AQUATIC VEGETATION MANAGEMENT PLAN

FOR HUDSON LAKE, LAPORTE COUNTY, Indiana

UPDATE 2009

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EXECUTIVE SUMMARY

Hudson Lake, historically at 432 surface acres, is the second largest natural inland lake in LaPorte County, IN and is located in the town of New Carlisle. The original surface acreage of the lake was significantly reduced during the last decade due to a substantial decrease in precipitation, although extensive rains in the spring of 2008 and 2009 raised the lake four feet, so that the lake was actually above the state mandated level for a short period in the summer of 2009. Concerns over the population of Eurasian water-milfoil (EWM) in the lake and its potential to interfere with recreational activities were the original impetus for seeking LARE funding for an aquatic vegetation management grant. 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 lake best management practices. This Aquatic Plant Management Plan for Hudson Lake summarizes data collected from 2007-2009 and reviews the effectiveness of plant management activities.

Reconnaissance mapping for non-native species and a Tier II aquatic plant survey were conducted on June 25th , 2009 and August 12th and 21st, 2009, respectively. Results from the Tier II aquatic plant survey identified a total of 17 species of aquatic plants, three of which are state-listed: 1) purple bladderwort (*Utricularia purpurea*); 2) Fries' pondweed (*Potamogeton freisii*) and 3) Water marigold (*Bidens beckii*). Two non-native species, EWM and curly-leaved pondweed (*Potamogeton crispus),* were observed. Curly-leaved pondweed was not found at any of the sample locations in 2009 although it was observed. This species was located at only 1 site in 2008 compared to 12 sites in 2007. One large and three very small beds of EWM were identified in the June survey of 2009, compared with three small beds of EWM in 2008, and five significant beds of EWM in 2007. This species was found at a frequency of 8.3% in 2009 compared with 19% in 2008 and 40.5% in 2007. Some small stands of common reed (*Phragmites australis*) were identified and should be herbicided before they become too invasive. Coontail (*Ceratophyllum demersum*) and eel-grass (*Vallisneria americana*) were the most frequently encountered native species and were found at >30% of the sampling sites in 2009. SDI and NDI values suggest high species diversity, indicating evenness in the abundance of species across the aquatic plant community.

The mapping of EWM targeted 12 acres of EWM in 2009 which was treated with 2, 4-D on July 17th by Aquatic Weed Control, Syracuse, IN. Twenty acres of EWM was treated in 2008 and in 2007 22.5 acres was treated. The state-listed species, water-marigold (*Bidens beckii*), was not observed in the bay where it was common in 2007 but was seen at one other location on the opposite side of the lake in 2009. There is concern that residual herbicide damage may have reduced the population but the ultimate cause of decline is unknown. Our management recommendation, given the apparent success of herbicide application in controlling EWM in 2007-2009, is to continue with this approach in 2010.

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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, Angela Sturdevant, Chip Long, and Greg Biberdorf 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 Bill Companik and Steve Varela of the HCLA fro their support on this project.

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INTRODUCTION

The Hudson Lake Conservation Association (HLCA) received a $16,750 grant in April, 2009 from the Indiana Department of Natural Resources (IDNR), Lake and River Enhancement Program (LARE). Aquatic Restoration Systems, LLC received $4,500 to prepare an aquatic plant management plan update 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 (Figure 1). 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. Although difficult to document, heavy growths of EWM are well known to frustrate the ability of anglers to fish without incessant line-snagging and reductions in the quality and size of fish catches, and snarl boat propellers reducing boat-related activities such as water skiing. Reductions in the extent of EWM are correlated with overall increases in aquatic plant diversity (Carpenter, 1980; Nichols and Lathrop, 1994) as well as the diversity, abundance, and size of certain cohort of game fish (e.g., Unmuth et al., 1999). As of the summer of 2007, recreational uses of the lake have not been significantly impaired by EWM; however, low water levels had negatively impacted boating and fishing at the far west end of the lake because the channels leading to this area were too shallow for navigation via watercraft. Approximately 15 years ago the authors of this survey noted very extensive and abundant populations of water-marigold *(Bidens beckii)* all along the central southern shore of Hudson Lake. Low water levels likely contributed to the expansion of EWM populations at the expense of water-marigold during this time. Heavy spring rains in 2008 increased water levels in the lake by two feet and allowed access to the west end of the lake by the southwest channel but not the northwest channel. Fortunately, as of the summer of 2009 significant additional precipitation had raised the lake level an additional two feet so that lake level was above the estimated legal level of 763.09 (V_3 Companies, 2008) for a short period of time until drainage from the outlet returned the lake to the legal level. It is unknown what impact increased water levels will have on the abundance and extent of EWM at Hudson Lake over a period of time but evidence from 2008 suggests a decrease in abundance of this weed from deeper water. A reduction in the population size of water-marigold *(Bidens beckii)* in 2008 raises the question of what impact additional herbicide treatment, stabilization of water levels, and further reductions in EWM will have on this species in 2010. It is hoped that there will be resurgence in abundance of this species as well as other desirable aquatic vegetation as has already been witnessed in the latter case.

1.2. Management History and Goals

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.

There are three state-initiated studies, providing management options that are publicly available for Hudson Lake. The three reports are available for download at http://www.in.gov/dnr/fishwild/7043.htm. 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. In the year one Aquatic Plant Management Plan for Hudson Lake (Scribailo and Alix 2008) the merits of a variety of commonly used options for control of EWM were discussed and three alternative strategies were proposed. These included; 1) treatment of existing EWM beds with 2, 4-D; 2) whole lake treatment with Sonar to control EWM; 3) release of water-milfoil weevils to provide long-term control of EWM. Consultation with IDNR resulted in the selection of option one as the most practical solution to the EWM problem. This approach has been continued in 2009 given the success of this method in 2008.

In summer of 2008 V_3 Companies presented their results of a LARE funded watershed diagnostic study performed on Hudson Lake. Their recommendations mostly centered on possible watershed improvement options and included a discussion of; 1) watershed best management practices for agricultural areas which included standard USDA recommendations on eliminating non-point sources of pollution; 2) watershed best management practices for urban areas that would create more permeable surfaces and reduce the amount of rainwater flow to the lake; 3) the feasibility of high capacity well installment to provide additional water from aquifers to increase lake levels. Results from the tier I and II aquatic plant surveys carried out by V_3 as part of their watershed diagnostic study are discussed in the body of this report.

Historically, Hudson Lake occupied an area of about 432 acres (0.68 square miles) with a maximum depth of 42 feet and an approximate volume of 5,060 ac-ft. The total watershed area tributary to Hudson Lake is approximately 5,170 acres. The Hudson Lake watershed is divided into three subwatersheds: Upstream Depressional, Saugany Lake, and Hudson Lake. The Upstream Depressional subwatershed area is approximately 870 acres; the Saugany Lake subwatershed area is approximately 715 acres; and the Hudson Lake subwatershed area is approximately 3,585 acres. Based on the National Land Cover Database 2001 (NCLD 2001), the three predominant land uses in the Hudson Lake watershed are cultivated crops (29.0%), forests (25.8%), and pasture/hay (10.7%). Developed area only accounts for 17.1% of the total watershed area. For more detailed information on watershed characteristics the reader is referred to the watershed diagnostic survey conducted by V_3 Companies (2008).

The IDNR has conducted fisheries surveys on Hudson Lake during 1972, 1978, 1981, and 1990. The results of the 1990 survey indicate that Hudson Lake has been able to support relatively stable populations of game fish. The survey collected 785fish that represented 15 different species. Of the fish collected, the three most abundant species by number were bluegill (*Lepomis macrochirus*), yellow perch (*Perca flavescens*), and redear sunfish (*Lepomis microlophus*). IDNR has not conducted fisheries surveys on Hudson Lake since 1990 (V_3 Companies 2008).

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 25th, 2009 to

determine the extent of their coverage and to locate beds to serve as potential candidates for control measures (i.e. herbicide application). A similar pre-treatment mapping was carried out on June 15th, 2008, and pre- and post-season surveys 0f 2007 was carried out on June 4, 2007 and August 11, respectively. Mapping efforts for EWM conducted in early June were hampered by the fact that it was difficult to observe plants in deeper parts of the lake, especially with the increase in water level. To resolve this issue, short rake pulls were carried out at increasing depths to determine the approximate locations where Eurasian water-milfoil was located.

A single floristic survey and post-treatment Tier II survey was conducted August 12th and 21st in 2009 compared to August 14-16th in 2008. In 2007 pre- and post-treatment floristic surveys 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 geo-referencing 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 1.0) was generated in a semi-systematic fashion using TerraSync™ 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 2.0). The same sites were sampled in 2009 as were sampled during 2008 and in both surveys in 2007 (i.e. pre- and post-treatment).

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). No voucher specimens were prepared in 2009 because all collected species had already been vouchered in the previous year.

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 2.1b 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 collectedfrom 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 Mapping Non-native Species

EWM was mapped on June 25th, 2009 and one large and four small beds were recorded two of which represent reduced beds mapped from 2008 and 2007(see Figures 3.0-6.0). The larger bed which is in deeper water is largely a monospecific stand and encompasses the area around points 43,62, 63, and 76 with the only other significant species being common coontail. The smaller beds are found at or close to points 7, 29, 38, and 39. Desirable aquatic plant species found near these locations include eel-grass, grass-leaved pondweed, opposite stonewort, sago pondweed, and common coontail. Nine beds of EWM were recorded from the post-treatment mapping in 2007 (Figure 5.0-6.0). Curly-leaved pondweed was not found at any sample location in 2009 and therefore no map is given for this species. It was only found at one point in 2008 and was collected at 14 points pre-treatment and from only 3 points post-treatment in 2007. This pattern is a reflection of the early season phenology of this species and indicates the species is not problematic at Hudson Lake. The overall absence of turions from post-treatment rake samples from 2007-2009 would also suggest it is not likely to show a sudden increase in abundance.

3.2. Tier II Post-treatment Survey

Based on the EWM mapping for 2009 (Figure 3.0) 2,4-D was applied to 12 acres on July 17th, 2009 by Aquatic Weed Control, Syracuse, Indiana. A three week window is recommended prior to the Tier II survey to allow the impacts of the herbicide to take effect (J. Donahoe, Aquatic Weed Control, pers. comm.). Data for the Tier II survey was collected from a total of 84 sampling points on August 12th and August 21st 2009. The depth distribution of these sampling points is shown in Table 3.0 in comparison to surveys from previous years (Table 2.0). The number of sites sampled by depth contour in 2009 were 8 (0-5ft), 22 (5-10ft), 16 (10-15 ft), 24 (15-20 ft) and 12 (20-25 ft). In 2008 there were 21, 17, 18, 15 and 13 from these respective depth classes versus 23, 18, 17, 16, and 10 respectively for the pre-treatment survey of 2007 and 23, 18, 16, 15, and 12, for the post-treatment survey in 2007. The increase in number of sites at greater depths in 2009 and 2008 is a reflection of a two foot increase in water level with each successive year. There is also a noticeable decrease in the number of points at the 0-5 foot contour since points from this class can only be lost with increasing water level. Forty seven percent of points with depths greater than 15 ft yielded no plants compared to 39% in 2007. Table 7.0 provides a quick reference summary of changes in lake parameters and species frequencies over the three year period of this study. Number of vegetated sites decreased to 75% in 2009 from 85% in 2008 and this is likely a reflection of further increases in water depth with plants at the deepest locations no longer having access to sufficient light to survive. Note that there has been a dramatic increase in number of points having only native plants from 2007 (38.1%) to 2008 (64.3%) to 2009 (70.2%) (Table 7.0) and this is directly related to continued decreases in the frequency of EWM. Reductions in EWM can be clearly seen on the maps in Figures 7.0-8.0 as well graphically in Figure 9.0 and in Table 7.0. A single collection of Coontail (*Ceratophyllum demersum*) from a depth of 24 ft recorded at point 68 represents the maximum plant depth for this survey (Appendix 11.2). The total number of species declined with increasing depth contour (Table 2.0). The maximum number of species in 2009 was greatest at the 5-10 and 10-15 ft contours (Table 3.0). The maximum number of species identified as well as the mean number per site declined from 2008 to 2009 but this is an artifact of the fact that more points had no plants. Note that actual native species richness was the highest of any year recorded for this study even though the maximum number per site was less (Table 4.0). Values of the SDI and NDI, have remained similar across all years of this study and indicate high species diversity across sites and suggests substantial population evenness. This 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 4.0).

Results for most species paralleled those from 2008 and 2007 (Table 5.0-7.0). In 2009 the most common species were eel-grass (*Vallisneria americana*) at 38.1% , coontail (*Ceratophyllum demersum*) at 31.0%, common naiad (*Najas flexilis*) at 22.6%, and opposite stonewort (*Chara contraria*) at 20.2%. The respective values for these species in 2008 were 31.0%, 36.9%, 16.7%, and 32.1%. In 2007 coontail,

EWM, and eel-grass (*Vallisneria americana*) were found at frequencies greater than 30% (Tables 5.0 and 6.0). Table 6.0 indicates that several species were observed after an absence in 2008. Several *Chara* species observed in 2003 and early season 2007 were found again in 2009. Visual observation indicated an increase in charophytes in shallow water zones possibly made available by the reduction in EWM . Charophytes are extremely important in the ecology of lakes and are critical in stabilizing bottom sediments and trapping turbidity (Scheffer 1998).

Notable changes in aquatic plant communities from 2007 to 2009 in terms of invasive species are the drop in frequency of EWM from 40.5% pre-treatment survey 2007 to 38.1% in the post-treatment survey of 2007 to 28.6% in 2008 to 8.3% in 2009 (Table 5.0, 7.0). The EWM plant dominance index dropped from 12. 1 to 5.7 to 2.1 over this time interval and is a reflection of a lower frequency of occurrence of EWM and lower rake scores for this species. In 2009 there was one point with a rake score over one, there were no sample points where EWM had a rake score over 1 in 2008, and in 2007 9.6% of sites had a rake score of 3 or higher (Tables 5.0, 7.0). EWM was not present in the 0-5 ft depth contour in 2009 but was present at 26.1% of sites in this category in 2008. Prior to our mapping efforts in 2007, there is almost no historical information on the distribution and abundance of EWM in Hudson Lake. Data from Alix (2006) for the year 2003 however indicate a frequency of EWM of 49.3% based on 134 sampling points.

Results indicate that several of the objectives stated in the previous aquatic plant management plan (Scribailo and Alix, 2009) have been met. The frequency of EWM is now below 10% which was set as a target goal. Only one rake toss in 2009 had an EWM value over 1.0 and no tosses had a value greater than 1.0 in 2008.

Native species showed some important increases in from 2007-2009. Particularly noteworthy are common bladderwort (*Utricularia macrorhiza*), and spiny naiad (*Najas marina*). The increase in frequency of all of the aforementioned species is directly related to increasing water depths in Little Hudson Lake with a concomitant increase in habitat quality for these species.

3.3. Trends in Secchi Disk Transparency

The 2007 diagnostic survey performed by V_3 (2007) provides a table of Secchi disk transparency values for the years 1991, 1995, 1999, 2005, and 2007. Our results indicate little fluctuation among 2007 pre-treatment (4.6 m), 2007 post-treatment (4.4 m), and 2008 post-treatment (4.0 m) and 2009 post-treatment values (3.7 m) which suggests minimal impact of herbicide application on Secchi disk transparency. Water in 2009 appeared to have high densities of motile phytoplankton or zooplankton which may have contributed to the slight reduction in secchi depth.

3.4. Threatened and Endangered Species

Table 8.0 provides the localities of all state-listed species observed from 2007-2009. As in the previous year three state-listed aquatic plant species, purple bladderwort, Fries' pondweed, and water-marigold were identified during the course of the survey work in 2009. 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 post-treatment survey of 2008 and at four sites during the post-treatment survey of 2007 as well as 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 was recorded as isolated in a small bed along the southwest corner of Big Hudson Lake in 2007 (Figure 4.0). Fries' pondweed (*Potamogeton friesii*, state-listed as threatened), was found at 1.2% of sites in 2009, 21.4% of sites in 2008 and at 23.8% and only at 3.6% in pre- and post-treatment surveys from 2007, respectively (Table 5.0). The drop in score in post-treatment 2007-2009 surveys is a reflection of the fact that this species is an early season one and is gone to turions by July. In 2009 and 2008 all specimens found were turions brought up on the rake. Important characteristics to distinguish both Fries pondweed and water-marigold from morphologically similar species are discussed in detail with illustrations in the Aquatic Plant Management

Report for 2007. The state-listed purple bladderwort (*Utricularia purpurea*) , although showing a substantial increase in frequency and dominance from 2007 to 2008, was not observed at any sample points in 2009. It was observed in healthy numbers in Little Hudson outside of sample points but it appeared to be losing in competition with spiny naiad in particular.

The state-listed species, water-marigold (*Bidens beckii*), as in 2008, was not observed in the bay where it was common in 2007 but it was seen at one other location on the opposite side of the lake in 2009. There is concern that residual herbicide damage may have reduced the population but the ultimate cause of decline is unknown. Continued monitoring will hopefully indicate an increase in abundance of this species over time.

3.5. Previous Aquatic Plant Surveys

Comments regarding previous aquatic plant surveys are again included here from last year's report to clarify the identity of species found in Hudson Lake. Several comments are worthwhile concerning the findings of the Tier I aquatic plant survey performed by V_3 during their watershed diagnostic study of 2007. The survey found 24 species, including 17 submersed, four floating, and three emergents. Although many of the aquatic plant species were identical to those previously found (see Table 7.0) a few differences are notable. They record white water buttercup (*Ranunculus longirostris*) as well American pondweed (*Potamogeton nodosus*) from the survey but these species have never been recorded from the lake previously. The latter species is often mistaken for common pondweed (*Potamogeton natans)* although the former is hard to mistake for anything else and likely represents a new record. They also record Northern water-milfoil (*Myriophyllum sibiricum*) from several beds in the lake although no previous studies have recorded this species. Given the difficulties in distinguishing the previous mentioned species from EWM this likely represents an identification error. Hybrids are also common between the two species further complicating this issue (Moody and Les, 2002). Unfortunately, no voucher specimens appear to have been collected by V_3 during there diagnostic study of Hudson Lake (V_3 2007), thus we cannot definitively verify or reject the identity of the aforementioned species. Several species in their list also bear out-of-date nomenclature including *Potamogeton pectinatus* (*Stuckenia pectinata*), *Utricularia vulgaris* (*Utricularia macrorhiza*), *Nymphaea tubersosa* (*Nymphaea odorata* subsp. *tuberosa*), *Scirpus acutus* (*Schoenoplectus acutus* var. *acutus*), *Ranunculus longirostris* (*Ranunculus aquatilis* var. *diffusus*) and *Zosterella dubia* which has been changed back to *Heteranthera dubia*. Several species of *Chara* and *Nitella* are also recorded but only to genus.

A comparison of aquatic plant species reports from the Tier II surveys of 2007- 2009 with other reports on Hudson Lake indicate that all Tier II surveys underestimate the total number of species in the water body. In 2003, Alix (2006) conducted a quantitative in-water sampling of Hudson Lake using 134 quadrats compared with 84 in-boat rake tosses used in our Tier II surveys. Twenty-eight submersed and free-floating species and an additional 15 species of emergents (N = 43) were recorded in 2003, whereas 20 species of submersed and floating species were found in the current study (Table 4.0). Fisheries management reports listed only a total of 11 taxa in 1972 and 11 taxa in 1978 although aquatic plants were only an incidental focus of these studies (Table7.0). Harza (1991) recorded only 19 taxa, whereas Scribailo and Alix (unpub. data) recorded 25 taxa (Table 7.0).

The differences outlined above suggest that current protocol for determining the number of samples and the strategy for data collection in Tier II surveys will underestimate species richness. The plant community management implications of underestimating richness are that herbicide applications may result in decisions based on inadequate information on the presence and distribution of rare and state-listed species. Although it can be argued that an underestimation of species richness would be expected to be reduced in lakes having a less diverse plant community, the fact remains that this parameter is contingent upon the distribution of species (i.e. patchy vs. uniform) and the design of the inventory. These problems underscore the importance of a lake reconnaissance (Tier I type survey) 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 of 2007 but was recorded twice in 2008 and was only

initially detected by a complete lake reconnaissance. Likewise in 2009 purple bladderwort was not recorded from any sample points.

4.0. BEST MANAGEMENT OPTIONS

A number of alternative management options for the control of EWM have been discussed in the previous years of the aquatic plant management report. A "no control option" was not considered in these recommendations but the consequences of this strategy can be briefly reviewed. Although it is possible to not control EWM the concern is that left unchecked the existing populations will continue to expand and choke off much of the littoral zone over time. There is extensive literature on the negative effects of EWM on lake ecology and the reader is referred to Aiken et al. (1979) for a summary of many of these impacts.

In their discussion of nuisance species, V_3 recommends the use of water-milfoil weevils to control EWM was discussed extensively in Scribailo and Alix (2008) who also recommended this management strategy. It was decided after considerable discussion with IDNR that herbicide application would provide the most immediate and predictable solution to the EWM problem on Hudson Lake. Estimates from data collected in 2008 and 2009 indicate that approximately 24 acres of EWM may need to be treated in 2010 (Figure 11.0). Although this is more than was treated in 2008 and 2009 there is still concern that there may be a resurgence in EWM (Jim Donahoe, personal communication). Deeper water levels appear to have caused a dramatic decline in EWM and data from 2010 will indicate if this is a real phenomenon. Given the success of herbicide application in 2007 through 2009 it appears that continued treatment with 2,4-D presents the best management option for EWM.

Phragmites australis (Common Reed), mapped in 2009 (Figure 3.0) since it was possible to reach it with higher water levels in Little Hudson Lake, and simply referred to as a species observation in the report of Scribailo and Alix (2008), should be controlled with herbicide on Little Hudson Lake before it becomes more aggressive. It is restricted to a few small areas at the current time with an estimated area of 3.5 acres (Figure 11.0). As long as no adjacent critical plant species are present the best herbicide control method would be for localized wicking treatment with Habitat® Herbicide at a rate of 2% v/v plus 1% v/v methylated seed oil as a surfactant. If sensitive adjacent plants are present wicking Rodeo Herbicide at 1% plus 1% v/v methylated seed oil as a surfactant can be used. Beds of common reed will be examined in June of 2010 to establish the best control strategy that will not harm native species.

As in the previous report, we recommend the establishment of an ecozone in the southwest bay to protect the integrity of the water-marigold population. The shallowness of the bay somewhat precludes the use of high-speed watercraft and this would assist in the protection of the water marigold. Designation of this area as an ecozone would prohibit consultants and lakefront property owners from applying herbicide within the bay. The possible implications and benefits of an ecozone will be discussed with the lake association at the meeting in March, 2010.

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. The primary group responsible for lake management issues, and the only group to which lake owners join, is the Hudson Lake Conservation Association. The president and main contact of the association is William (Bill) Companik. 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. A lake survey was designed and sent for approval to Bill Companik in the first year of the Hudson Lake AVMP study for dissemination to lake residents in 2007 but he decided that the survey would not provide information that was of relevance to conservation issues at that time. Lake

associations members are kept in contact concerning lake issues through email correspondence from Bill Companik HCLA president.

6.0. MANAGEMENT IMPLEMENTATION STRATEGY

As stated in the 2009 Aquatic Vegetation Management Plan with some modification here the primary objectives of the aquatic plant management strategy are to: 1) reduce the coverage and abundance of EWM so that Tier II survey results indicate a frequency of less than 10% and no rake score higher than 1.0 for this species 2) improve the quality of native aquatic plant communities and recreational activities through the control of EWM; 3) 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 goals for the HLCA that can be achieved within the five year time span window projected for the aquatic plant management plan.

Following the current plan invasive aquatic plant species will be mapped in June of 2010, 2, 4-D will be applied in early July to control EWM (to a maximum of 35 acres), and a selective herbicide will be used for common reed dependending upon the species composition of the plant community. A post-treatment Tier II survey will be carried out in early August of 2010. If the acreage of EWM is smaller than expected there is the option of a second application in late August as was carried out in 2007. 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 the budget section. This approach will reduce EWM in a growing season and hopefully 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 although this amount should decrease over time as it already has. An advantage of this alternative is that it does not require a large initial cost share by the HCLA.

The Hudson Lake Conservation Association is relying on the fact that the LARE program of IDNR will fund the fourth year of the AVMP study. The association has not pursued any other funding sources. Due to the small size of the lake associations membership there is not enough revenue to support studies of the lake without IDNR support.

Basic deadlines for interactions among the contractors (AQRS), the lake association, and IDNR are as follows;

December 15th Contractor sends report on years activities to IDNR LARE for review
December 31st Contractor sends permit information for 2010 to HCLA
January 15th HCLA submits permit to IDNR LARE
Mar 1st Contractor sends revised version of AVMP to IDNR LARE
Mar 15th IDNR LARE informs HCLA of funding decision

7.0. PUBLIC EDUCATION

A public meeting was held for the HCLA on March 14th 2010, during which Robin W. Scribailo (Aquatic Restoration Systems, LLC, Porter, IN) presented information discussing, fundamentals of lake ecology, management issues facing Hudson lake, and possible control options available. Twenty-five people attended this meeting and most were lake residents. Although questions related to lake ecology and management options were fielded and answered, these were not recorded by the HLCA or consultants. Overall perceptions from lake residents seem to indicate that they are satisfied with the progress made with the control of EWM. Repeated presentations on the findings of the aquatic plant studies along with information on the value of aquatic plant communities seems to have had a positive influence on the overall public perceptions of the importance of maintaining lake integrity. Some questions centered on possible

residual damage of herbicide for EWM on native species and that there were bare areas on the lake bottom. Both Robin Scribailo and Jim Donahoe of Aquatic Control reassured residents of the specificity of the herbicide. Residents also expressed concern as to whether the lake level was actually set at the state-mandated lake level.

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. 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 glacial stone 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.

As in the previous year 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

The costs are presented here for treatment of EWM with 2,4-D and for treatment of common reed with Habitat. As discussed previously, the same funding is budgeted for EWM control in 2010 as in 2009 because of concerns over a possible resurgence in EWM populations. Funding is included for monitoring of water-marigold which will include mapping and quadrats within populations to assess population size.

Treatment Type:	Cost:
2,4 D liquid ($350.00 per acre) x 24 acres	$8400
Habitat herbicide X ($600 per acre) x 3.5 acres	$2100
Monitoring of water-marigold	$400
Aquatic Vegetation Management Plan Update	4500
TOTAL	$ 15400

9.0. MONITORING AND EVALUATION PLAN

In all cases monitoring of the effectiveness of any treatment method will involve comparisons of the frequency and rake scores 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. The goals of the aquatic plant management plan have not changed since the original plan although the management strategies are now focused on the use of herbicides to control EWM rather than other management options.

Table 1.0. 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 2.0. Summary of species richness values and mean rake scores apportioned by survey. Parenthetical values represent standard error.

Depth Contour (ft)	Number of Sites: Total	Sites: w/Plants	Sites: w/Native Plants	Species: Total	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 3.0. Summary of species richness values and mean rake scores for the years 2008 and 2009. 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
Post-treatment Survey (August 2008)									
0-5	21	20	17	14	16	6	3.19 (0.31)	3.00 (0.31)	2.8
5-10	17	17	9	13	12	8	3.76 (0.40)	3.29 (0.42)	2.6
10-15	18	18	13	15	13	6	3.06 (0.36)	2.50 (0.33)	1.8
15-20	15	11	9	4	3	4	0.93 (0.18)	0.80 (0.14)	0.8
20-25	13	7	6	3	2	3	0.69 (0.24)	0.62 (0.18)	0.5
Post-treatment Survey (August 2009)									
0-5	8	7	7	8	8	3	1.63 (0.38)	1.63 (0.38)	2.0
5-10	22	22	18	14	13	5	2.95 (0.21)	2.77 (0.17)	2.8
10-15	16	15	12	13	12	5	2.94 (0.36)	2.75 (0.34)	2.8
15-20	24	16	16	6	6	4	1.08 (0.22)	1.08 (0.22)	1.3
20-25	12	3	3	3	3	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
2008‡	17	15	8	2.4	2.1	0.91	0.90
2009‡	21	20	5	1.9	1.8	0.89	0.88

*Alix (2006)
†Pre-treatment
‡Post-treatment)

Table 5.0. Summary of frequency and dominance values of aquatic macrophytes apportioned by depth and calculated from data collected during the post-treatment survey (August 2009). 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	
Bidens beckii (Water-marigold)	1.2	98.8	1.2	0.0	0.0	0.2
Ceratophyllum demersum (Coontail)	31.0	69.0	23.8	1.2	6.0	11.2
Chara contraria (Opposite stonewort)	20.2	79.8	13.1	3.6	3.6	8.3
Chara globularis (Fragile stonewort)	2.4	97.6	2.4	0.0	0.0	0.5
Chara haitensis (Haitian stonewort)	1.2	98.8	1.2	0.0	0.0	0.2
Chara vulgaris (Common stonewort)	2.4	97.6	2.4	0.0	0.0	0.5
Elodea canadensis (Common water-weed)	1.2	98.8	1.2	0.0	0.0	0.2
Heteranthera dubia (Water star grass)	2.4	97.6	2.4	0.0	0.0	0.5
**Myriophyllum spicatum* (Eurasian Water-milfoil)	8.3	91.7	7.1	1.2	0.0	2.1
Najas flexilis (Common naiad)	22.6	77.4	19.0	2.4	1.2	6.4
Najas marina (Spiny naiad)	10.7	89.3	4.8	2.4	3.6	6.0
Nitella flexilis (Smooth stonewort)	6.0	94.0	6.0	0.0	0.0	1.2
Potamogeton amplifolius (Broad-leaved pondweed)	3.6	96.4	3.6	0.0	0.0	0.7
Potamogeton friesii (Fries' pondweed)	1.2	98.8	1.2	0.0	0.0	0.2
Potamogeton gramineus (Grass-leaved pondweed)	6.0	94.0	4.8	1.2	0.0	1.7
Potamogeton natans (Common pondweed)	3.6	96.4	3.6	0.0	0.0	0.7
Potamogeton zosteriformis (Flat-stem pondweed)	1.2	98.8	1.2	0.0	0.0	0.2
Stuckenia pectinata (Sago pondweed)	9.5	90.5	8.3	1.2	0.0	2.4
Utricularia gibba (Humped bladderwort)	1.2	98.8	1.2	0.0	0.0	0.2
Utricularia macrorhiza (Common bladderwort)	10.7	89.3	6.0	3.6	1.2	4.5
Vallisneria americana (Eel-grass)	38.1	61.9	35.7	1.2	1.2	9.0

Table 5.0. –Continued.

Depth contour: 0-5 ft.

Species	Frequency of Occurrence (%)	Rake Score Frequency per Species (%)				Plant Dominance Index
		0	1	3	5	
Ceratophyllum demersum (Coontail)	12.5	87.5	12.5	0.0	0.0	2.5
Najas flexilis (Common naiad)	12.5	87.5	12.5	0.0	0.0	2.5
Najas marina (Spiny naiad)	37.5	62.5	25.0	12.5	0.0	12.5
Potamogeton gramineus (Grass-leaved pondweed)	12.5	87.5	0.0	12.5	0.0	7.5
Potamogeton natans (Common pondweed)	12.5	87.5	12.5	0.0	0.0	2.5
Stuckenia pectinata (Sago pondweed)	12.5	87.5	12.5	0.0	0.0	2.5
Utricularia gibba (Humped bladderwort)	12.5	87.5	12.5	0.0	0.0	2.5
Utricularia macrorhiza (Common bladderwort)	50.0	50.0	25.0	25.0	0.0	20.0
Depth contour: 5-10 ft.						
Bidens beckii (Water-marigold)	4.5	95.5	4.5	0.0	0.0	0.9
Ceratophyllum demersum (Coontail)	4.5	95.5	4.5	0.0	0.0	0.9
Chara contraria (Opposite stonewort)	40.9	59.1	27.3	4.5	9.1	17.3
Chara haitensis (Haitian stonewort)	4.5	95.5	4.5	0.0	0.0	0.9
Chara vulgaris (Common stonewort)	9.1	90.9	9.1	0.0	0.0	1.8
**Myriophyllum spicatum* (Eurasian Water-milfoil)	18.2	81.8	13.6	4.5	0.0	5.5
Najas flexilis (Common naiad)	54.5	45.5	40.9	9.1	4.5	18.2
Najas marina (Spiny naiad)	18.2	81.8	0.0	4.5	13.6	16.4
Potamogeton amplifolius (Broad-leaved pondweed)	9.1	90.9	9.1	0.0	0.0	1.8
Potamogeton gramineus (Grass-leaved pondweed)	18.2	81.8	18.2	0.0	0.0	3.6
Potamogeton natans (Common pondweed)	9.1	90.9	9.1	0.0	0.0	1.8
Stuckenia pectinata (Sago pondweed)	22.7	77.3	18.2	4.5	0.0	6.4

Table 5.0. –Continued.

Species	Frequency of Occurrence (%)	Rake Score Frequency per Species (%)				Plant Dominance Index
		0	1	3	5	
Utricularia macrorhiza (Common bladderwort)	22.7	77.3	13.6	4.5	4.5	10.0
Vallisneria americana (Eel-grass)	59.1	40.9	50.0	4.5	4.5	17.3
Depth contour: 10-15 ft.						
Ceratophyllum demersum (Coontail)	50.0	50.0	37.5	0.0	12.5	20.0
Chara contraria (Opposite stonewort)	37.5	62.5	25.0	6.3	6.3	15.0
Chara globularis (Fragile stonewort)	12.5	87.5	12.5	0.0	0.0	2.5
Heteranthera dubia (Water star grass)	12.5	87.5	12.5	0.0	0.0	2.5
**Myriophyllum spicatum* (Eurasian Water-milfoil)	18.8	81.3	18.8	0.0	0.0	3.8
Najas flexilis (Common naiad)	31.3	68.8	31.3	0.0	0.0	6.3
Najas marina (Spiny naiad)	12.5	87.5	12.5	0.0	0.0	2.5
Nitella flexilis (Smooth stonewort)	12.5	87.5	12.5	0.0	0.0	2.5
Potamogeton amplifolius (Broad-leaved pondweed)	6.3	93.8	6.3	0.0	0.0	1.3
Potamogeton friesii (Fries' pondweed)	6.3	93.8	6.3	0.0	0.0	1.3
Potamogeton zosteriformis (Flat-stem pondweed)	6.3	93.8	6.3	0.0	0.0	1.3
Stuckenia pectinata (Sago pondweed)	12.5	87.5	12.5	0.0	0.0	2.5
Vallisneria americana (Eel-grass)	75.0	25.0	75.0	0.0	0.0	15.0
Depth contour: 15-20 ft.						
Ceratophyllum demersum (Coontail)	58.3	41.7	45.8	0.0	12.5	21.7
Chara contraria (Opposite stonewort)	4.2	95.8	0.0	4.2	0.0	2.5
Elodea canadensis (Common water-weed)	4.2	95.8	4.2	0.0	0.0	0.8
Najas flexilis (Common naiad)	4.2	95.8	4.2	0.0	0.0	0.8
Nitella flexilis (Smooth stonewort)	12.5	87.5	12.5	0.0	0.0	2.5
Vallisneria americana (Eel-grass)	25.0	75.0	25.0	0.0	0.0	5.0

Table 5.0. –Continued.

Depth contour: 20-25 ft.

Species	Frequency of Occurrence (%)	Rake Score Frequency per Species (%)				Plant Dominance Index
		0	1	3	5	
Ceratophyllum demersum (Coontail)	16.7	83.3	8.3	8.3	0.0	6.7
Chara contraria (Opposite stonewort)	8.3	91.7	8.3	0.0	0.0	1.7
Vallisneria americana (Eel-grass)	8.3	91.7	8.3	0.0	0.0	1.7

Table 6.0. 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[¥]	2003[И]	2007[A]	2007[B]	2007[C]	2008[†]	2009[†]
Bidens beckii	Water-marigold				X	X		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	X	X	X	X
Chara sp.	Stonewort	X	X	X					X		
Chara aspera	Rough stonewort					X					
Chara contraria	Opposite stonewort				X	X	X	X		X	X
Chara globularis	Fragile stonewort					X		X			X
Chara haitensis	Haitian stonewort					X	X	X			X
Chara vulgaris	Common stonewort					X					X
Chara zeylanica	Ceylonian stonewort							X			
Cyperus sp.	Sedge							X		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	X	X	X
Heteranthera dubia	Water star grass				X	X	X	X	X	X	X
Juncus sp.	Rush						X	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 sibiricum	Northern water-milfoil								X		
Myriophyllum spicatum	Eurasian water-milfoil				X	X	X	X		X	X
Najas sp.	Naiad			X							
Najas flexilis	Common naiad					X	X	X	X	X	X
Najas marina L.	Spiny naiad					X	X	X	X	X	X

Table 6.0.–Continued

Taxon	Common Name	Survey Year									
		1972[*]	1978[**]	1991[§]	1998[¥]	2003[И]	2007[A]	2007[B]	2007[C]	2008[†]	2009[†]
Nitella sp.									X		
Nitella flexilis	Smooth stonewort					X	X	X		X	X
Nitella tenuissima	Compact stonewort						X				
Nuphar sp.	Spatterdock	X	X								
Nuphar advena (*N. luteum*)	Common Spatterdock			X	X	X	X	X	X	X	
Nuphar variegata	Bull-head pond lily										
Nymphaea sp.	Water-lily	X	X								
Nymphaea odorata subsp. *tuberosa* (*N. tuberosa*)	Fragrant water-lily			X	X	X	X	X	X	X	
Phragmites australis	Common reed						X	X		X	
Pontederia cordata	Pickerel weed				X	X	X		X		
Potamogeton amplifolius	Large-leaved pondweed				X	X	X	X	X	X	X
Potamogeton crispus	Curly-leaved pondweed	X	X	X	X	X	X	X	X	X	
Potamogeton foliosus subsp. *foliosus*	Leafy pondweed					X					
Potamogeton friesii	Fries' pondweed				X	X	X	X	X	X	X
Potamogeton gramineus	Grass-leaved pondweed				X	X	X	X	X	X	X
Potamogeton illinoensis	Illinois pondweed	X	X	X	X	X	X	X	X	X	
Potamogeton natans	Common pondweed			X	X	X	X	X		X	X
Potamogeton nodosus	Long-leaf pondweed			X					X		
Potamogeton pusillus subsp. *tenuissimus*	Broad-leaved small pondweed					X					
Potamogeton zosteriformis	Flat-stem pondweed				X	X	X	X	X	X	X
Ranunculus longirostris	Long-beak water buttercup								X		
Sagittaria sp.	Arrowhead			X							
Sagittaria latifolia	Common arrowhead					X					
Sagittaria rigida	Stiff arrowhead				X	X					
Schoenoplectus acutus var. *acutus*	Hard-stem bulrush					X			X		

Table 6.0.–Continued

Taxon	Common Name	Survey Year									
		1972[*]	1978[**]	1991[§]	1998[¥]	2003[И]	2007[A]	2007[B]	2007[C]	2008[†]	2009[†]
Schoenoplectus pungens	Three-square bulrush						X				
Schoenoplectus tabernaemontani	Great bulrush					X	X	X		X	
Scirpus sp.	Bulrush	X	X	X	X						
Sparganium emersum	Dwarf bur-reed					X					
Sparganium eurycarpum	Giant bur-reed								X		
Spirodela polyrrhiza	Great duckweed					X					
Stuckenia filiformis (*Potamogeton filiformis*)	Threadleaf-pondweed			X							
Stuckenia pectinata (*Potamogeton pectinatus*)	Sago pondweed	X	X	X	X	X	X	X	X	X	X
Typha sp.	Cat-tail	X	X	X							
Typha latifolia	Broad-leaved cat-tail					X	X			X	
Typha angustifolia	Narrow-leaved cattail									X	
Utricularia gibba	Humped bladderwort					X	X				X
Utricularia macrorhiza (*U. foliosa*; *U. vulgaris*)	Common bladderwort			X	X	X	X	X		X	X
Utricularia minor	Small bladderwort					X					
Utricularia purpurea	Purple bladderwort				X	X	X	X		X	
Vallisneria americana	Eel-grass			X	X	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)
[A] AQRS Pre-treatment survey
[B]AQRS Post-treatment survey
[C]V3 Tier I Survey
[†] AQRS Post-treatment survey

Table 7.0. Summary parameters for Hudson Lake over a three year period.

Date	6/21/2007	8/17/2007	8/14/2008	8/21/2009
Depth range (ft)	0 to 25	0 to 25	0 to 25	0 to 25
Sample sites (n)	84	84	84	84
Secchi (ft)	15.1	14.3	13.0	12.0
Littoral depth (ft)	22.0	23.0	24.0	23.0
Sites with plants (%)	84.5	83.3	86.9	75.0
Sites with native plants only (%)	38.1	42.9	64.3	70.2
Species (N)	17	21	19	21
Native species (N)	15	19	18	20
Species/site (max)	6	9	8	5
Mean species/ site	2.42	2.50	2.49	1.85
Native species/site	1.87	2.08	2.19	1.76
Species diversity	0.90	0.91	0.91	0.89
Native Diversity	0.88	0.90	0.90	0.88
Species occurrence	6/21/2007	8/17/2007	8/14/2008	8/21/2009
Water-marigold (BIDBEC)			2.4	2.1
Coontail (CERDEM)	33.3	32.1	36.9	31.0
Opposite stonewort (CHACON)	28.6	32.1	32.1	20.2
Fragile stonewort (CHAGLO)		4.8		2.4
Haitian stonewort (CHAHAI)				1.2
Common stonewort (CHAVUL)				2.4
Ceylonian stonewort (CHAZEY)		2.4		
Common water-weed (ELOCAN)				1.2
Water star grass (HETDUB)	8.3	11.9	2.4	2.4
Eurasian water-milfoil (MYRSPI)	40.5	38.1	28.6	8.3
Common naiad (NAJFLE)	3.6	17.9	16.7	22.6
Spiny naiad (NAJMAR)	1.2	4.8	6.0	10.7
Smooth stonewort (NITFLE)	4.8	4.8	3.6	6.0
Compact stonewort (NITTEN)		2.4		
Large-leaved pondweed (POTAMP)	7.1	6.0	10.7	3.6
Curly-leaved pondweed (POTCRI)	14.3	3.6	1.2	
Fries' pondweed (POTFRI)	23.8	3.6	21.4	1.2
Grass-leaved pondweed (POTGRA)	2.4	9.5	4.8	6.0
Illinois pondweed (POTILL)	10.7	14.3	11.9	
Common pondweed (POTNAT)			1.2	3.6
Flat-stem pondweed (POTZOS)	13.1	10.7	6.0	1.2
Sago pondweed (STUPEC)	9.5	8.3	13.1	9.5
Humped bladderwort (UTRGIB)		1.2		1.2
Common bladderwort (UTRMAC)	2.4	4.8	11.9	10.7
Purple bladderwort (UTRPUR)	4.8	2.4	7.1	
Eel-grass (VALAME)	33.3	34.5	31.0	38.1
Species dominance	6/21/2007	8/17/2007	8/14/2008	8/21/2009
Water-marigold (BIDBEC)			0.5	0.2
Coontail (CERDEM)	10.0	10.2	7.9	11.2
Opposite stonewort (CHACON)	10.0	14.0	13.1	8.3

Table 7.0.–Continued

Species dominance	6/21/2007	8/17/2007	8/14/2008	8/21/2009
Fragile stonewort (CHAGLO)		1.0		0.5
Haitian stonewort (CHAHAI)				0.2
Common stonewort (CHAVUL)				0.5
Ceylonian stonewort (CHAZEY)		0.5		
Common water-weed (ELOCAN)				0.2
Water star grass (HETDUB)	1.7	0.2	0.5	0.5
Eurasian water-milfoil (MYRSPI)	13.8	12.9	5.7	2.1
Common naiad (NAJFLE)	0.7	4.5	4.8	6.4
Spiny naiad (NAJMAR)	0.2	1.0	1.2	6.0
Smooth stonewort (NITFLE)	1.0	1.0	0.7	1.2
Compact stonewort (NITTEN)		0.5		
Large-leaved pondweed (POTAMP)	1.9	2.1	2.6	0.7
Curly-leaved pondweed (POTCRI)	2.9	0.7	0.2	
Fries' pondweed (POTFRI)	6.2	2.4	5.2	0.2
Grass-leaved pondweed (POTGRA)	0.5	0.5	1.0	1.7
Illinois pondweed (POTILL)	2.1	3.8	2.4	
Common pondweed (POTNAT)			0.2	0.7
Flat-stem pondweed (POTZOS)	2.6	2.1	1.2	0.2
Sago pondweed (STUPEC)	1.9	1.7	2.6	2.4
Humped bladderwort (UTRGIB)		0.2		0.2
Common bladderwort (UTRMAC)	0.5	1.0	4.8	4.5
Purple bladderwort (UTRPUR)	1.0	1.0	1.4	
Eel-grass (VALAME)	6.7	9.3	7.6	9.0

Table 8.0. Locations of state-listed species at Hudson Lake (2007-2009).

Species	Common Name	Point	Coordinates	
		Number	Easting	Northing
Utricularia purpurea	purple bladderwort	9	536239.6	4618141.8
		13	536181.9	4618284.8
		14	536261.9	4618278.9
		16	536365.6	4618352.9
		37	536995.2	4618119.6
Potamogeton friesii	Fries pondweed	16	536365.6	4618352.9
		25	538369.3	4618045.5
		26	538180.4	4618271.4
		27	538090.4	4618388.5
		28	537965.6	4618556.6
		29	537841.9	4618595.6
		30	537680.4	4618586.3
		32	537450.8	4618471.4
		33	537284.1	4618404.8
		34	537139.6	4618434.4
		35	537013.7	4618386.3
		38	537369.3	4618049.2
		39	537687.8	4617930.7
		40	537832.7	4617859.3
		42	538253.5	4617835.1
		44	538282.6	4618074.1
		47	538005.5	4618478.4
		48	537829.1	4618556.6
		50	537404.6	4618391.3
		51	537091.8	4618348.9
		52	537065.0	4618179.1
		55	537377.8	4618107.6
		56	537578.9	4618051.8
		67	537458.6	4618430.6
		76	538153.7	4618117.8
Bidens beckii	water marigold	5	537218.8	4618041.3
		23	538460.9	4617973.1

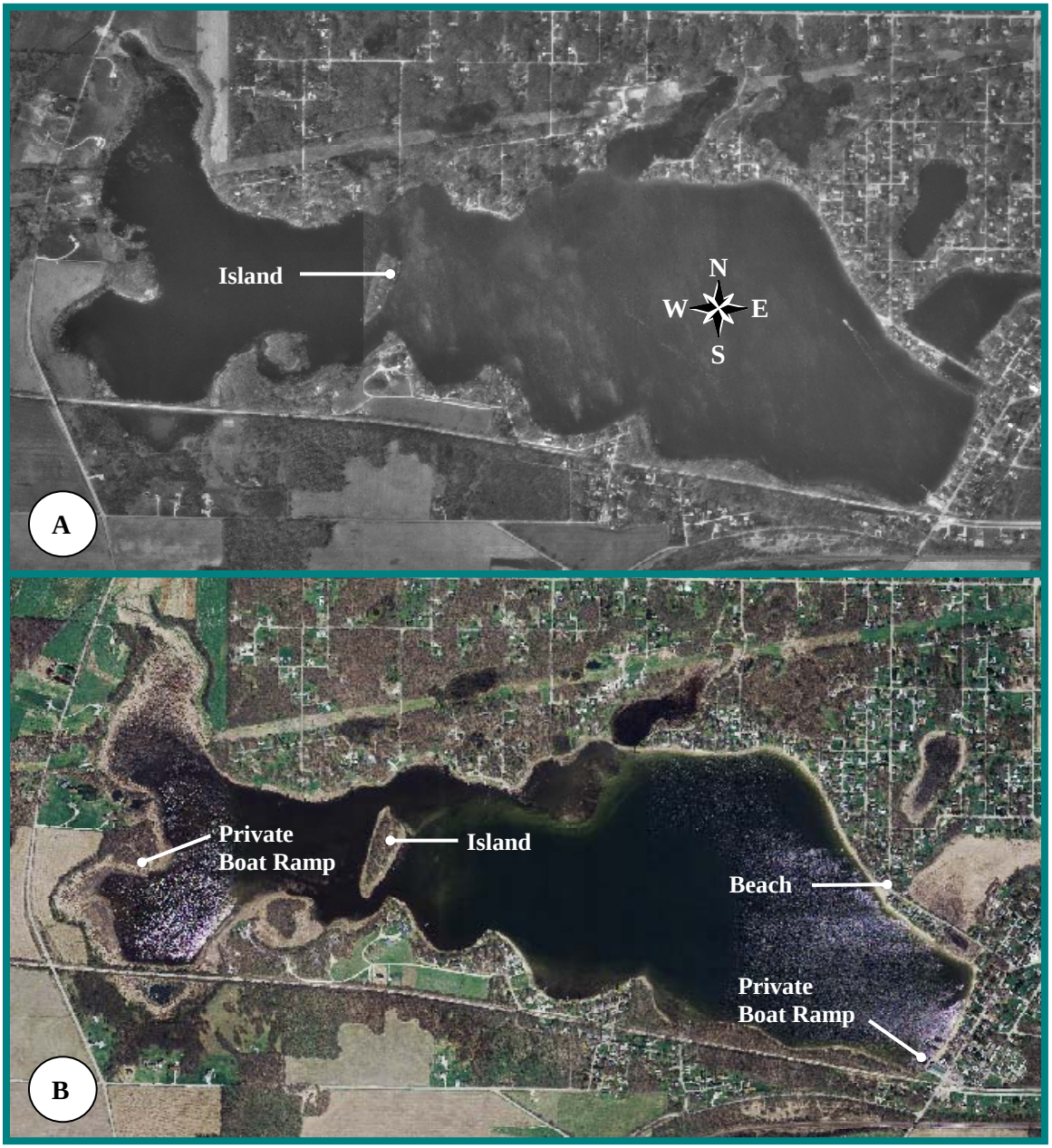

Figure 1.0. Aerial photographs of Hudson Lake, LaPorte County, Indiana. A. 1999 overhead view of the lake. B. 2006 overhead view of the lake. (Orthophotographs courtesy of the United States Geological Survey.)

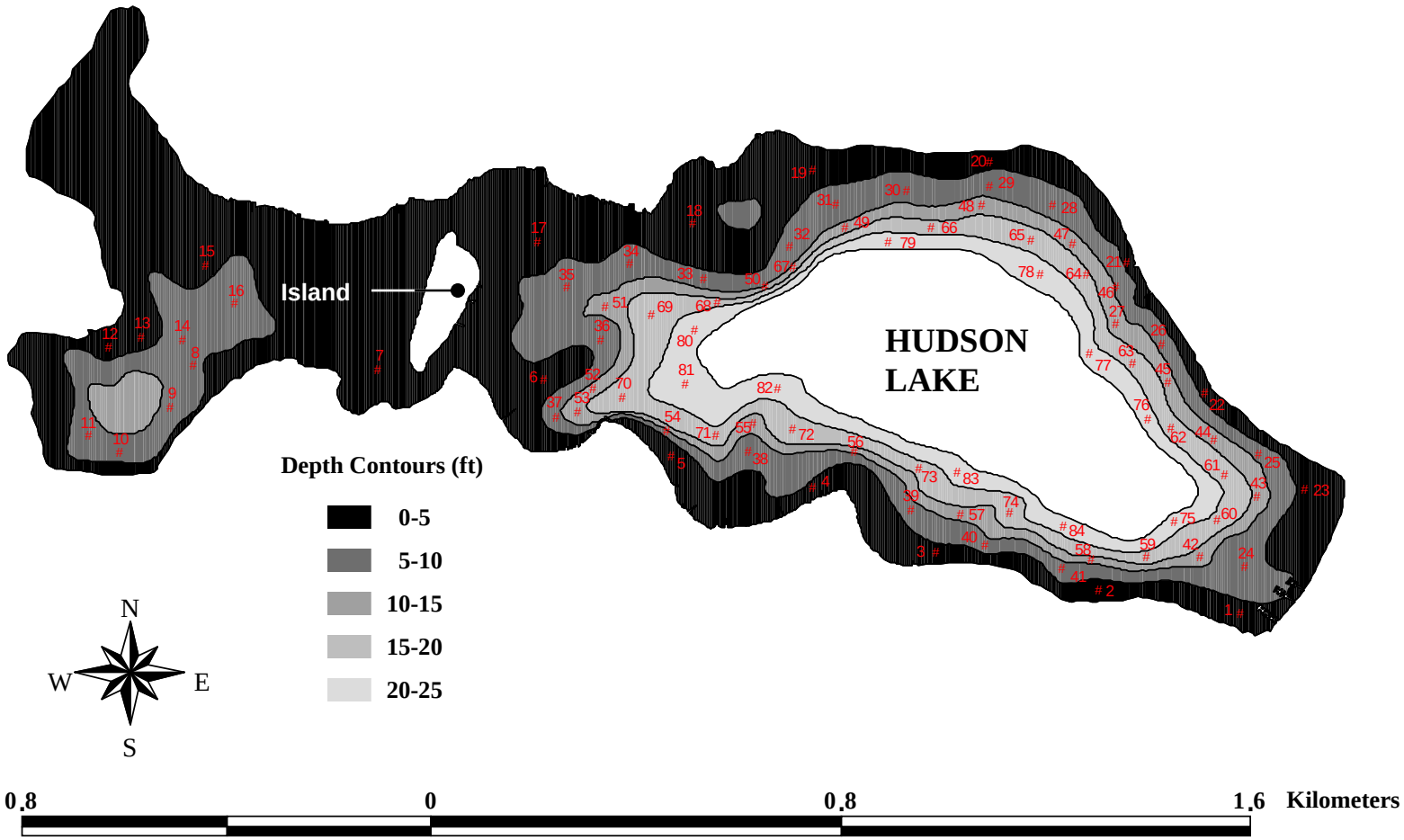

Figure 2.0. Distribution of sample locations in Hudson Lake.

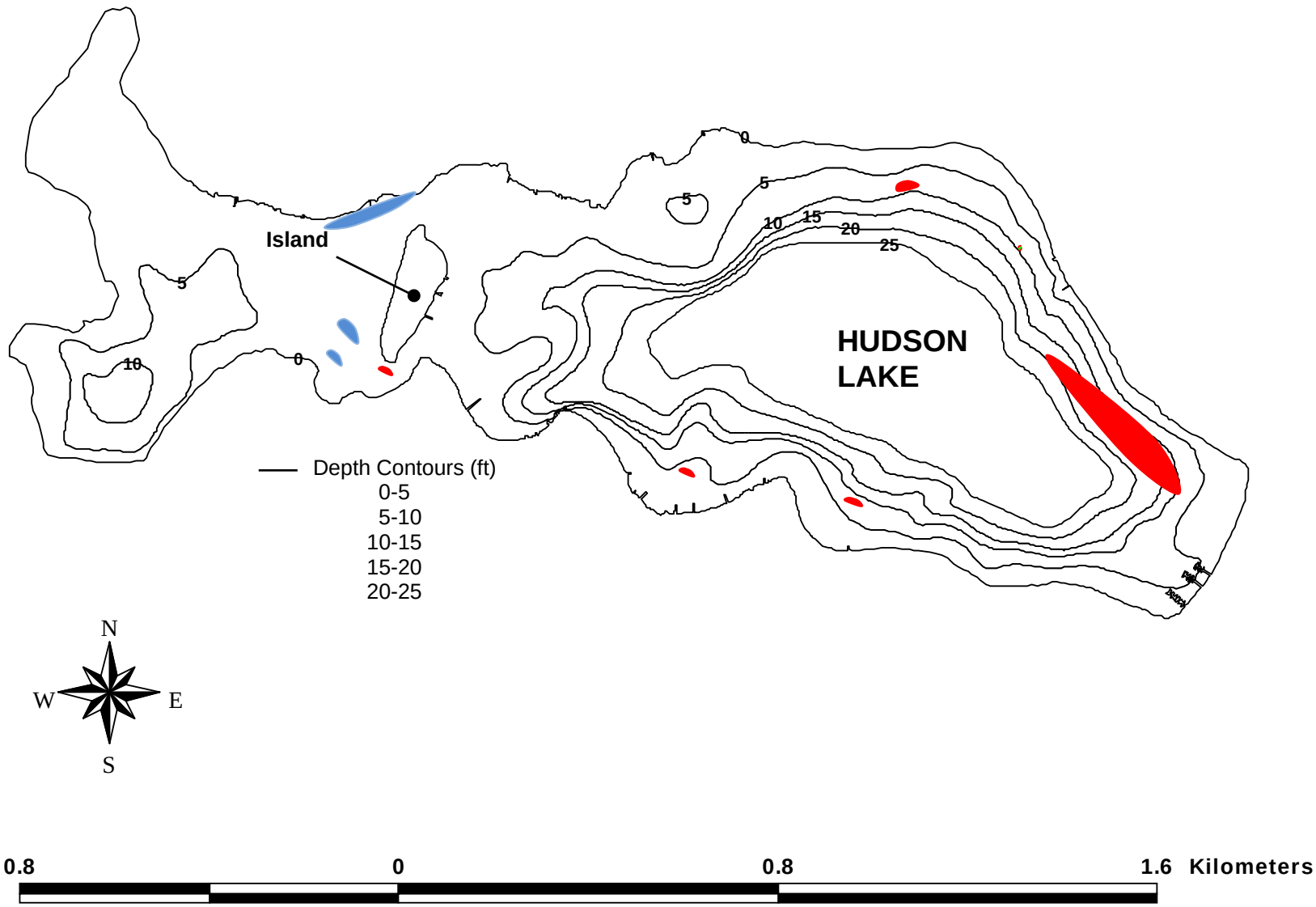

Figure 3.0. Pre-treatment extent of Eurasian water-milfoil –red (*Myriophyllum spicatum*) and common reed -blue (*Phragmites australis*) in June 2009.

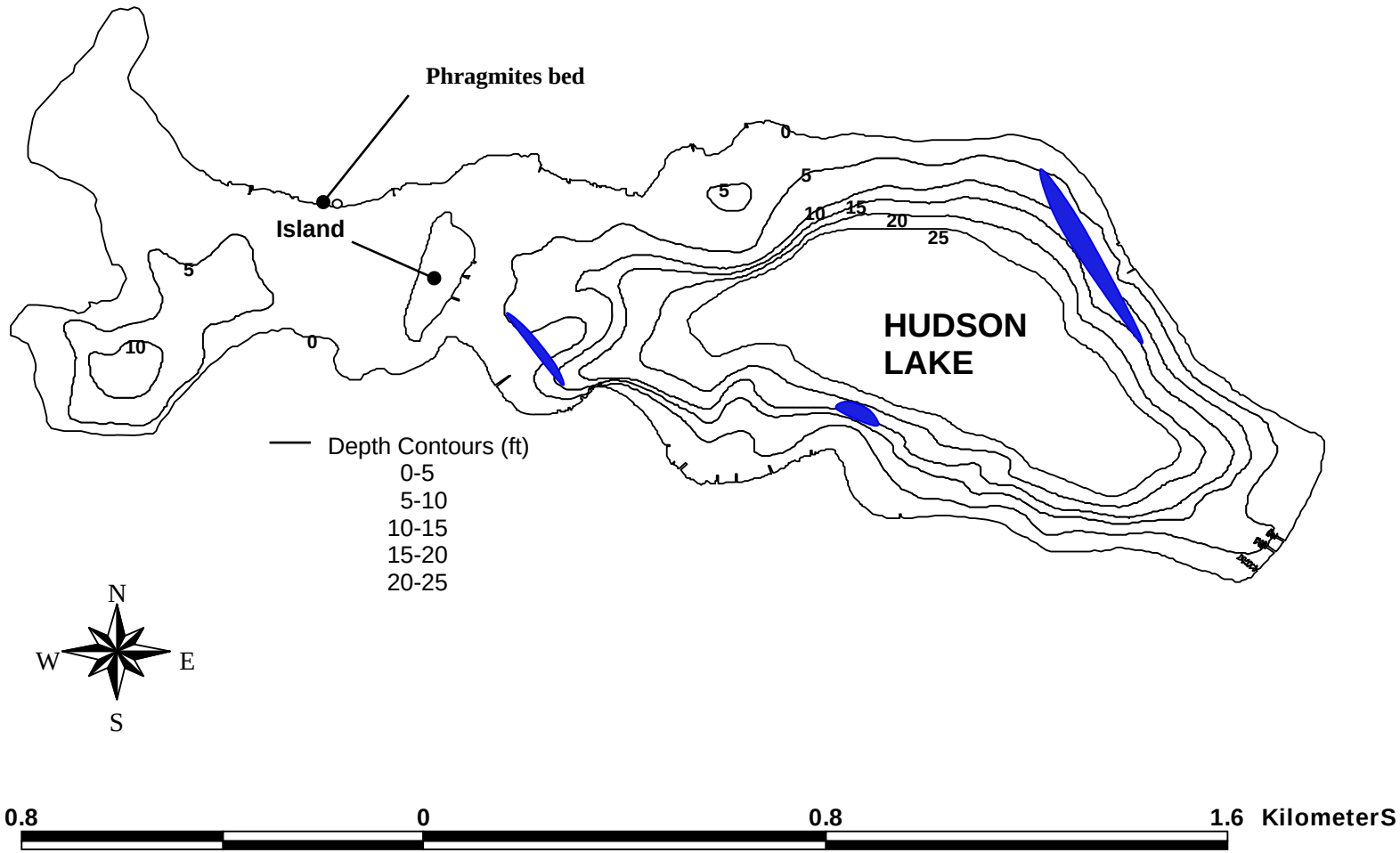

Figure 4.0. Pre-treatment extent of Eurasian water-milfoil (*Myriophyllum spicatum*) in June 2008. The location of the *Phragmites australis* bed is indicated.

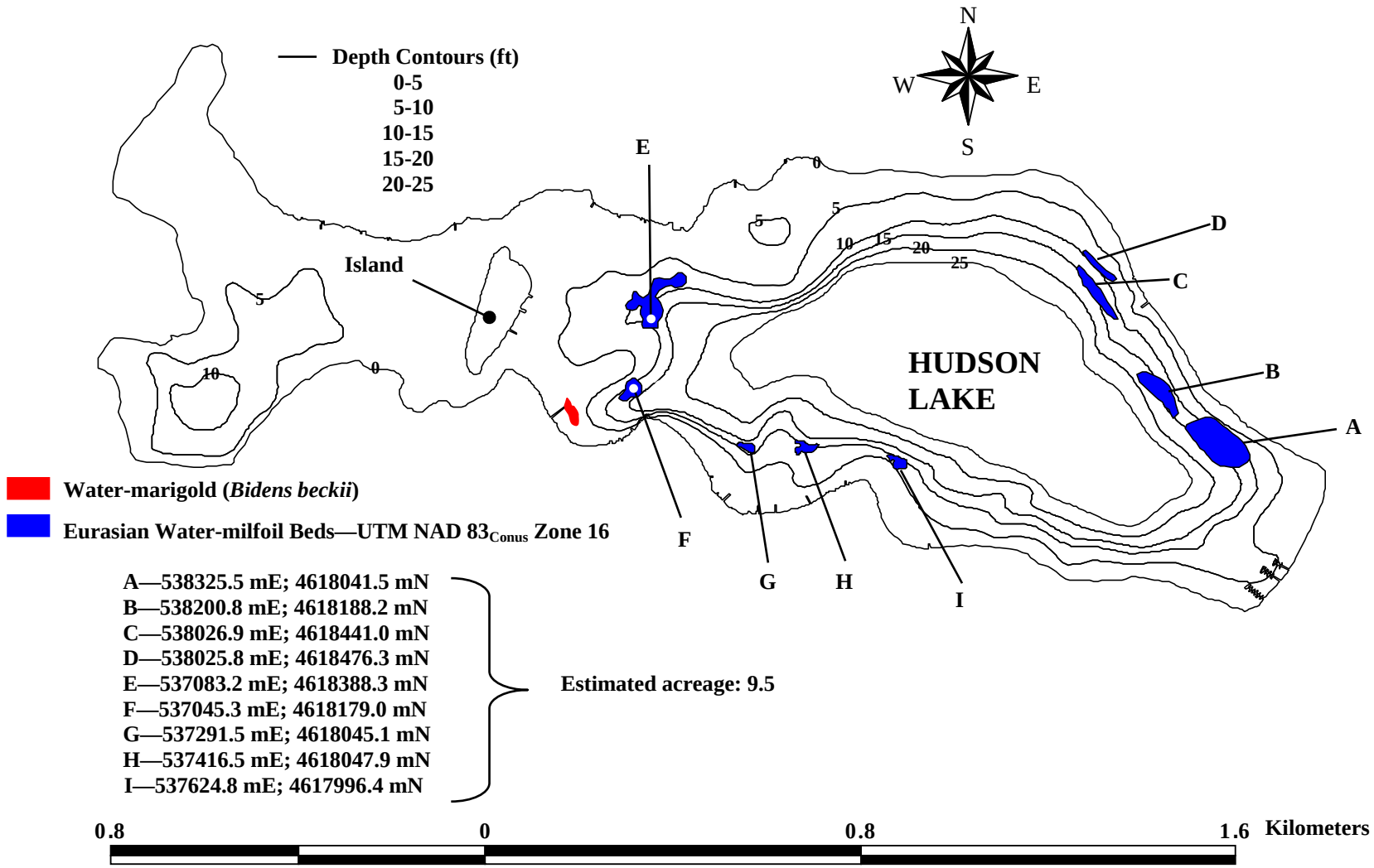

Figure 5.0. Post-treatment extent of Eurasian water-milfoil (*Myriophyllum spicatum*) and location of water-marigold (*Bidens beckii*) in August 2007.

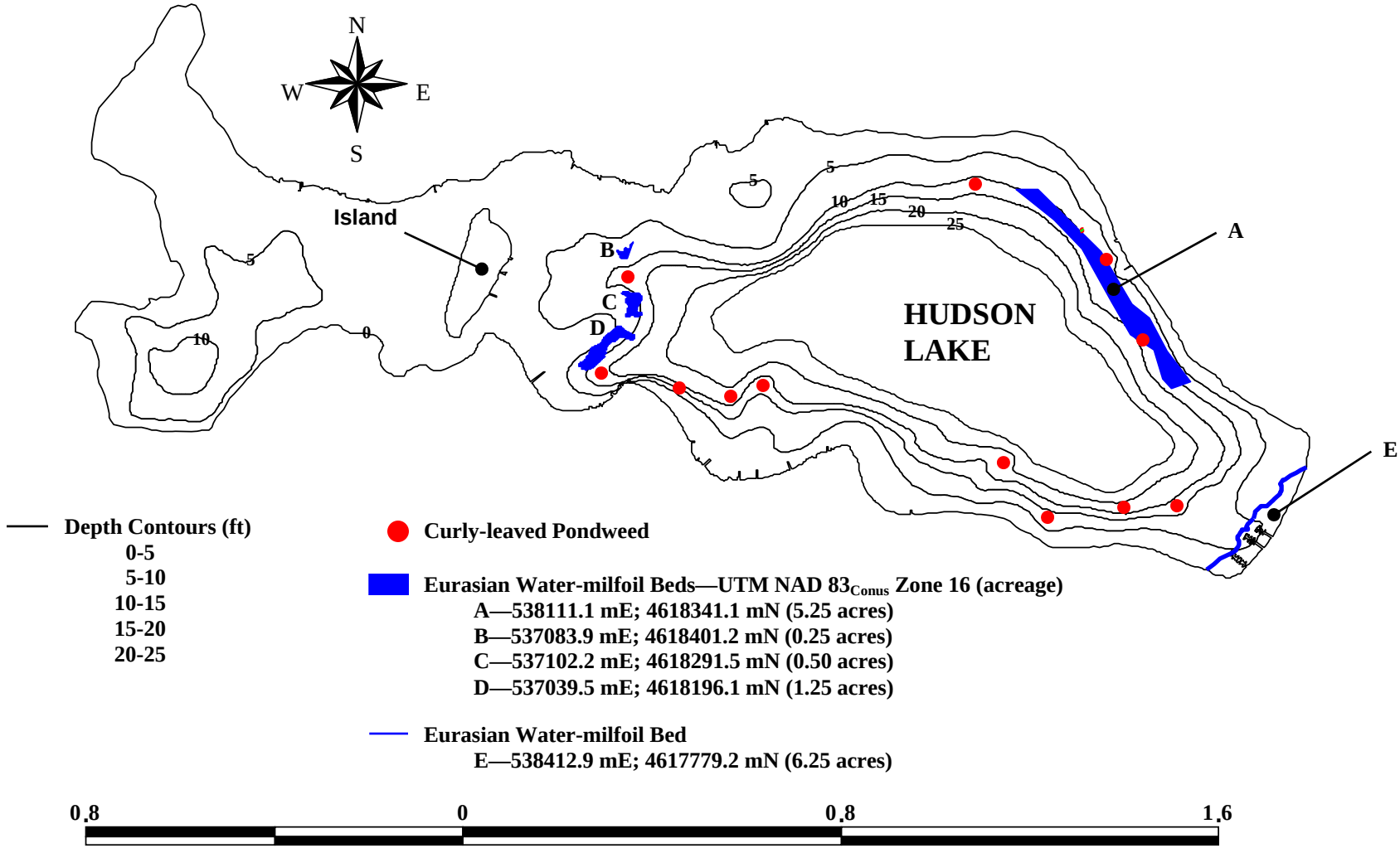

Figure 6.0. Pre-treatment extent of Eurasian water-milfoil (*Myriophyllum spicatum*) and curly-leaved pondweed (*Potamogeton crispus*) in June 2007.

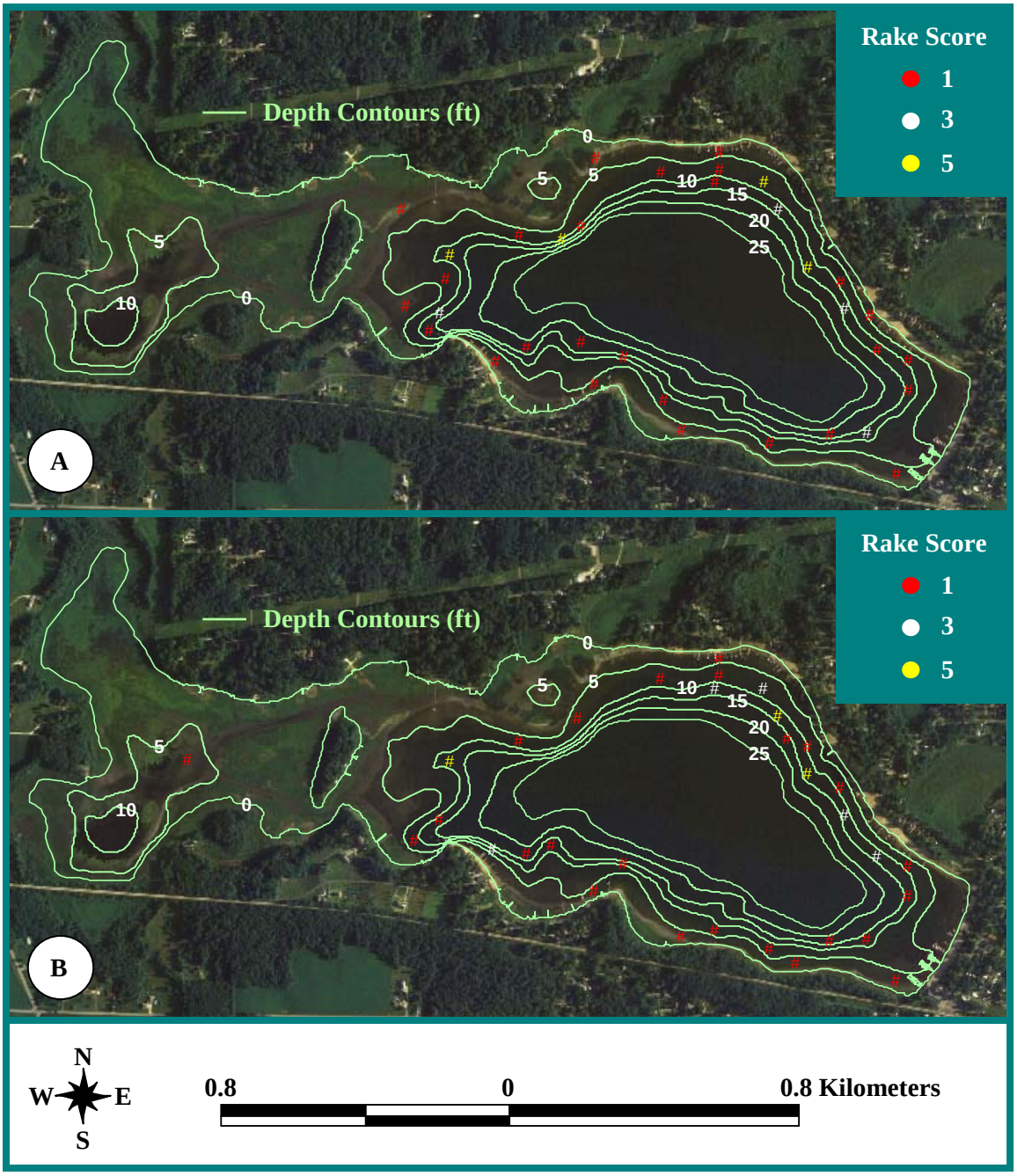

Figure 7.0. Distribution and abundance of *Myriophyllum spicatum* (Eurasian water-milfoil). A. Pre-treatment survey (2007). B. Post-treatment survey (2007). (Orthophotographs courtesy of the United States Geological Survey.)

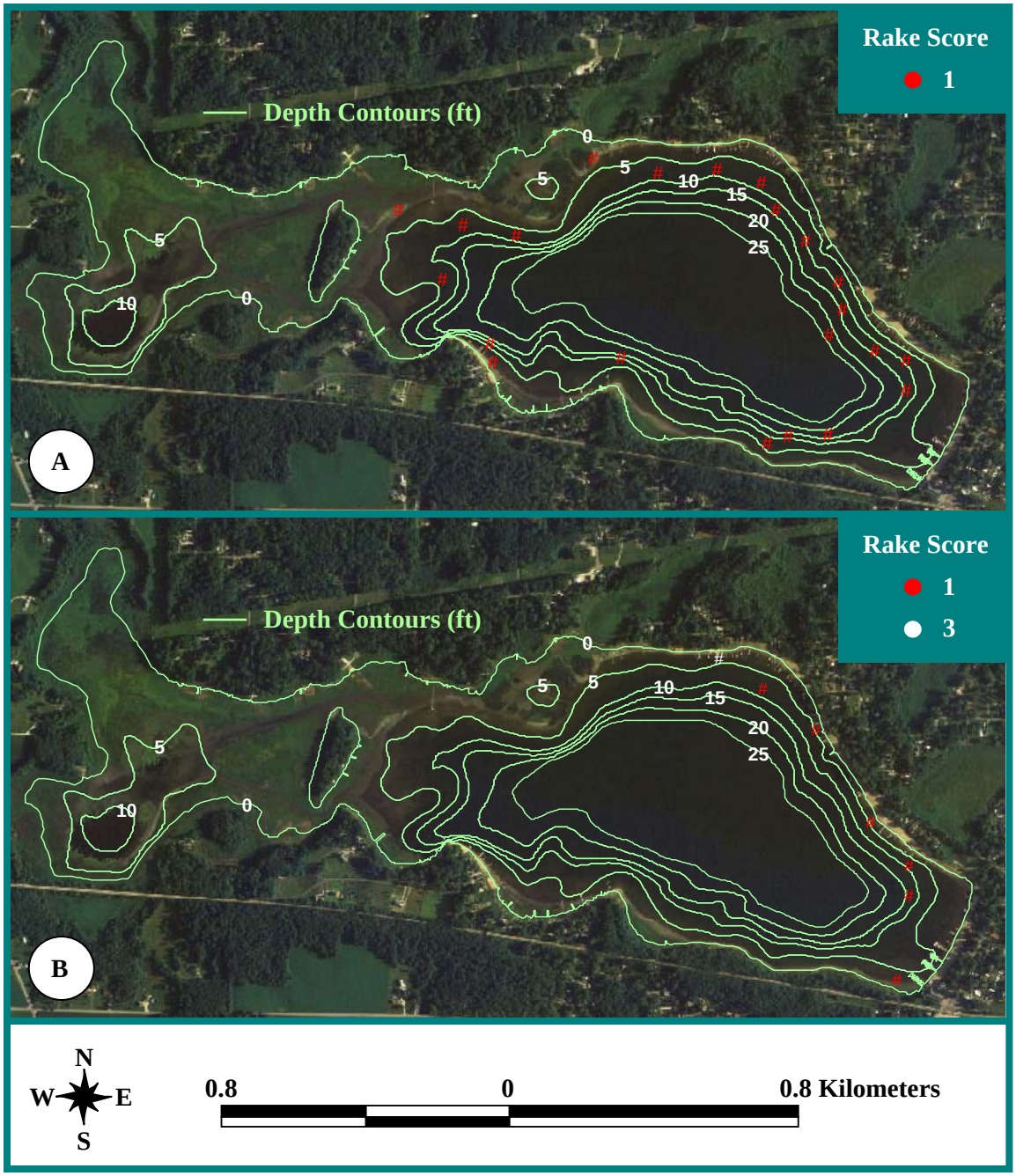

Figure 8.0. Distribution and abundance of *Myriophyllum spicatum* (Eurasian water-milfoil). A. Post-treatment survey (2008). B. Post-treatment survey (2009). (Orthophotographs courtesy of the United States Geological Survey.

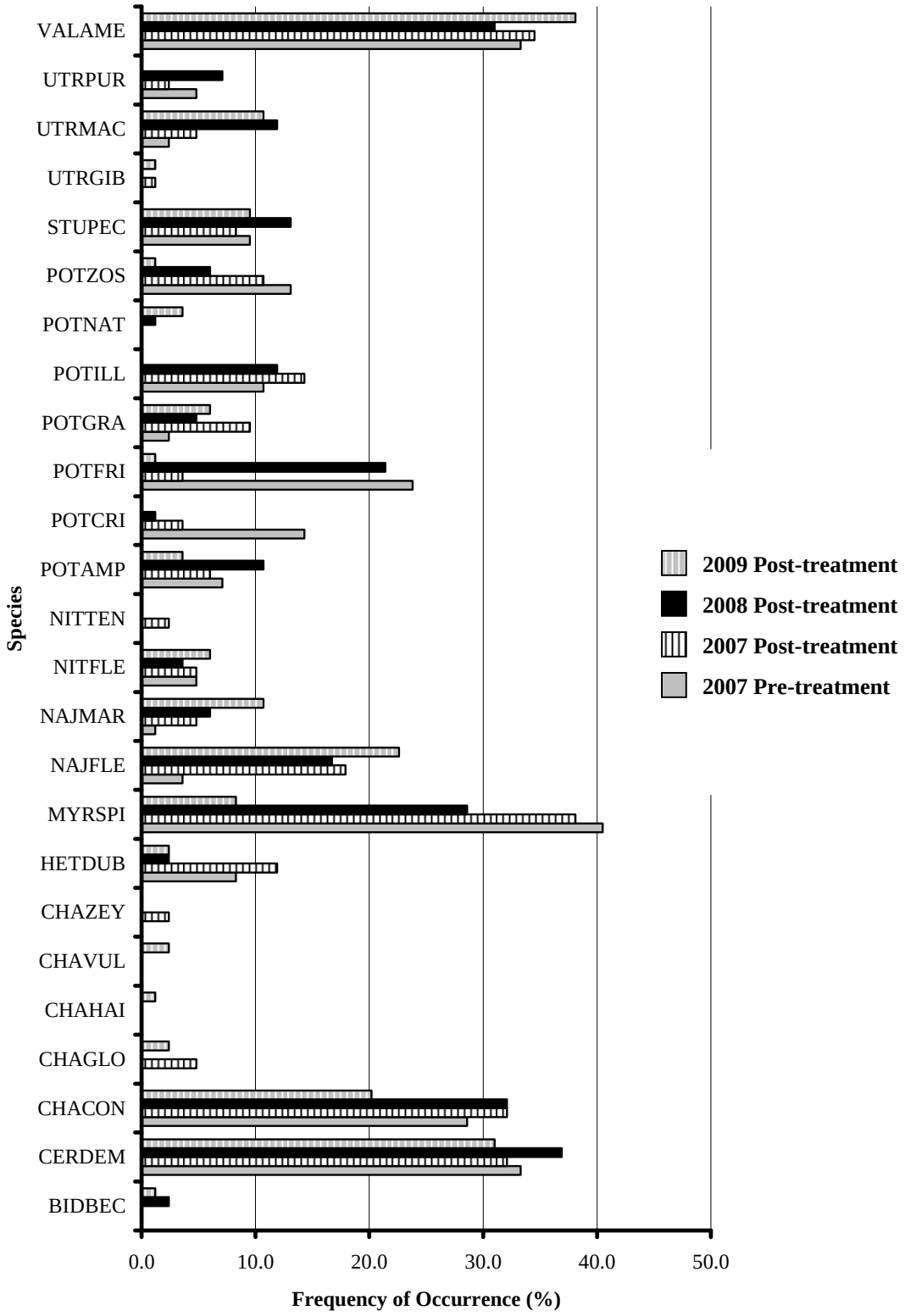

Figure 9.0. Frequency of occurrence values of aquatic plant species for Hudson Lake over multiple years.

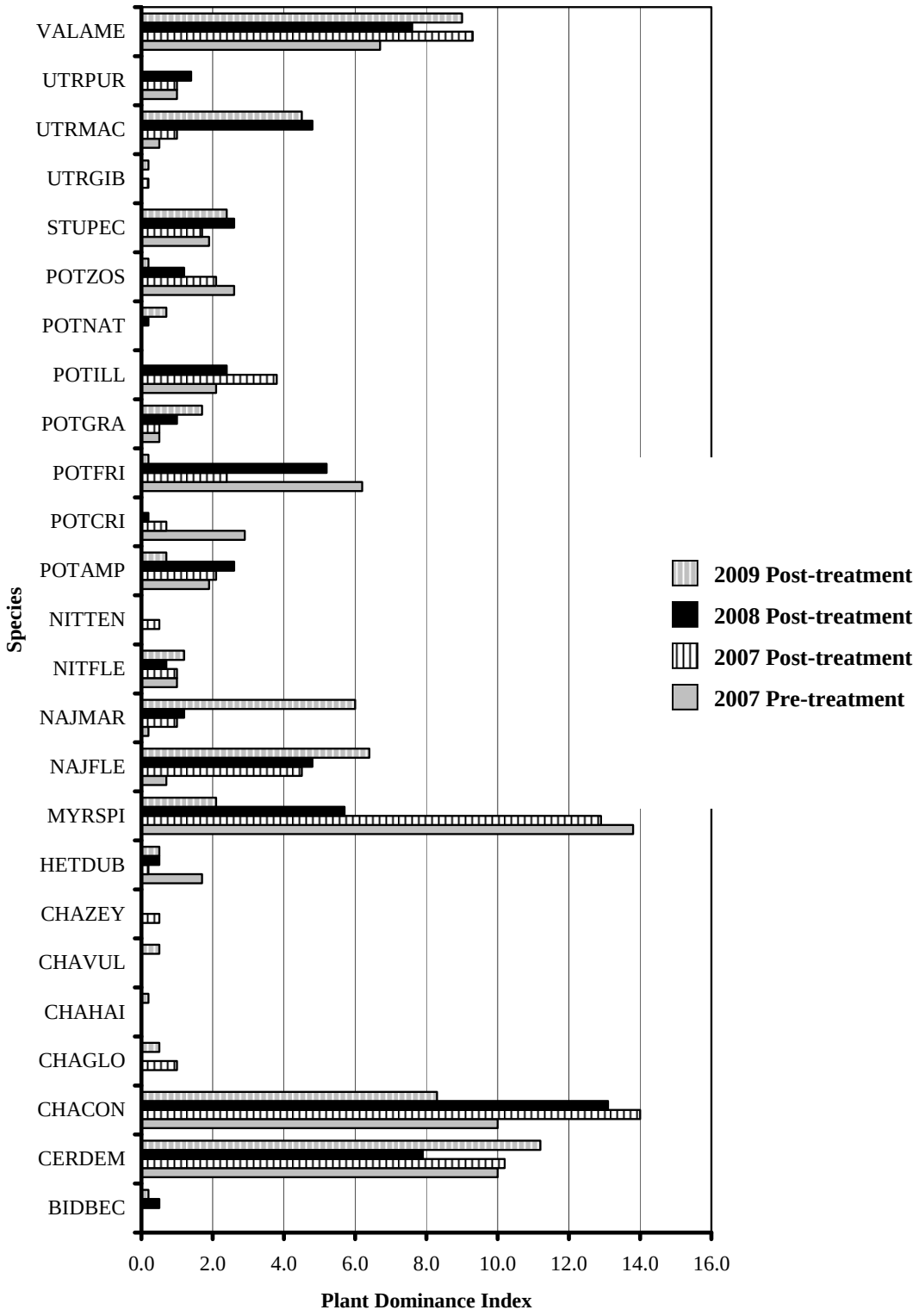

Figure 10.0. Plant dominance index values of aquatic plant species for Hudson Lake over multiple years.

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11.0. APPENDICES

11.1 Post-treatment Water Body Cover Sheet

Aquatic Vegetation Random Sampling (Tier 2)

Waterbody Cover Sheet

Surveying Organization:	Aquatic Restoration Systems, LLC		
Contact Information:	Robin W. Scribailo (rscribailo@pnc.edu)		
Waterbody Name:	Hudson Lake	Lake ID:	
County:	LaPorte	Date:	August 12, 21, 2009
Habitat Stratum:	IL	Average Lake Depth (ft):	
Lake Level:	764		
Crew Leader:	Robin W. Scribailo	GPS Metadata	
Recorder:	Robin W. Scribailo	Datum: NAD 83	Zone: 16 / Accuracy: 1.9
Secchi Depth (ft):	12.0	Method:	D
Points Surveyed:	84	Total # of Species:	21
Littoral Zone (acres):	27.5	Littoral Zone Maximum Depth (ft):	26.0

☐ Measured
■ Estimated

■ Measured
☐ Estimate (historical Secchi)
☐ Estimated (current Secchi)

Notable Conditions:

11.2 Tier II Data Sheets

WATERBODY NAME: Hudson Lake	DATE: August 21, 2009
COUNTY: LaPorte	SECCHI DEPTH (ft): 12.0
SITE ID:	MAXIMUM PLANT DEPTH (ft): 24.0
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)	VALAME	MYRSPI	POTNAT	NAJFLE	STUPEC	CHACON	POTGRA	UTRMAC	NAJMAR	NYMODO	SCHTAB	CHAVUL									NOTES
1	T	538334.3	4617716.5	5.5	1	1	1																		
2	T	538055.0	4617765.2	6.5				5																	
3	T	537736.8	4617843.2	5.5	1			1	1																
4	T	537496.5	4617976.3	5.5	1			1		1															
5	T	537218.8	4618041.3	6.5	1					5															
6	T	536970.4	4618198.8	8.0	1		1	1																	
7	T	536645.7	4618218.3	4.5			1				3														
8	T	536284.4	4618227.0	4.8								3													
9	T	536239.6	4618141.8	5.5								1	5												
10	T	536139.9	4618047.4	5.5								1	5												
11	T	536080.4	4618082.6	6.5								1	5												
12	T	536119.6	4618265.3	5.0									1	9	9										
13	T	536181.9	4618284.8	5.2								3	3			1									
14	T	536261.9	4618278.9	6.0								5				1									

Other plant species observed at lake:

WATERBODY NAME: Hudson Lake	DATE: August 21, 2009
COUNTY: LaPorte	SECCHI DEPTH (ft): 12.0
SITE ID:	MAXIMUM PLANT DEPTH (ft): 24.0
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)	UTRMAC	NAJMAR	UTRGIB	CERDEM	STUPEC	NAJFLE	VALAME	MYRSPI	CHACON	CHAHAI	POTGRA	POTAMP	BIDBEC	CHAGLO	POTFRI						NOTES
15	T	536309.3	4618433.7	4.5	1	1																			
16	T	536365.6	4618352.9	4.5	3	3	1																		
17	T	536958.4	4618480.0	5.0																					
18	T	537261.0	4618518.6	5.0				1																	
19	T	537498.1	4618627.4	5.0	1				1	1															
20	T	537842.3	4618645.3	7.0				1	3	1	1	3													
21	T	538110.2	4618439.1	6.5						1		1	1	1	1										
22	T	538262.9	4618171.2	7.5						1		1	5		1										
23	T	538460.9	4617973.1	6.5							5				1	1	1								
24	T	538343.3	4617812.2	9.1						1	3		1												
25	T	538369.3	4618045.5	10.5						1	1	1	1					1							
26	T	538180.4	4618271.4	11.5				1		1	1														
27	T	538090.4	4618388.5	12.0				1		1	1							1							
28	T	537965.6	4618556.6	11.5						1	1	1	1						1						

Other plant species observed at lake:

WATERBODY NAME: Hudson Lake	DATE: August 21, 2009
COUNTY: LaPorte	SECCHI DEPTH (ft): 12.0
SITE ID:	MAXIMUM PLANT DEPTH (ft): 24.0
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)	NAJFLE	VALAME	CERDEM	STUPEC	NAJMAR	NITFLE	CHACON	POTZOS	POTAMP	POTGRA	HETDUB										NOTES
29	T	537841.9	4618595.6	13.0	1	1	1	1	1																
30	T	537680.4	4618586.3	12.0		1				1															
31	T	537543.3	4618559.4	10.0	3	1																			
32	T	537450.8	4618471.4	9.2		1		1			3														
33	T	537284.1	4618404.8	13.0		1					3	1													
34	T	537139.6	4618434.4	9.5	1	1		1																	
35	T	537013.7	4618386.3	9.5	3	1					1		1												
36	T	537080.4	4618278.9	10.5		1	5				1		1												
37	T	536995.2	4618119.6	13.0							1														
38	T	537369.3	4618049.2	9.1	1			1			1														
39	T	537687.8	4617930.7	10.0		1					1			1											
40	T	537832.7	4617859.3	11.0																					
41	T	537984.1	4617808.5	12.0		1		1			5														
42	T	538253.5	4617835.1	14.5			1								1										

Other plant species observed at lake:

WATERBODY NAME: Hudson Lake	DATE: August 21, 2009
COUNTY: LaPorte	SECCHI DEPTH (ft): 12.0
SITE ID:	MAXIMUM PLANT DEPTH (ft): 24.0
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)	CERDEM	MYRSPI	VALAME	NITFLE	ELOCAN	CHACON	HETBUB	NAJMAR	NAJFLE												NOTES
43	T	538367.4	4617957.9	15.0	5	1																			
44	T	538282.6	4618074.1	15.0	1		1																		
45	T	538191.0	4618192.5	16.0	1		1	1	1																
46	T	538090.4	4618310.9	16.0	1		1																		
47	T	538005.5	4618478.4	15.5	1			1																	
48	T	537829.1	4618556.6	19.0	1		1	1																	
49	T	537558.7	4618509.7	19.0	1																				
50	T	537404.6	4618391.3	16.5			1			3															
51	T	537091.8	4618348.9	14.2			1				1	1													
52	T	537065.0	4618179.1	17.0	1																				
53	T	537036.0	4618132.2	16.0	1																				
54	T	537212.1	4618093.1	17.0			1						1												
55	T	537377.8	4618107.6	16.5	1		1																		
56	T	537578.9	4618051.8	16.0																					

Other plant species observed at lake:

WATERBODY NAME: Hudson Lake	DATE: August 21, 2009	Aquatic Restoration Systems AQRS, LLC
COUNTY: LaPorte	SECCHI DEPTH (ft): 12.0	
SITE ID:	MAXIMUM PLANT DEPTH (ft): 24.0	
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.*	

Species Codes:

Point ID	R/T	Easting	Northing	Depth (ft)	CERDEM	VALAME	NITFLE	CHACON																	NOTES
57	T	537786.6	4617922.2	15.0	1	1	1																		
58	T	538041.3	4617828.4	18.5	1																				
59	T	538150.8	4617832.8	19.2	1																				
60	T	538289.3	4617908.8	19.1	5																				
61	T	538302.7	4618002.6	19.2	5																				
62	T	538197.7	4618098.7	21.0	1																				
63	T	538123.9	4618230.5	20.0																					
64	T	538030.9	4618413.5	19.1	5																				
65	T	537922.9	4618485.1	20.0																					
66	T	537728.5	4618509.7	24.0																					
67	T	537458.6	4618430.6	23.0		1		1																	
68	T	537311.2	4618358.0	24.0	3																				
69	T	537179.7	4618329.4	19.1																					
70	T	537124.4	4618161.7	19.3																					

Other plant species observed at lake:

WATERBODY NAME: Hudson Lake	DATE: August 21, 2009	Aquatic Restoration Systems AQRS, LLC
COUNTY: LaPorte	SECCHI DEPTH (ft): 12.0	
SITE ID:	MAXIMUM PLANT DEPTH (ft): 24.0	
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.*	

Species Codes:

Point ID	R/T	Easting	Northing	Depth (ft)	CERDEM																				NOTES
71	T	537307.4	4618083.5	19.2	1																				
72	T	537456.1	4618096.9	19.1																					
73	T	537703.9	4618014.9	20.0																					
74	T	537883.0	4617925.3	19.5																					
75	T	538203.2	4617906.3	24.2																					
76	T	538153.7	4618117.8	24.1																					
77	T	538037.4	4618251.3	26.0																					
78	T	537942.1	4618413.3	24.5																					
79	T	537644.8	4618481.9	26.0																					
80	T	537265.5	4618300.8	24.3																					
81	T	537248.3	4618188.4	25.0																					
82	T	537427.5	4618180.7	24.2																					
83	T	537778.2	4618009.2	24.1																					
84	T	537985.9	4617896.7	24.1																					

Other plant species observed at lake:

11.3. Indiana Special Plant Survey Forms

11.3.1 Fries' Pondweed (*Potamogeton friesii*)

Quad Code

Indiana Special Plant Survey Form

Element Name: *Potamogeton friesii*

Surveyor (s): **Robin W. Scribailo** Date: **08/21/2009** Time: **10:00 a.m.**

Location: **Hudson Lake** ¼ ¼ ¼

Sec. T R Quad name:

Repeat visit: Yes ☒ No ☐ Repeat visit needed: Yes ☐ No ☒ When:

EO boundaries mapped: Yes ☒ No ☐ County **LaPorte**

Area name (if applicable)

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	**100** % Mature
☐ Seed dispersing	☐ 1001-10,000	☐ 100 yd^2-2 ac	☐ % Senescent
☐ Dormant	☐ 10,000+	☐ 2 ac+	

Comments on above: **From turions**

Compared to your last visit to this site:	Approx. # Indiv.	Popultaion Area	Age Class:
	☐ more	☐ more	☒ same
	☐ same	☐ same	☐ diff.
	☒ less	☒ less	

Reproduction. Is reproduction occurring? Type: ☐ sexual ☒ asexual ☐ both

EO RANK **C** Date **08/21/2009**

A = very good example, B = good example, C = average example, D = poor example, X = destroyed

EO RANK Comments:

Population Distribution ☐ solitary, ☐ clumps/dense groups, ☐ patches/cushions

☒ small colonies or large carpets, ☒ large, almost pure population stands.

Vigor: ☐ very feeble, ☐ feeble, ☒ normal, ☐ 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: **Sand**

Associated Natural Community/Plant Community:

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

Characteristic associated species: *Chara contraria, Myriophyllum spicatum, Najas flexilis, & Vallisneria americana*

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 #

11.3. Indiana Special Plant Survey Forms

11.3.2 Water-marigold (*Bidens beckii*)

Quad Code

Indiana Special Plant Survey Form

Element Name: *Bidens beckii*

Surveyor (s): **Robin W. Scribailo** Date: **08/21/2009** Time: **1:15 p.m.**

Location: **Hudson Lake** ¼ ¼ ¼

Sec. T R Quad name:

Repeat visit: Yes ☒ No ☐ Repeat visit needed: Yes ☒ No ☐ When: **1 yr.**

EO boundaries mapped: Yes ☐ No ☒ County **LaPorte**

Area name (if applicable)

Biology

Phenology	Approx # Indiv	Population Area	Age Class
☒ In leaf	☒ 1-10	☒ 1 yd^2	☐ % Seedlings
☐ In bud	☐ 11-50	☐ 1-5 yd^2	**100** % 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	☐ 10,000+	☐ 2 ac+	

Comments on above:

Compared to your last visit to this site:	Approx. # Indiv.	Popultaion Area	Age Class:
	☐ more	☐ more	☒ same
	☐ same	☐ same	☐ diff.
	☒ less	☒ less	

Reproduction. Is reproduction occurring? Type: ☐ sexual ☐ asexual ☐ both

EO RANK: **C** Date: **08/21/2009**

A = very good example, B = good example, C = average example, D = poor example, X = destroyed

EO RANK Comments:

Population Distribution ☐ solitary, ☐ clumps/dense groups, ☐ patches/cushions

☒ small colonies or large carpets, ☐ large, almost pure population stands.

Vigor: ☐ very feeble, ☒ feeble, ☐ normal, ☐ 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:

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

Characteristic associated species: *Potamogeton amplifolius, Potamogeton gramineus, & Vallisneria americana*

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 #

11. 4. Herbicide Application Permit

			Return to: Page 1 of 5
APPLICATION FOR AQUATIC VEGETATION CONTROL PERMIT	**FOR OFFICE USE ONLY**		DEPARTMENT OF NATURAL RESOURCES
State Form 26727 (R4 / 2-04)	License No.		Division of Fish and Wildlife
Approved State Board of Accounts 2004			Commercial License Clerk
[ ] Whole Lake [X] Multiple Treatment Areas	Date Issued		402 West Washington Street, Room W273
Check type of permit			Indianapolis, IN 46204
INSTRUCTIONS: Please print or type information	Lake County		FEE: $5.00

Applicant's Name: Bill Companik	Lake Assoc. Name: Hudson Lake Conservation Association	
Rural Route or Street: 7365 East Hudson Pointe Lane		Phone Number: 574-654-3066
City and State: New Carlisle		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:
Does water flow into a water supply	[ ] Yes	[ ] 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	see attached map		
Total acres to be controlled	6	Proposed shoreline treatment length (ft)		Perpendicular distance from shoreline (ft)	on map
Maximum Depth of Treatment (ft)	7	Expected date(s) of treatment(s)	mid July 2010		

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: [ ] Rake [X] Visual [ ] Other (specify)

Aquatic Plant Name	Check if Target Species	Relative Abundance % of Community
Eurasian Water-milfoil	X	50%
Sago pondweed		20%
common naiad		10%
Eel-grass		10%
Opposite stonewort		10%

Treatment Area #	B	LAT/LONG or UTM's	see attached map
Total acres to be controlled	15	Proposed shoreline treatment length (ft)	Perpendicular distance from shoreline (ft)
Maximum Depth of Treatment (ft)	20	Expected date(s) of treatment(s)	mid July 2010

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: [ ] Rake [X] Visual [ ] Other (specify)

Aquatic Plant Name	Check if Target Species	Relative Abundance % of Community
Eurasian Water-milfoil	X	30%
Common coontail		40%
Eel-grass		10%
Opposite stonewort		10%
Common naiaid		10%

INSTRUCTIONS: Applicant must sign the application and is the only signature required. If applicant is also a certified chemical applicator, sign the "certified applicator" signature box

Applicant Signature	Date
Certified Applicator'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-F	LAT/LONG or UTM's	see attached map		
Total acres to be controlled	3	Proposed shoreline treatment length (ft)		Perpendicular distance from shoreline (ft)	
Maximum Depth of Treatment (ft)	10	Expected date(s) of treatment(s)	Jul-10		
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. Habitat herbicide

Plant survey method: Rake X Visual Other (specify)

Aquatic Plant Name	Check if Target Species	Relative Abundance % of Community
Eurasian water-milfoil	X	50%
Common naiaid		10%
Common pondweed		10%
Grass-leaved pondweed		10%
Opposite stonewort		10%
Eel-grass		10%

Treatment Area #	G-J	LAT/LONG or UTM's	see attached map		
Total acres to be controlled	3.5	Proposed shoreline treatment length (ft)		Perpendicular distance from shoreline (ft)	
Maximum Depth of Treatment (ft)	3	Expected date(s) of treatment(s)	Jul-10		
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. Habitat herbicide

Plant survey method: Rake Visual Other (specify)

Aquatic Plant Name	Check if Target Species	Relative Abundance % of Community
Common reed	X	80%
mixed grasses/sedges		20%

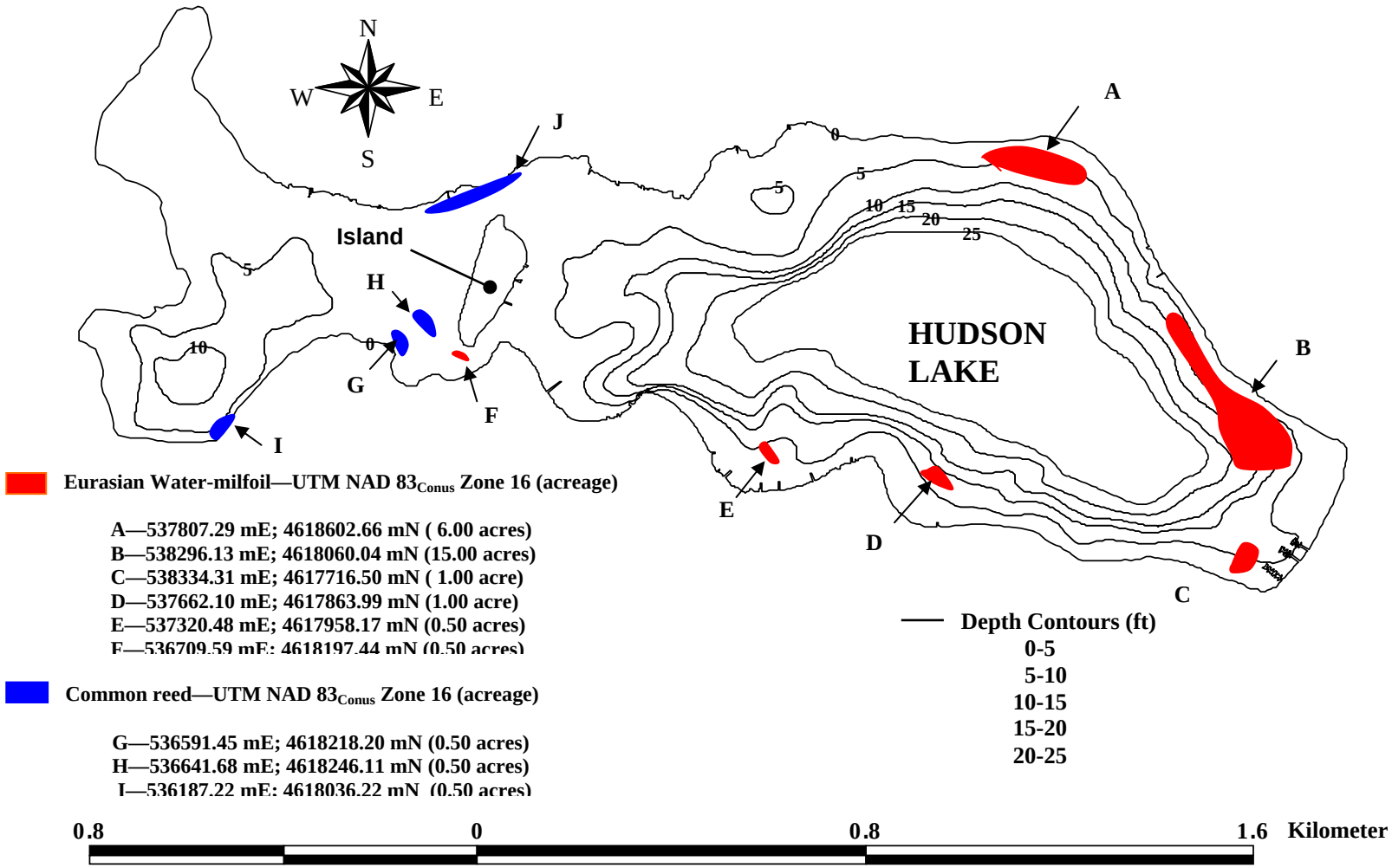

Figure 11.0. Estimated acreage map for treatment of Eurasian water-milfoil (*Myriophyllum spicatum*- red) and common reed (*Phragmites australis* - blue).