958.4	4618480.0	1.2		9	3		1				1			9									80%
18	T	537261.0	4618518.6	1.0		9	1										9								
19	T	537498.1	4618627.4	1.0			1	1					1												
20	T	537842.3	4618645.3	3.5			3	1	1	1	1	1	1	1											
21	T	538110.2	4618439.1	3.0			1	1					1					1							
22	T	538262.9	4618171.2	3.5			1	1										1	1						
23	T	538460.9	4617973.1	3.0			1			1		1	1							1	1				
24	T	538343.3	4617812.2	5.5			3	1			1	1	1												
25	T	538369.3	4618045.5	6.5			3				1	1	1	1											
26	T	538180.4	4618271.4	7.5			1					1	1	1											
27	T	538090.4	4618388.5	8.5							1			5								1			
28	T	537965.6	4618556.6	7.5								1		3											

Other plant species observed at lake: *Chara haitensis*, *Elodea canadensis*, *Juncus* sp., & *Nuphar advena* sp. advena

Tier II Data Sheets (Post-treatment Survey) continued.

WATERBODY NAME: Hudson Lake	DATE: August 11, 14, & 17, 2007
COUNTY: LaPorte	SECCHI DEPTH (ft): 14.3
SITE ID:	MAXIMUM PLANT DEPTH (ft): 23.0
SURVEYING ORGANIZATION: Aquatic Restoration	WEATHER: Cloudy
CREW LEADER: Robin W. Scribailo	COMMENTS (Include voucher codes – V1, V2…):
RECORDER: Mitchell S. Alix	
CONTACT INFO: rscribailo@pnc.edu	*Rake score (1, 3, or 5). 9 = algae, emergent, or species observed but not sampled.*

Aquatic Restoration Systems AQRS, LLC

Species Codes:

Point ID	R/T	Easting	Northing	Depth (ft)	MYRSPI	VALAME	POTFRI	NAJMAR	HETDUB	CHACON	NAJFLE	POTILL	POTZOS	STUPEC	CHAGLO	POTAMP	CERDEM	POTCRI							NOTES
29	T	537841.9	4618595.6	9.7	1	1	1	1	1																
30	T	537680.4	4618586.3	8.3	1	1																			
31	T	537543.3	4618559.4	6.7		1																			
32	T	537450.8	4618471.4	5.5	1	1				3															
33	T	537284.1	4618404.8	9.0	1	1				1	3	1													
34	T	537139.6	4618434.4	5.5		1				1	1		1	1	1										
35	T	537013.7	4618386.3	5.5							3	3													
36	T	537080.4	4618278.9	6.5												5									
37	T	536995.2	4618119.6	9.0	1	1											5								
38	T	537369.3	4618049.2	5.5		1		1	1	1		3		1											
39	T	537687.8	4617930.7	6.0		3					1	1	1												
40	T	537832.7	4617859.3	7.0	1	1				5	1	1			1										
41	T	537984.1	4617808.5	8.0	1	1		1		1					1		1	1							
42	T	538253.5	4617835.1	10.5	1	1											1								

Other plant species observed at lake: *Bidens beckii*

Tier II Data Sheets (Post-treatment Survey) continued.

WATERBODY NAME: Hudson Lake	DATE: August 11, 14, & 17, 2007
COUNTY: LaPorte	SECCHI DEPTH (ft): 14.3
SITE ID:	MAXIMUM PLANT DEPTH (ft): 23.0
SURVEYING ORGANIZATION: Aquatic Restoration	WEATHER: Cloudy
CREW LEADER: Robin W. Scribailo	COMMENTS (Include voucher codes – V1, V2…):
RECORDER: Mitchell S. Alix	
CONTACT INFO: rscribailo@pnc.edu	*Rake score (1, 3, or 5). 9 = algae, emergent, or species observed but not sampled.*

Aquatic Restoration Systems AQRS, LLC

Species Codes:

Point ID	R/T	Easting	Northing	Depth (ft)	MYRSPI	POTCRI	CERDEM	VALAME	HETDUB	NITFLE	POTILL	POTZOS	NAJMAR	POTFRI											NOTES
43	T	538367.4	4617957.9	11.0	1	1	1	1																	
44	T	538282.6	4618074.1	11.5	3			3	1																
45	T	538191.0	4618192.5	12.2	3			1																	
46	T	538090.4	4618310.9	12.0	1				1	1	1														
47	T	538005.5	4618478.4	12.0	5		1					1													
48	T	537829.1	4618556.6	13.2	3				1			1													
49	T	537558.7	4618509.7	16.0				1																	
50	T	537404.6	4618391.3	13.0			3						1												
51	T	537091.8	4618348.9	10.5	5																				
52	T	537065.0	4618179.1	13.0	1		3																		
53	T	537036.0	4618132.2	12.0			1																		
54	T	537212.1	4618093.1	13.0	3			1	1																
55	T	537377.8	4618107.6	12.5	1	1	1		1			1													
56	T	537578.9	4618051.8	12.2	1			3						1											

Other plant species observed at lake: *Bidens beckii*

Tier II Data Sheets (Post-treatment Survey) continued.

WATERBODY NAME: Hudson Lake	DATE: August 11, 14, & 17, 2007
COUNTY: LaPorte	SECCHI DEPTH (ft): 14.3
SITE ID:	MAXIMUM PLANT DEPTH (ft): 23.0
SURVEYING ORGANIZATION: Aquatic Restoration	WEATHER: Cloudy
CREW LEADER: Robin W. Scribailo	COMMENTS (Include voucher codes – V1, V2…):
RECORDER: Mitchell S. Alix	
CONTACT INFO: rscribailo@pnc.edu	*Rake score (1, 3, or 5). 9 = algae, emergent, or species observed but not sampled.*

Aquatic Restoration Systems AQRS, LLC

Species Codes:

Point ID	R/T	Easting	Northing	Depth (ft)	CHACON	VALAME	MYRSPI	CERDEM	POTZOS	ALGA	HETDUB	NITFLE													NOTES
57	T	537786.6	4617922.2	11.0	1	5																			
58	T	538041.3	4617828.4	14.5		1																			
59	T	538150.8	4617832.8	15.5			1	1	1																
60	T	538289.3	4617908.8	15.5				5																	
61	T	538302.7	4618002.6	15.5				5																	
62	T	538197.7	4618098.7	17.2				1		9															10%
63	T	538123.9	4618230.5	16.0				1		9															10%
64	T	538030.9	4618413.5	15.5			1	1			1														
65	T	537922.9	4618485.1	16.0		1		1			1														
66	T	537728.5	4618509.7	20.0				1																	
67	T	537458.6	4618430.6	20.5				1				1													
68	T	537311.2	4618358.0	20.2																					0
69	T	537179.7	4618329.4	15.5																					0
70	T	537124.4	4618161.7	16.0				1																	

Other plant species observed at lake:

Tier II Data Sheets (Post-treatment Survey) continued.

WATERBODY NAME: Hudson Lake	DATE: August 11, 14, & 17, 2007
COUNTY: LaPorte	SECCHI DEPTH (ft): 14.3
SITE ID:	MAXIMUM PLANT DEPTH (ft): 23.0
SURVEYING ORGANIZATION: Aquatic Restoration	WEATHER: Cloudy
CREW LEADER: Robin W. Scribailo	COMMENTS (Include voucher codes – V1, V2…):
RECORDER: Mitchell S. Alix	
CONTACT INFO: rscribailo@pnc.edu	*Rake score (1, 3, or 5). 9 = algae, emergent, or species observed but not sampled.*

Aquatic Restoration Systems AQRS, LLC

Species Codes:

Point ID	R/T	Easting	Northing	Depth (ft)	CERDEM	MYRSPI	NITFLE	POTZOS	HETDUB																NOTES
71	T	537307.4	4618083.5	15.5	1	1	1	1																	
72	T	537456.1	4618096.9	15.5																					0
73	T	537703.9	4618014.9	17.0	1																				
74	T	537883.0	4617925.3	15.5	1		1	1	1																
75	T	538203.2	4617906.3	20.5	1																				
76	T	538153.7	4618117.8	20.2																					0
77	T	538037.4	4618251.3	22.0																					0
78	T	537942.1	4618413.3	20.5																					0
79	T	537644.8	4618481.9	23.0	1																				
80	T	537265.5	4618300.8	20.5																					0
81	T	537248.3	4618188.4	21.5																					0
82	T	537427.5	4618180.7	20.5																					0
83	T	537778.2	4618009.2	20.5																					0
84	T	537985.9	4617896.7	21.0																					0

Other plant species observed at lake:

11.6. Tier II Standard Data Summary Sheet (Post-treatment Survey).

Occurrence and abundance of submersed aquatic plants in Hudson Lake.

County:	LaPorte	Sites with plants:	70	Mean species/site:	2.50
Date:	AUG 11, 14, & 17, 2007	Sites with native plants:	38	Standard error (ms/s):	0.23
Secchi (ft):	14.3	Number of species:	21	Mean native species/site:	2.08
Maximum plant depth (ft):	23	Number of native species:	19	Standard error (mns/s):	0.20
Trophic status:	Oligotrophic	Maximum species/site:	9	Species diversity:	0.91
Total sites:	84			Native species diversity:	0.90

All depths (0 to 25 ft)	Frequency of	Rake score frequency per species				Plant Dominance
Species	Occurrence	0	1	3	5	
CERDEM (*Ceratophyllum demersum*)	32.1	67.9	26.2	2.4	3.6	10.2
CHACON (*Chara contraria*)	32.1	67.9	17.9	9.5	4.8	14.0
CHAGLO (*Chara globularis*)	4.8	95.2	4.8	0.0	0.0	1.0
CHAZEY (*Chara zeylanica*)	2.4	97.6	2.4	0.0	0.0	0.5
HETDUB (*Heteranthera dubia*)	11.9	88.1	11.9	0.0	0.0	0.2
MYRSPI (*Myriophyllum spicatum*)	38.1	61.9	28.6	6.0	3.6	12.9
NAJFLE (*Najas flexilis*)	17.9	82.1	15.5	2.4	0.0	4.5
NAJMAR (*Najas marina*)	4.8	95.2	4.8	0.0	0.0	1.0
NITFLE (*Nitella flexilis*)	4.8	95.2	4.8	0.0	0.0	1.0
NITTEN (*Nitella tenuissima*)	2.4	97.6	2.4	0.0	0.0	0.5
POTAMP (*Potamogeton amplifolius*)	6.0	94.0	4.8	0.0	1.2	2.1
POTCRI (*Potamogeton crispus*)	3.6	96.4	3.6	0.0	0.0	0.7
POTFRI (*Potamogeton friesii*)	3.6	96.4	8.3	1.2	0.0	2.4
POTGRA (*Potamogeton gramineus*)	9.5	90.5	2.4	0.0	0.0	0.5
POTILL (*Potamogeton illinoensis*)	14.3	85.7	11.9	2.4	0.0	3.8
POTZOS (*Potamogeton zosteriformis*)	10.7	89.3	10.7	0.0	0.0	2.1
STUPEC (*Stuckenia pectinata*)	8.3	91.7	8.3	0.0	0.0	1.7
UTRGIB (*Utricularia gibba*)	1.2	98.8	1.2	0.0	0.0	0.2
UTRMAC (*Utricularia macrorhiza*)	4.8	95.2	4.8	0.0	0.0	1.0
UTRPUR (*Utricularia purpurea*)	2.4	97.6	1.2	1.2	0.0	1.0
VALAME (*Vallisneria americana*)	34.5	65.5	29.8	3.6	1.2	9.3

Depth: 0 to 5 ft	Frequency of	Rake score frequency per species				Plant Dominance
Species	Occurrence	0	1	3	5	
CERDEM (*Ceratophyllum demersum*)	8.7	91.3	8.7	0.0	0.0	1.7
CHACON (*Chara contraria*)	69.6	30.4	34.8	21.7	13.0	33.0
CHAGLO (*Chara globularis*)	4.3	95.7	4.3	0.0	0.0	0.9
CHAZEY (*Chara zeylanica*)	8.7	91.3	8.7	0.0	0.0	1.7
MYRSPI (*Myriophyllum spicatum*)	26.1	73.9	26.1	0.0	0.0	5.2
NAJFLE (*Najas flexilis*)	26.1	73.9	26.1	0.0	0.0	5.2
NITFLE (*Nitella tenuissima*)	8.7	91.3	8.7	0.0	0.0	1.7
POTAMP (*Potamogeton amplifolius*)	17.4	82.6	17.4	0.0	0.0	3.5
POTFRI (*Potamogeton friesii*)	4.3	95.7	4.3	0.0	0.0	0.9
POTGRA (*Potamogeton gramineus*)	30.4	69.6	26.1	4.3	0.0	7.8
POTILL (*Potamogeton illinoensis*)	13.0	87.0	13.0	0.0	0.0	2.6
POTZOS (*Potamogeton zosteriformis*)	4.3	95.7	4.3	0.0	0.0	0.9
STUPEC (*Stuckenia pectinata*)	21.7	78.3	21.7	0.0	0.0	4.3
UTRGIB (*Utricularia gibba*)	4.3	95.7	4.3	0.0	0.0	0.9
UTRMAC (*Utricularia macrorhiza*)	17.4	82.6	17.4	0.0	0.0	3.5
UTRPUR (*Utricularia purpurea*)	7.4	92.6	3.7	3.7	0.0	3.5
VALAME (*Vallisneria americana*)	17.4	82.6	17.4	0.0	0.0	3.5

Depth: 5 to 10 ft	Frequency of	Rake score frequency per species				Plant Dominance
Species	Occurrence	0	1	3	5	
CERDEM (*Ceratophyllum demersum*)	16.7	83.3	11.1	0.0	5.6	7.8
CHACON (*Chara contraria*)	50.0	50.0	27.8	16.7	5.6	21.1
CHAGLO (*Chara globularis*)	16.7	83.3	16.7	0.0	0.0	3.3
HETDUB (*Heteranthera dubia*)	11.1	88.9	11.1	0.0	0.0	2.2
MYRSPI (*Myriophyllum spicatum*)	61.1	38.9	50.0	5.6	5.6	18.9
NAJFLE (*Najas flexilis*)	44.4	55.6	33.3	11.1	0.0	13.3
NAJMAR (*Najas marina*)	16.7	83.3	16.7	0.0	0.0	3.3
POTAMP (*Potamogeton amplifolius*)	5.6	94.4	0.0	0.0	5.6	5.6
POTCRI (*Potamogeton crispus*)	5.6	94.4	5.6	0.0	0.0	1.1
POTFRI (*Potamogeton friesii*)	5.6	94.4	5.6	0.0	0.0	1.1
POTGRA (*Potamogeton gramineus*)	5.6	94.4	5.6	0.0	0.0	1.1
POTILL (*Potamogeton illinoensis*)	44.4	55.6	33.3	11.1	0.0	13.3

Tier II Standard Data Summary Sheet (Post-treatment Survey) continued.

POTZOS (*Potamogeton zosteriformis*)	11.1	88.9	11.1	0.0	0.0	2.2
STUPEC (*Stuckenia pectinata*)	11.1	88.9	11.1	0.0	0.0	2.2
VALAME (*Vallisneria americana*)	83.3	16.7	77.8	5.6	0.0	18.9

Depth: 10 to 15 ft	**Frequency of**	**Rake score frequency per species**				**Plant Dominance**
Species	**Occurrence**	**0**	**1**	**3**	**5**	
CERDEM (*Ceratophyllum demersum*)	48.3	56.3	31.3	12.5	0.0	13.8
CHACON (*Chara contraria*)	6.3	93.8	6.3	0.0	0.0	1.3
HETDUB (*Heteranthera dubia*)	31.3	68.8	31.3	0.0	0.0	6.3
MYRSPI (*Myriophyllum spicatum*)	75.0	25.0	37.5	25.0	12.5	36.0
NAJFLE (*Najas flexilis*)	6.3	93.8	6.3	0.0	0.0	1.3
NAJMAR (*Najas marina*)	6.3	93.8	6.3	0.0	0.0	1.3
NITFLE (*Nitella flexilis*)	6.3	93.8	6.3	0.0	0.0	1.3
POTCRI (*Potamogeton crispus*)	12.5	87.5	12.5	0.0	0.0	2.5
POTFRI (*Potamogeton friesii*)	6.3	93.8	6.3	0.0	0.0	1.3
POTILL (*Potamogeton illinoensis*)	6.3	93.8	6.3	0.0	0.0	1.3
POTZOS (*Potamogeton zosteriformis*)	18.8	81.3	18.8	0.0	0.0	3.8
VALAME (*Vallisneria americana*)	50.0	50.0	31.3	12.5	6.3	20.0

Depth: 15 to 20 ft	**Frequency of**	**Rake score frequency per species**				**Plant Dominance**
Species	**Occurrence**	**0**	**1**	**3**	**5**	
CERDEM (*Ceratophyllum demersum*)	80.0	20.0	66.7	0.0	13.3	26.7
CHACON (*Chara contraria*)	6.7	93.3	6.7	0.0	0.0	1.3
HETDUB (*Heteranthera dubia*)	20.0	80.0	20.0	0.0	0.0	4.0
MYRSPI (*Myriophyllum spicatum*)	20.0	80.0	20.0	0.0	0.0	4.0
NITFLE (*Nitella flexilis*)	13.3	86.7	13.3	0.0	0.0	2.7
POTZOS (*Potamogeton zosteriformis*)	20.0	80.0	20.0	0.0	0.0	4.0
VALAME (*Vallisneria americana*)	13.3	86.7	13.3	0.0	0.0	2.7

Depth: 20 to 25 ft	**Frequency of**	**Rake score frequency per species**				**Plant Dominance**
Species	**Occurrence**	**0**	**1**	**3**	**5**	
CERDEM (*Ceratophyllum demersum*)	25.0	75.0	25.0	0.0	0.0	5.0
NITFLE (*Nitella flexilis*)	8.3	91.7	8.3	0.0	0.0	1.7

11.7. Indiana Special Plant Survey Forms

11.7.1. *Fries' Pondweed (Potamogeton friesii)*

Quad Code:_____

Indiana Special Plant Survey Form

Element Name: POTAMOGETON FRIESII

Surveyor (s): SCRIBAILO & ALIX Date: 06/12/2007 Time: ___ to ___ A.M.

Contact information (telephone or email): rscribailo@pnc.edu

Location: ____ ¼ ____ ¼ ____ ¼ ____ Sec. ____T ____R ____ Quad name: _____

Repeat visit: Yes No Repeat visit needed: (Yes) No When: 06/2008

EO boundaries mapped: Yes (No) County: LA PORTE

points yes

Area name (if applicable): HUDSON LAKE

UTM NAD 83 Biology 536365.6 mE ; 4618352.9 mN

Phenology	Approx # Indiv	Population Area	Age Class
X In leaf	__ 1-10	__ 1 yd^2	__ % Seedlings
X In bud	__ 11-50	__1-5 yd^2	__% Immature
X In flower	__ 51-100	__5-10 yd^2	__% 1st year
__In fruit	X 101-1000	X 10-100 yd^2	__% Mature
__Seed Dispersing	__ 1001-10,000	__100 yd^2-2 ac	__%Senescent
__Dormant	__10,001+	__2 ac +	

Comments on above: _____

Compared to your last visit to this site:	Approx # Indiv	Population Area	Age Class
	X more	X more	X same
	__same	__same	__diff
	__less	__less	

Reproduction Is reproduction occurring? Y Type: __sexual, __asexual, X both

Show exact location and boundaries of taxon on map. (attach)

Population Distribution __ solitary, ✓ clumps or dense groups, __small patches or cushions

__small colonies or large carpets, __large, almost pure population stands.

Vigor: 1) very feeble, 2) feeble, 3) normal, 4) exceptionally vigorous

Evidence of symbiotic or parasitic relationships: —

Habitat

Aspect	Slope	Light	Topographic Position	Moisture
__N	__Flat	__Open	__Crest	__Inundated (Hydric)
__E	__0-10'	__Filtered	__Upper slope	__Saturated (Wet-mesic)
__S	__10-35'	__Shade	__Mid-Slope	__Moist (Mesic)
__W	__35' +		__Lower slope	__Dry (Xeric)
	__Vertical		__Bottom	

Elevation: _____ft to _____ft. Surface Relief: __/: __∪:__∩:__—:__~~

Substrate/Soils: Marl

Associated Natural Community/Plant Community: Aquatic

List other members of this genus co-occurring at this site: — none

Characteristic associated species: Chara contraria, & Utricularia

Macrorhiza

Estimated size of potential Habitat: (as in population area) Boundaries mapped: yes no

Ownership info: (if known) _____

NOTE: Collect specimen if a healthy, viable population exists. Collection # 5A

PVNC

11.7.2. *Purple Bladderwort (Utricularia purpurea)*

Quad Code:_____

Indiana Special Plant Survey Form

Element Name: UTRICULARIA PURPUREA

Surveyor (s): SCRIBAILO & ALIX Date: 06/04/2007 Time: ___ to ___ AM

Contact information (telephone or email): rscribailo@anc.edu

Location: ____ ¼ ____ ¼ ____ ¼ ____ Sec. ____T ____R ____ Quad name: _____

Repeat visit: Yes No Repeat visit needed: (Yes) No When: 07/2008

EO boundaries mapped: Yes (No) County: LAPORTE

Points yes

Area name (if applicable): HUDSON LAKE

UTM NAD83 Biology 536181.9 mE; 4618284.8 mN

Phenology	Approx # Indiv	Population Area	Age Class
X In leaf	__ 1-10	__ 1 yd^2	__ % Seedlings
__In bud	X 11-50	X 1-5 yd^2	__% Immature
__In flower	__ 51-100	__5-10 yd^2	__% 1st year
__In fruit	__101-1000	__10-100 yd^2	__% Mature
__Seed Dispersing	__ 1001-10,000	__100 yd^2-2 ac	__%Senescent
__Dormant	__10,001+	__2 ac +	

Comments on above: _____

Compared to your last visit to this site:	Approx # Indiv	Population Area	Age Class
	__more	__more	X same
	__same	__same	__diff
	X less	X less	

Reproduction Is reproduction occurring? ? Type: __sexual, __asexual, __both

Show exact location and boundaries of taxon on map. (attach)

Population Distribution __ solitary, __clumps or dense groups, ✓small patches or cushions

__small colonies or large carpets, __large, almost pure population stands.

Vigor: 1) very feeble, 2) feeble, 3) normal, ? 4) exceptionally vigorous

Evidence of symbiotic or parasitic relationships: ——

Habitat

Aspect	Slope	Light	Topographic Position	Moisture
__N	__Flat	__Open	__Crest	__Inundated (Hydric)
__E	__0-10'	__Filtered	__Upper slope	__Saturated (Wet-mesic)
__S	__10-35'	__Shade	__Mid-Slope	__Moist (Mesic)
__W	__35' +		__Lower slope	__Dry (Xeric)
	__Vertical		__Bottom	

Elevation: _____ft to _____ft. Surface Relief: ___/: ___∪:___∩:___—:___~~

Substrate/Soils: ——

Associated Natural Community/Plant Community: Aquatic

List other members of this genus co-occurring at this site: UTRICULARIA MACRORHIZA

Characteristic associated species: CHARA CONTRARIA

Estimated size of potential Habitat: (as in population area) Boundaries mapped: yes no

Ownership info: (if known) _____

NOTE: Collect specimen if a healthy, viable population exists. Collection # Sn PNC

11.7.3. *Water-marigold (Bidens becjkii)*

Quad Code:_____

Indiana Special Plant Survey Form

Element Name: BIDENS BECKII

Surveyor (s): ALIX & SCRIBAILO Date: 08/11/2007 Time: ___ to ___ P.M.

Contact information (telephone or email): malix@pnc.edu

Location: ____ ¼ ____ ¼ ____ ¼ ____ Sec. ____T ____R ____ Quad name: _____

Repeat visit: Yes No Repeat visit needed: (Yes) No When: 08/2008

EO boundaries mapped: (Yes) No County: LAPORTE

Area name (if applicable): HUDSON LAKE

Biology

Phenology	Approx # Indiv	Population Area	Age Class
✓ In leaf	__ 1-10	__ 1 yd^2	__ % Seedlings
__In bud	✓ 11-50	__1-5 yd^2	__% Immature
__In flower	__ 51-100	✓ 5-10 yd^2	__% 1st year
__In fruit	__101-1000	__10-100 yd^2	__% Mature
__Seed Dispersing	__ 1001-10,000	__100 yd^2-2 ac	__%Senescent
__Dormant	__10,001+	__2 ac +	

Comments on above: _____

Compared to your last visit to this site:	Approx # Indiv	Population Area	Age Class
	__more	__more	✓ same
	__same	__same	__diff
	✓ less	✓ less	

Reproduction Is reproduction occurring? ? Type: __sexual, __asexual, __both

Show exact location and boundaries of taxon on map. (attach)

Population Distribution __ solitary, ✓ clumps or dense groups, __small patches or cushions

__small colonies or large carpets, __large, almost pure population stands.

Vigor: 1) very feeble, 2) feeble, (3) normal, 4) exceptionally vigorous

Evidence of symbiotic or parasitic relationships: _____

Habitat

Aspect	Slope	Light	Topographic Position	Moisture
__N	__Flat	__Open	__Crest	__Inundated (Hydric)
__E	__0-10'	__Filtered	__Upper slope	__Saturated (Wet-mesic)
__S	__10-35'	__Shade	__Mid-Slope	__Moist (Mesic)
__W	__35' +		__Lower slope	__Dry (Xeric)
	__Vertical		__Bottom	

Elevation: _____ft to _____ft. Surface Relief: __/: __∪:__∩:__—:__~~

Substrate/Soils: Marl

Associated Natural Community/Plant Community: Aquatic

List other members of this genus co-occurring at this site: None

Characteristic associated species: NYMPHAEA ODORATA Subsp. TUBEROSA, STUCKENIA PECTINATA & CERATOPHYLLUM DEMERSUM

Estimated size of potential Habitat: (as in population area) Boundaries mapped: yes no

Ownership info: (if known) _____

NOTE: Collect specimen if a healthy, viable population exists. Collection # 5A
PAC.

11.8. Herbicide Application Permits

11.8.1. Alternative I (2, 4-D)

APPLICATION FOR AQUATIC VEGETATION CONTROL PERMIT
State Form 26727 (R / 11-03)
Approved State Board of Accounts 1987
[ ] Whole Lake [X] 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 4
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: Neal Connolly	Lake Assoc. Name: Hudson Lake Conservation Association	
Rural Route or Street: 55555 Pine Avenue		Phone Number: 574-210-2222
City and State: South Bend IN		ZIP Code: 46514
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): Hudson	Nearest Town: New Carlisle	County: Laporte
Does water flow into a water supply	[ ] Yes	[X] 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 # A	LAT/LONG or UTM's 537095.5 mE; 4618376.6 mN		
Total acres to be controlled 16	Proposed shoreline treatment length (ft) On map	Perpendicular distance from shoreline (ft) on map	
Maximum Depth of Treatment (ft) 15	Expected date(s) of treatment(s) Mid July 2008		

Treatment method: [X] Chemical [ ] Physical [ ] Biological Control [ ] 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. 2,4-D

Plant survey method: [X] Rake [ ] Visual [ ] Other (specify) _____

Aquatic Plant Name	Check if Target Species	Relative Abundance % of Community
Eurasian Water-milfoil (*Myriophyllum spicatum*)	X	100

Treatment Area # B	LAT/LONG or UTM's 537979.7 mE; 4618498.0 mN		
Total acres to be controlled 30.5	Proposed shoreline treatment length (ft) on map	Perpendicular distance from shoreline (ft) on map	
Maximum Depth of Treatment (ft) 15	Expected date(s) of treatment(s) Mid July 2008		

Treatment method: [X] Chemical [ ] Physical [ ] Biological Control [ ] 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. 2,4-D

Plant survey method: [X] Rake [ ] Visual [ ] Other (specify)

Aquatic Plant Name	Check if Target Species	Relative Abundance % of Community
Eurasian Water-milfoil (*Myriophyllum spicatum*)	X	100

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

[ ] Approved [ ] Disapproved	Fisheries Staff Specialist
[ ] Approved [ ] 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

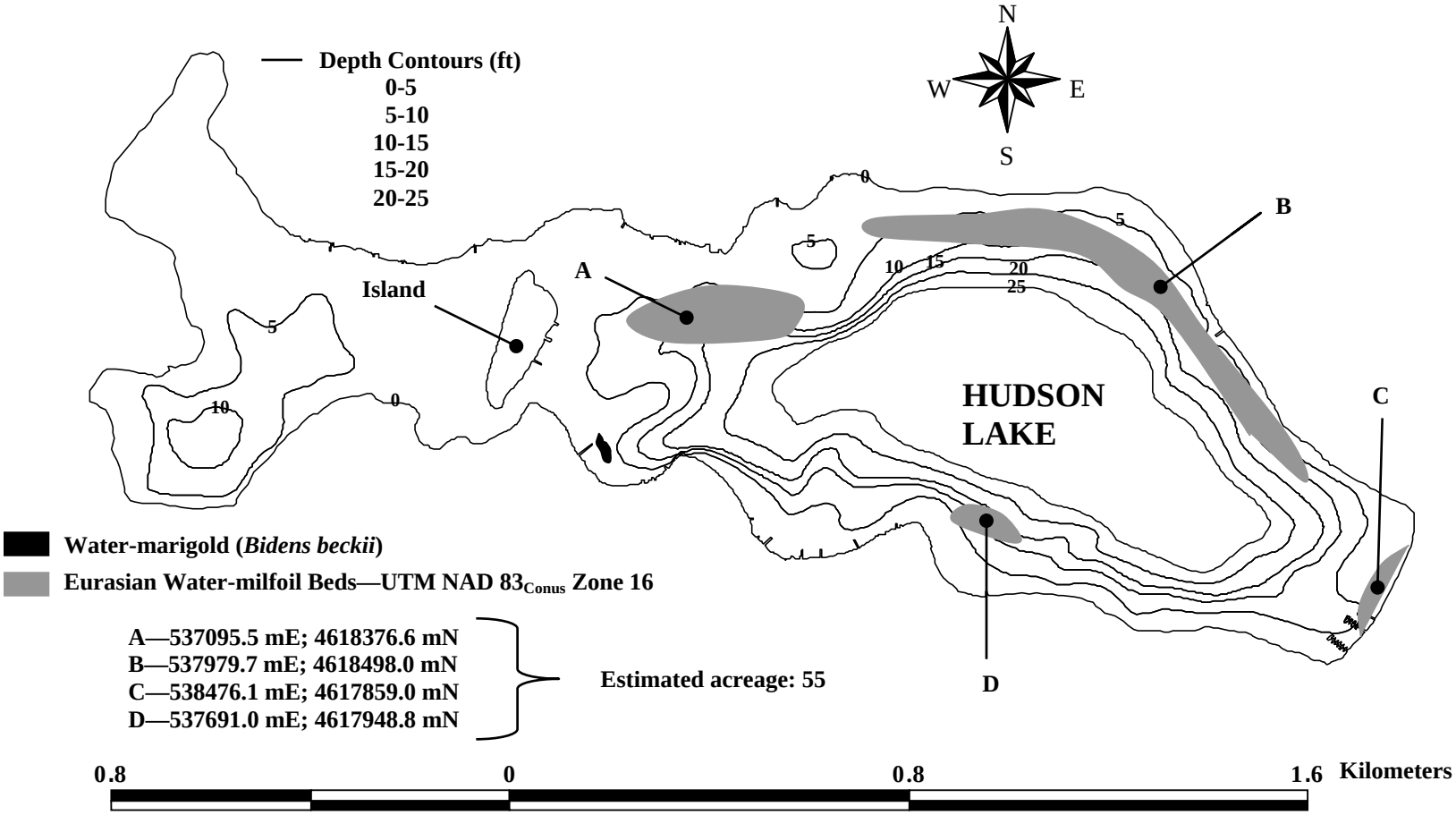
Treatment Area # C	LAT/LONG or UTM's 538476.1 mE; 4617859.0 mN		
Total acres to be controlled 5	Proposed shoreline treatment length (ft) on map	Perpendicular distance from shoreline (ft) on map	
Maximum Depth of Treatment (ft) 5	Expected date(s) of treatment(s) Mid July 2008		
Treatment method: [X] Chemical [ ] Physical [ ] Biological Control [ ] 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. 2,4-D			
Plant survey method: [X] Rake [ ] Visual [ ] Other (specify)			

Aquatic Plant Name	Check if Target Species	Relative Abundance % of Community
Eurasian water-milfoil (*Myriophyllum spicatum*)	X	100

Treatment Area # D	LAT/LONG or UTM's 537691.0 mE; 4617948.8 mN		
Total acres to be controlled 3.5	Proposed shoreline treatment length (ft) on map	Perpendicular distance from shoreline (ft) on map	
Maximum Depth of Treatment (ft) 10	Expected date(s) of treatment(s) Mid July 2008		
Treatment method: [X] Chemical [ ] Physical [ ] Biological Control [ ] 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. 2,4-D			
Plant survey method: [X] Rake [ ] Visual [ ] Other (specify)			

Aquatic Plant Name	Check if Target Species	Relative Abundance % of Community
Eurasian	X	100

Map of EWM Beds to be Treated using Alternative I (2, 4-D)



11.8.2. Alternative II (Sonar®)

APPLICATION FOR AQUATIC VEGETATION CONTROL PERMIT

State Form 26727 (R / 11-03)
Approved State Board of Accounts 1987

[x] 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: Aquatic Weed Control	Lake Assoc. Name: Professional Weed Control Company	
Rural Route or Street: P. O. Box 325		Phone Number: 574-533-2597
City and State: Syracuse IN		ZIP Code: 46567
Certified Applicator (if applicable): Jim Donahoe	Company or Inc. Name: Above	Certification Number: F-19215
Rural Route or Street: P. O. Box 325		Phone Number: 574-533-2597
City and State: Syracuse IN		ZIP Code: 46567

Lake (One application per lake): Hudson	Nearest Town: New Carlisle	County: Laporte
Does water flow into a water supply	[ ] Yes	[X] No

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

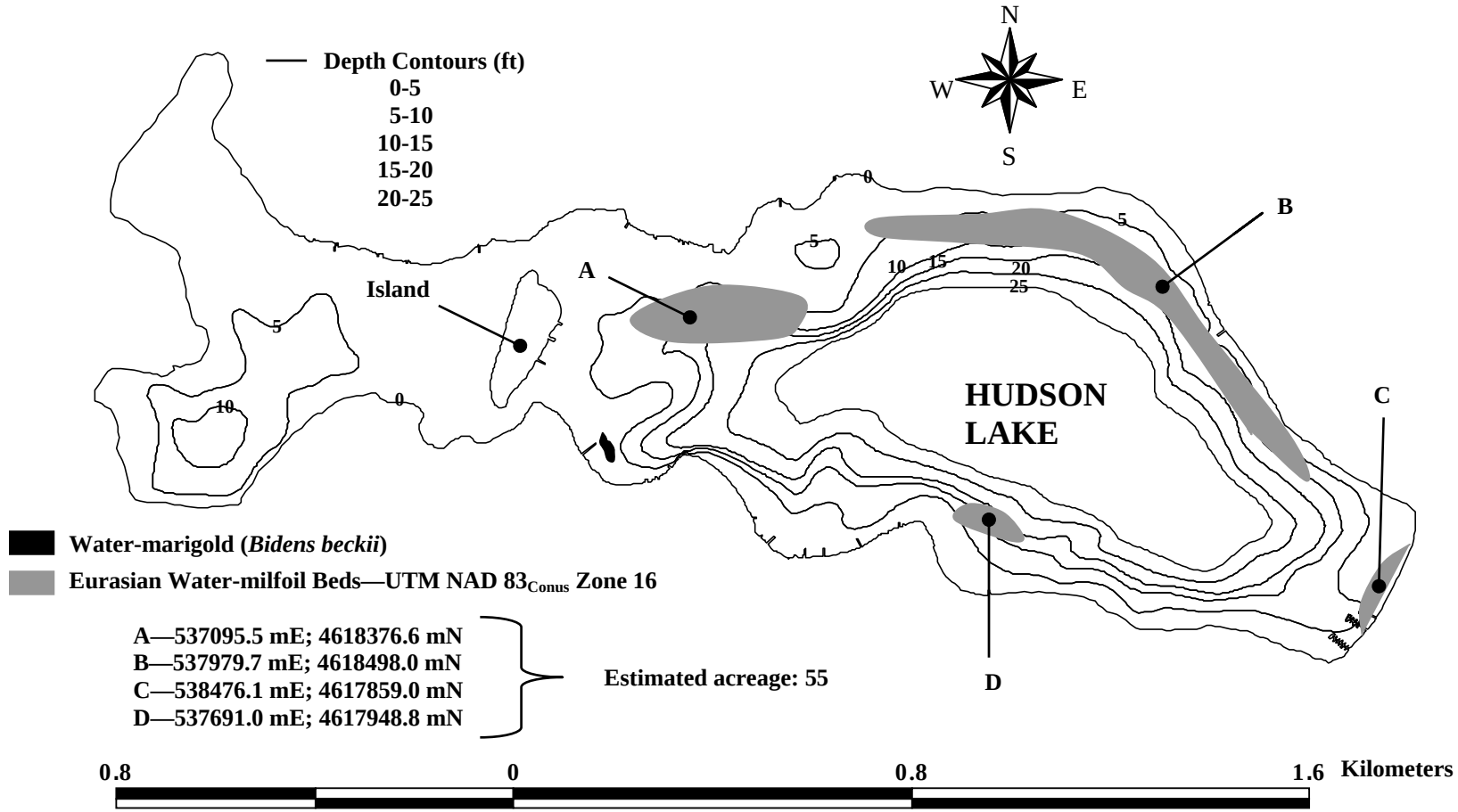
Treatment Area # A	LAT/LONG or UTM's Whole Lake		
Total acres to be controlled 55	Proposed shoreline treatment length (ft) On map	Perpendicular distance from shoreline (ft) on map	
Maximum Depth of Treatment (ft) 15	Expected date(s) of treatment(s) Mid July 2008		

Treatment method: [X] Chemical [ ] Physical [ ] Biological Control [ ] 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. Sonar whole-lake treatment 16 ppb maintained at 6 ppb.

Plant survey method: [X] Rake [ ] Visual [ ] Other (specify)

Aquatic Plant Name	Check if Target Species	Relative Abundance % of Community
Eurasian water-milfoil (*Myriophyllum spicatum*)	X	100


N
W
E
S
Depth Contours (ft)
0-5
5-10
10-15
15-20
20-25
Island
A
B
C
D
HUDSON LAKE
0
5
10
15
20
25
Water-marigold (*Bidens beckii*)
Eurasian Water-milfoil Beds—UTM NAD 83Conus Zone 16
A—537095.5 mE; 4618376.6 mN
B—537979.7 mE; 4618498.0 mN
C—538476.1 mE; 4617859.0 mN
D—537691.0 mE; 4617948.8 mN
Estimated acreage: 55
0.8
0
0.8
1.6
Kilometers

11.8.3. Alternative III (Weevils)

APPLICATION FOR AQUATIC VEGETATION CONTROL PERMIT

State Form 26727 (R / 11-03)
Approved State Board of Accounts 1987

[X] 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: Neal Connolly	Lake Assoc. Name: Hudson Lake Conservation Assocation	
Rural Route or Street: 55555 Pine Avenue		Phone Number: 574-210-2222
City and State: South Bend IN		ZIP Code: 46514
Certified Applicator (if applicable)	Company or Inc. Name: Above	Certification Number
Rural Route or Street		Phone Number: 1-800-940-4025
City and State		ZIP Code: 44224

Lake (One application per lake): Hudson	Nearest Town: New Carlisle	County: Laporte
Does water flow into a water supply		[ ] Yes [X] No

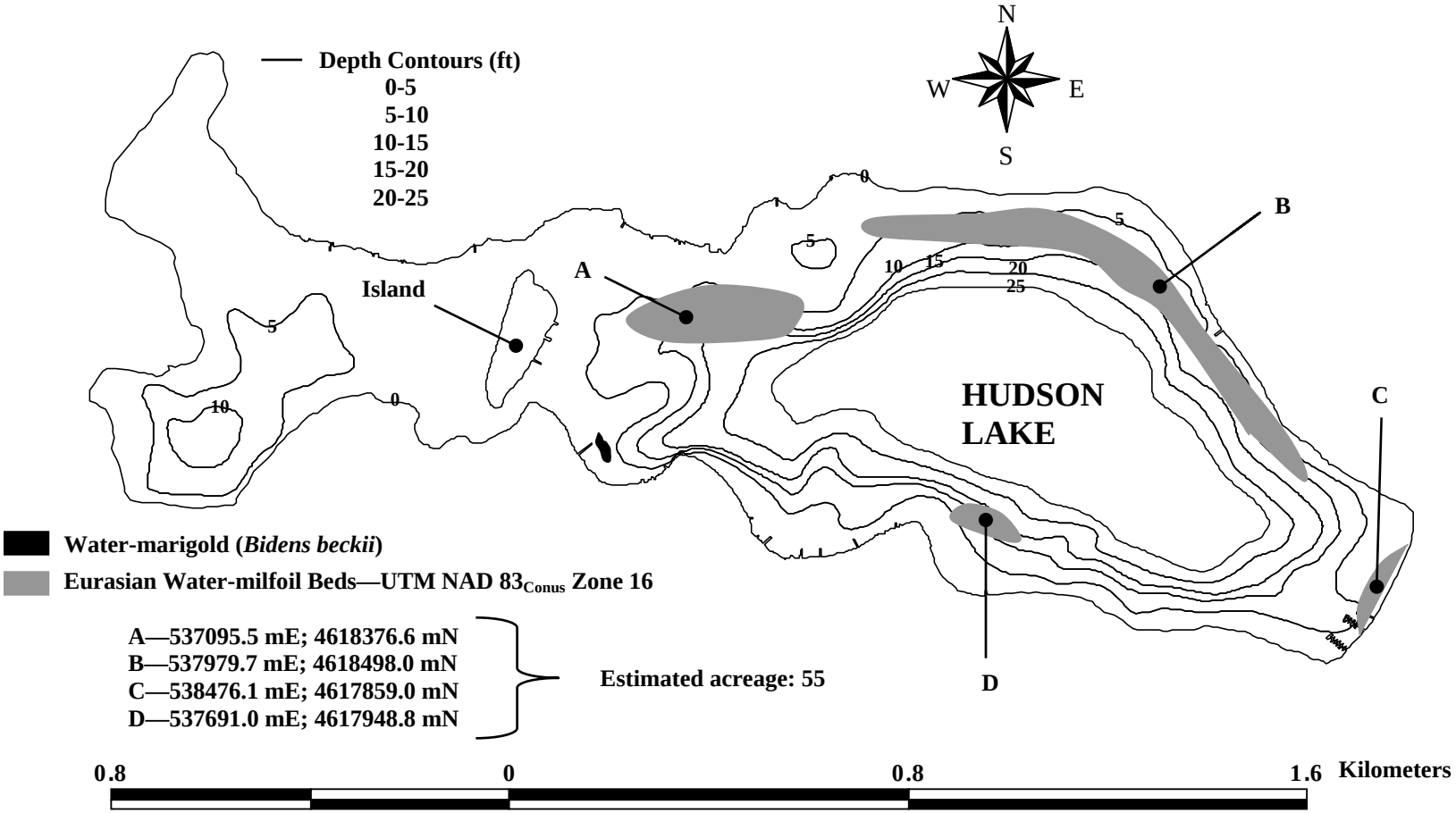
Please complete one section for *EACH* treatment area. Attach lake map showing treatment area and denote location of any water supply intake.

Treatment Area # whole lake	LAT/LONG or UTM's whole lake		
Total acres to be controlled 55	Proposed shoreline treatment length (ft) On map	Perpendicular distance from shoreline (ft) on map	
Maximum Depth of Treatment (ft) 15	Expected date(s) of treatment(s) Mid July 2008		

Treatment method: [ ] Chemical [ ] Physical [X] Biological Control [ ] 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. Introduction of 20,000 weevils

Plant survey method: [X] Rake [ ] Visual [ ] Other (specify)

Aquatic Plant Name	Check if Target Species	Relative Abundance % of Community
Eurasian Water-milfoil (*Myriophyllum spicatum*)	X	100

Map of EWM Beds to be Treated using Alternative III (Weevils)