2004 SUMMARY REPORT
of
SAND LAKE

Lake County, Illinois

Prepared by the

LAKE COUNTY HEALTH DEPARTMENT
ENVIRONMENTAL HEALTH SERVICES
LAKES MANAGEMENT UNIT
3010 Grand Avenue
Waukegan, Illinois 60085

Christina L. Sanders
Jennifer Wudi
Michael Adam
Mary Colwell
Mark Pfister

February 2005

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Sand Lake, located in Lake Villa Township, is a glacial lake, created over 13,000 years ago by receding glaciers. Settlement of the land around the lake began in the 1830's, and included settlement by the Lehman family, who were the original owners of the lake. After the construction of the Wisconsin Central Railway in 1877, summer cottages began popping up around the lake. Large-scale settlement began in the 1930's and continued through the 1950's. The Sand Lake Property Owner's Association (SLPOA) was formed in the 1950's and still exists today. Sand Lake has a surface area of 100.9 acres and mean and maximum depths of 9.2 and 32 feet, respectively. It has a very small watershed that is primarily residential, but does have a decent amount of open space. The lake is used by Sand Lake residents, as well as Lake Villa Township residents for swimming, boating and fishing and is managed by the SLPOA and Lake Villa Township.

Water quality parameters, such as nutrients, suspended solids, oxygen, temperature and water clarity were measured and the plant community was assessed each month from May-September 2004. Sand Lake was stratified from May-September. Total phosphorus (TP) levels were low throughout the summer, and the most likely source of phosphorus was internal phosphorus loading and release from decomposing plants. Total suspended solids (TSS) concentrations were also low, but did not coincide with TP concentrations. Water clarity was very high in May and June, but varied throughout the summer with fluctuations in TSS. The concentrations of many parameters in Sand Lake have changed many times in the past 10-15 years due to management activities that have affected the water quality and clarity of the lake.

Eurasian Watermilfoil (EWM) dominated the plant community in 2004 and has dominated the lake since the early 1960's. However, including EWM, eight different plant species were found in Sand Lake over the course of the summer. The abundance of plants provided Sand Lake with low TP and TSS concentrations by reducing sediment resuspension in shallow areas and competing with planktonic algae for nutrients. However, it provided many of the residents with a navigational challenge. The current herbicide program began in 2003 and will continue in 2004, when an expansion of the treatment area will likely occur. The milfoil weevil was stocked in Sand Lake, but did not have the desired effects and does not appear to be controlling the EWM at this time.

Approximately 86% of the Sand Lake shoreline is developed and nearly all of that developed shoreline consists of rip rap and seawall. Because these two shoreline types dominate, little erosion was occurring around Sand Lake. However, Canada Thistle, Buckthorn, Purple Loosestrife, Multiflora Rose and Reed Canary Grass were present along 23% of the shoreline. These are exotic plant species that out-compete native vegetation and provide poor habitat for wildlife. Due to the residential nature of the shoreline on Sand Lake, a relatively small number of waterfowl and bird species were observed during the summer.

LAKE IDENTIFICATION AND LOCATION

Sand Lake is located along Illinois State Route 132 partially in the Village of Lindenhurst and partially in unincorporated Lake Villa Township (T 45N, R 10E, S 2, 3). Sand Lake has a surface area of 100.9 acres (GPS calculation) and mean and maximum depths of 9.2 feet and 32.0 feet, respectively. The lake has a total volume of approximately 910 acre-feet and a shoreline length of 1.6 miles (Figure 1, Appendix A). The watershed of Sand Lake encompasses approximately 203.7 acres, draining mostly the area immediately surrounding it (Figure 2). The watershed to lake surface area ratio of less than 2:1 is very small. This is positive because it may help prevent serious water quality problems that often accompany a larger watershed to lake ratio. However, lakes with small ratios often experience more severe water level fluctuations throughout the summer as well as the accumulation of solids and nutrients because lake retention time (the time it takes all the water in the lake to be replaced) is high. It takes 11 years for all of the water volume of Sand Lake to flush out of the lake and be replenished by new water (Table 1). The water level of Sand Lake dropped by nearly two feet during the summer 2004, which is not surprising given its small watershed. However, it is recommended that in the future, staff gauge readings be taken weekly or bi-weekly if possible. This will give lake managers a much better idea of lake level fluctuations relative to rainfall events and can aid in future decisions regarding lake level.

Based on the most recent land use survey of the Sand Lake watershed (2000), residential areas dominate the watershed, making up about 22% of the area (Figure 3). The lake itself makes up approximately half of the watershed and other land uses each make up about 5-10% of the watershed (Table 1, Appendix A). The large amount of residential area that makes up the watershed can be good or bad, depending on the activities of homeowners that live around the lake. If homeowners are educated about how their daily activities affect the lake and take steps to prevent additional sediment and nutrients from entering the water, there could be some improvement in water quality over time. However, if residents go about their daily activities with no regard to how it may affect the lake, water quality could be degraded over time. Water exits Sand Lake over a spillway on the north end and flows under Grand Avenue before eventually entering Mill Creek and then the Des Plaines River. The lake is located in the Mill Creek sub basin, within the Des Plaines River watershed.

BRIEF HISTORY OF SAND LAKE

Sand Lake is of glacial origin, created over 13,000 years ago during the last ice age. Thanks to the gathering of extensive Lake Villa historical information (particularly Lake Miltmore) by Norman Pischke, a 50-year resident of Lake Miltmore, records of the first inhabitants, settlers and land owners in the area are known. In the early 1800’s, the area of Lake Villa was inhabited by the Potawatami, Chippewa and Ottowa Indian tribes. These tribes were forced to move west of the Mississippi River by 1836. A treaty signed in 1829 had given them seven years to move, and no white men were permitted to settle their land until that time. However, white men and their families (mostly from the east

FIGURE 2

FIGURE 3

coast) settled the land in 1834, before the treaty deadline. The Lehman family settled in the area in the early 1800's and purchased several hundred acres of land north of Grand Ave. E.J. Lehman had visions of creating Lake Villa as a resort area, catering to rich living. In 1877 the Wisconsin Central Railway was built and this opened the way for development. Sand Lake and other surrounding lakes became summer resort spots for city dwellers, and summer cottages began popping up around the lakes. Large-scale settlement began in the 1930's and 1940's and the Sand Lake Property Owner's Association (SLPOA) was formed in the 1950's. Sand Lake is managed by SLPOA and Lake Villa Township. Management is funded by key sales for the village boat launch, which brings in approximately $3,000 per year. The village has provided additional funding in the past for special projects.

SUMMARY OF CURRENT AND HISTORICAL LAKE USES

Currently, access to Sand Lake is open to residents of Lake Villa Township through the Lake Villa Township Beach, Park and Boat Launch (with the purchase of a key). The general public can access the lake through the Lake County Forest Preserve District parcel on the northwest side of the lake (Figure 4). The lake's main uses are boating, swimming and fishing. Currently, the biggest management concern expressed by the SLPOA is EWM management.

The licensed beach on Sand Lake (Lake Villa Township Beach) was sampled every two weeks by the Lake County Health Department to test for the presence of *E. coli*. *E. coli* bacteria is found virtually everywhere, but is in very high numbers in the feces of warm-blooded animals, including humans. While most strains of *E. coli* itself are not harmful, the bacteria may indicate the presence of other pathogens such as *Giardia*, which can cause serious illness in humans. The beach was not closed at any time during the summer of 2004. It had been closed once in 2003 and only twice in 2002. Wind events can increase *E. coli* counts because as waves wash up on the beach, they resuspend sand and sediment, which contain a large number of *E. coli.* The *E. coli* are resuspended into the water column and can lead to elevated sample levels. This is likely the reason behind these closings, as that side of the lake receives a lot of wave action. Regardless, *E. coli* contamination does not appear to be a serious problem on the Sand Lake beach.

LIMNOLOGICAL DATA – WATER QUALITY

Water samples collected from Sand Lake were analyzed for a variety of water quality parameters (See Appendix B for methodology). Samples were collected at 3 foot and 28-29 foot depths (depending on site water depth) from the deep hole location in the lake (Figure 4). Sand Lake was thermally stratified from late May-September. Thermal stratification occurs when a lake divides into an upper, warm water layer (epilimnion) and a lower, cold water layer (hypolimnion). When stratified, the epilimnetic and hypolimnetic waters do not mix, and the hypolimnion typically becomes anoxic (dissolved oxygen (DO) = 0 mg/l) by mid-summer. This phenomenon is a natural occurrence in Sand Lake and is not necessarily a bad thing if enough of the lake volume remains oxygenated. The surface waters of Sand Lake remained well oxygenated during the summer. Near-surface DO concentrations remained above 5.0 mg/l (a level below which some aquatic organisms become stressed) for the entire summer. The lake became near anoxic at depths below 20 feet in June and July and below 16 feet in August and September. According to the morphometric data from the bathymetric map created for Sand Lake in 1988 (Figure 1), approximately 46% of the lake volume remains oxygenated throughout the summer and it does not appear that low oxygen concentrations posed a threat to aquatic life in the lake.

Phosphorus is a nutrient that can enter lakes through runoff or be released from lake sediment, and high levels of phosphorus typically cause algal blooms or produce high plant density. The 2004 average epilimnetic phosphorus concentration in Sand Lake was 0.032 mg/l (half of the Lake County median total phosphorus (TP) concentration of 0.063 mg/l). The average hypolimnetic phosphorus concentration was 0.107 mg/l (less than the county median value of 0.178 mg/l) (Table 2, Appendix A). The hypolimnetic phosphorus concentration in 2004 was three times higher than the epilimnetic concentration. This is typical in a stratified lake, and the difference may be even more pronounced if stratification begins early in the summer. During stratification, oxygen is depleted in the hypolimnion, triggering chemical reactions at the sediment surface. These reactions result in the release of phosphorus from the sediment into the water column, and are known as internal phosphorus loading. Internal phosphorus loading is more pronounced in lakes that have a history of high nutrient enrichment or have a very dense plant community because the sediment tends to be more organic in these types of lakes. Typically, the hypolimnion is thermally isolated from the epilimnion during the summer and phosphorus builds up in the bottom waters, reaching the sunlit surface waters only during fall turnover. At this time, all of the hypolimnetic phosphorus is distributed throughout the water column. If the lake volume is large, the TP concentration will be diluted. However, even after dilution, the increase in TP to the epilimnion can produce late season algae blooms. Because Sand Lake had stratified by late May and remained stratified through early September, the buildup of phosphorus in the hypolimnion was relatively high throughout the entire summer. (Table 2, Appendix A).

The average epilimnetic phosphorus concentration in 2004 was 15% higher than the 1999 concentration (0.027 mg/l). This represents a small change and could be the result of climatic differences between the two years or seasonal differences in the set up and breakdown of thermal stratification. The average epilimnetic TP concentration in 1992 was much higher (0.073 mg/l) (Table 3, Appendix A). This was the result of almost complete plant removal by an herbicide treatment of Sonar™ in the spring of 1990. Without the benefits provided by the abundant plants typically found in Sand Lake, which prevent sediment resuspension and compete with algae for resource, algae blooms and sediment resuspension caused a substantial increase in the TP concentrations in the water column. The 1988 average TP concentration (0.048 mg/l) was also much higher than in recent years. This also was the result of near complete plant removal by a whole lake Sonar™ treatment in 1987.

Total suspended solids (TSS) is a measure of the amount of suspended material, such as algae or sediment, in the water column. High TSS values are typically correlated with poor water clarity and can be detrimental to many aspects of the lake ecosystem, including the plant and fish communities. A large amount of material in the water column can inhibit successful predation by sight-feeding fish, such as bass and pike, or settle out and smother fish eggs. High turbidity caused by sediment or algae can shade out native aquatic plants, resulting in their reduction or disappearance from the littoral zone. This eliminates the benefits provided by plants, such as habitat for many fish species and stabilization of the lake bottom. The average 2004 epilimnetic TSS concentration in Sand Lake (3.3 mg/l) was approximately half of the median value for Lake County Lakes (7.9 mg/l). TSS concentrations increased from a low of 1.7 mg/l in May to a high of 5.2 mg/l in July and then decreased again in August and September. The source of the increase in early July may have been a combination of decomposing curly leaf pondweed (which dies back naturally at the end of June) and decomposing EWM, which had been treated in early May and early June. Strong relationships did not exist between TSS and TP or TSS and total volatile solids (TVS, a measure of organic matter, such as algae, in the water column). This indicates that although some of the TSS was made up of decomposing plant material, the primary source of TSS in Sand Lake is sediment.

The average 2004 epilimnetic TSS concentration (3.3 mg/l) has increased only slightly since 1999, when the average concentration was 2.7 mg/l (Table 2, Appendix A). As with TP, this difference may be the result of several variables, including the difference in thermal stratification between the two years, a difference in plant density, which can cause an increase or decrease in resuspended sediment and decomposing plant material, or a difference in the frequency and density of boat traffic, which can stir up sediment in shallower areas of the lake. Additionally, as with TP, the TSS concentrations in 1992 and 1988 were much higher than in recent years as a result of complete plant removal by whole-lake herbicide treatments (Table 3, Appendix A).

As a result of the low TP and TSS concentrations throughout the summer, the average Secchi depth (water clarity) of Sand Lake (7.80 feet) was over twice the county median and reached a high of nearly 11 feet in May (Table 2, Appendix A). Secchi depth decreased each month from May-July and then increased from July-September, in accordance with decreases and increases in TSS (Figure 5). Although some plants were removed and the decomposition of these plants may have caused the decrease in Secchi

Figure 4

FIGURE 5

depth in the early part of the summer, the fact that many plants were left in the lake likely resulted in the recovery of Secchi depth in August and September. Once the treated plants had died and decomposed, water clarity improved again. This would probably not have happened if complete removal of the plants in Sand Lake had occurred. The average Secchi depth was even higher in 1999 (10.2 feet), but was very low in 1992 and 1988. Once again, this was the result of complete plant removal, which opened the lake up for more frequent boat traffic and the resuspension of sediments throughout the summer (Table 3, Appendix A).

Having accurate and consistent historical data is very important. This can be achieved through the Volunteer Monitoring Program (VLMP). This Illinois Environmental Protection Agency (IEPA) program, organized and run by the Northeastern Illinois Planning Commission (NIPC), involves the collection of water quality data by a volunteer in the same sampling location and along the same time frame each year. Although the amount of data collected is often limited, it can provide valuable historical information on water clarity and, therefore, water quality on many Lake County lakes. This is especially true for a lake like Sand Lake. The water quality is currently very good and any changes in water clarity and quality that may occur from changes in the lake or watershed in the future can be tracked over time and can give early warning of problems. There is currently no date set for the next full water quality study by our staff on Sand Lake. Having a quality VLMP in place in the meantime can help provide valuable information to lake managers who may be able to take action on certain issues before they become irreversible problems. VLMP data can also be used to give accurate historical data about the lake, water quality and management activities so that changes in different variables can be more readily and accurately explained.

Conductivity is the measure of different chemical ions in solution. As the concentration of these ions increases, conductivity increases. The conductivity of a lake is dependent on the lake and watershed geology, the size of the watershed flowing into the lake, the land uses within that watershed, evaporation and bacterial activity. Conductivity has been shown to be highly correlated (in urban areas) with chloride ions found in road salt mixtures. Water bodies most subject to the impacts of road salts are streams, wetlands or lakes draining major roadways and large parking lots. Although the average 2004 epilimnetic conductivity (0.6248 mS/cm) in Sand Lake was below the county median, it had increased by 14% since sampling in 1999 and 29% since sampling in 1992, when the epilimnetic averages were 0.5476 mS/cm and 0.4826 mS/cm, respectively. Conductivity changes can occur seasonally and even with depth, but over the long term, increased conductivity levels can be a good indicator of potential watershed or lake problems and an increase in pollutants entering the lake if the increasing trend is noted over a period of years. High conductivity levels (which often indicate an increase in sodium or potassium chloride) can eventually change the plant and algae community, as more salt tolerant plants and algae take over. Sodium, potassium and chloride ions can bind substances in the sediment, preventing their uptake by plants and reducing native plant densities. Additionally, juvenile aquatic organisms may be more susceptible to high chloride concentrations. Because of the small size of the watershed of Sand Lake, it is not readily apparent what is causing the increase in conductivity. The increase may be the result of potentially heavier winter salting of the residential roads surrounding the lake (roads make up approximately 12% of all land use in the watershed) or a build-up of salts in the lake due to its high residence time. According to runoff estimates based on land use in the watershed, it takes approximately 11 years for all of the water in Sand Lake to flush through the lake and be replaced. This is an extremely long residence time and many materials can build up in the water column before eventually being flushed out. The high conductivity levels are cause for concern, but there may not be much that can be done about it. Non-point runoff, such as that which picks up road salt and enters the lake during rain events, is very difficult to control and the residence time of the lake is unlikely to change to any great extent.

Typically, lakes are either phosphorus (P) or nitrogen (N) limited. This means that one of these nutrients is in short supply relative to the other and that any addition of phosphorus or nitrogen to the lake might result in an increase of plant or algal growth. Other resources necessary for plant and algae growth include light or carbon, but these are typically not limiting. Most lakes in Lake County are phosphorus limited, but to compare the availability of nitrogen and phosphorus, a ratio of total nitrogen to total phosphorus (TN:TP) is used. Ratios less than or equal to 10:1 indicate nitrogen is limiting. Ratios greater than or equal to 15:1 indicate that phosphorus is limiting. Ratios greater than 10:1, but less than 15:1 indicate that there are enough of both nutrients to facilitate excess algal or plant growth. Sand Lake had a 2004 average TN:TP ratio of 29:1. This indicates that the lake is phosphorus limited and that a small increase in phosphorus concentrations in the epilimnion could result in algae blooms in the future. Although the average epilimnetic total Kjeldahl nitrogen (TKN) concentration was lower than the majority of the lakes in Lake County, high nitrogen concentrations relative to phosphorus concentrations resulted in this high ratio. In highly nutrient-enriched lakes, phosphorus levels have often reached the point where either very large increases or very large decreases in phosphorus would be necessary to trigger changes in algae density. On the other hand, less enriched lakes, such as Sand Lake, are typically more sensitive to increases or decreases in phosphorus, and algae could become a problem with relatively small increases in TP. The 1999 TN:TP ratio was 17:1 as a result of a lower average TKN concentration and was 10:1 in 1992 because of lower TKN concentrations and much higher TP concentrations. Care should be taken to ensure that the nutrient concentrations (especially phosphorus) continue to remain low so that algae does not become a problem in the future.

Phosphorus levels can also be used to indicate the trophic state (productivity level) of a lake. The Trophic State Index (TSI) uses phosphorus concentrations, chlorophyll *a* (algae biomass) levels and Secchi depth to classify and compare lake trophic states using just one value. The TSI is set up so that an increase in phosphorus concentration is related to an increase in algal biomass and a corresponding decrease in Secchi depth. A moderate TSI value (TSI $\geq 40 < 50$) indicates mesotrophic conditions, typically characterized by relatively low nutrient concentrations, low algae biomass, adequate DO concentrations and relatively good water clarity. High TSI values indicate eutrophic (TSI

≥ 50<70) to hypereutrophic (TSI ≥70) lake conditions, typically characterized by high nutrient concentrations, high algal biomass, low DO levels, a rough fish population, and low water clarity. Sand Lake had an average phosphorus TSI (TSIp) value of 54, indicating slightly eutrophic conditions. Although the lake falls into the eutrophic category, it does not exhibit all of the characteristics of eutrophic lakes mentioned above. This is likely the result of a very dense plant community. Plants compete with algae for resources and prevent sediment resuspension, both of which help reduce TP levels in the water column. Water quality on Sand Lake is above average and the lake ranked 37th out of 161 lakes studied in Lake County since 2000. Besides the dense plant community present, this may also be partly due to its glacial origin. Most man-made lakes in this geographical area fall into the eutrophic and hypereutrophic categories, while many of the glacial lakes rank higher (Table 4, Appendix A).

Most of the water quality parameters just discussed can be used to analyze the water quality of Sand Lake based on use impairment indices established by the Illinois Environmental Protection Agency (IEPA). According to this index, Sand Lake provides *Full* support of aquatic life and swimming, and *Partial* support of recreational activities (such as boating) as a result of the high percent plant coverage. The lake provides *Full* overall use.

LIMNOLOGICAL DATA – AQUATIC PLANT ASSESSMENT

Aquatic plant surveys were conducted every month for the duration of the study (See Appendix B for methodology). Shoreline plants of interest were also recorded. However, no quantitative surveys were made of these shoreline plant species and the data are purely observational. Light level was measured at two-foot intervals from the water surface to the lake bottom. When light intensity falls below 1% of the level at the water surface, plants are no longer able to grow. Using this information, as well as a bathymetric map, the lake area that has the potential to support aquatic plant growth can be determined. Depth of percent light intensity varied from 20 feet in June to 10 feet in July and August (Appendix C). Based on morphometric data for Sand Lake, 85% of the lake area had the potential for plant growth (to 20 feet). In 2004, GPS satellite readings were taken in early June to determine the area of plant coverage based on visual observation of those plants growing to within approximately two feet of the water surface. Based on GPS data, approximately 33 acres or 33% of the lake surface area was covered with plants growing near the water surface (Figure 6). This was exactly the same plant acreage mapped in both July and August 2002, indicating that the plant beds may change shape and size from year to year, but overall coverage is not increasing (Figure 7). Eight different plant species were present in Sand Lake during the summer of 2004 (Tables 5 & 6). Only two of the 8 species (Eurasian watermilfoil (EWM) and curly leaf pondweed) are exotic species. EWM dominates Sand Lake’s plant community and presents serious navigational problems. However, the sheer density of these plants kept water clarity from being very low by reducing sediment resuspension in the littoral zone and competing with planktonic algae for resources.

Table 5. Aquatic and shoreline plants on Sand Lake, May-September 2004.

Aquatic Plants	
Chara	*Chara* sp.
Coontail	*Ceratophyllum demersum*
Water Stargrass	*Heteranthera dubia*
Eurasian Watermilfoil^	*Myriophyllum spicatum*
Spatterdock	*Nuphar variegata*
Curlyleaf Pondweed^	*Potamogeton crispus*
Sago Pondweed	*Potamogeton pectinatus*
Small Pondweed	*Potamogeton pusillus*
Shoreline Plants	
Deadly Nightshade	*Atropa belladonna*
Canada Thistle^	*Cirsium arvense*
Daisy Fleabane	*Erigeron annuus*
Jewelweed	*Impatiens pallida*
Blue Flag Iris	*Iris* sp.
Purple Loosestrife^	*Lythrum salicaria*
Reed Canary Grass^	*Phalaris arundinacea*
Pickerelweed	*Pontederia cordata*
Multiflora Rose^	*Rosa multiflora*
Goldenrod	*Solidago* sp.
Wild Grape	*Vitis* sp.
Trees/Shrubs	
Silver Maple	*Acer saccharinum*
Common Buckthorn^	*Rhamnus cathartica*
Willow	*Salix* sp.

^Exotic plant or tree species

FIGURE 6

FIGURE 7

As mentioned above, EWM was the dominant plant in the lake in 2004, occurring at 73% of the plant sampling sites throughout the summer. This exotic plant species invaded Sand Lake many years ago and has been a dominant species in the plant community. In 1999, the SLPOA hired EnviroScience, Inc. to stock the milfoil weevil (*Euhrychiopsis lecontei*) in the lake. This very tiny insect serves as a biological control for EWM, and when present in large enough numbers, can cause significant damage to milfoil beds. It is not intended to eradicate the milfoil from a lake, but rather, to reduce the density to manageable levels. In 1999, 10,000 weevils were stocked in three EWM beds in the lake. Two monitoring sites were established. The weevils showed good success during the summer of 1999 but did not appear to successfully overwinter and were not present in high numbers during the summer of 2000. Six thousand more weevils were stocked in two of the same sites in 2000, with little success. No weevils were stocked in 2001 and assessments by our staff in June and August indicated that weevil density was low and weevil damage was sparse. Twenty thousand weevils were stocked in Sand Lake on August 4, 2002. Staff performed an assessment in the stocking area three weeks after stocking occurred (August 27, 2002). A second assessment was conducted on September 15, 2002. Weevil density was very low at all sites, including near the stocking area. The main reason for low weevil density is thought to be the extremely high density of plants vs. the number of weevils stocked. Weevil density as calculated using the number of weevils stocked (at a 70% survival rate) and the actual density of plants in one acre of the stocked area (approximately 1.5-2.0 million plants per vegetated acre) was calculated as 0.007 weevils per stem of EWM. This is far too low to expect damage to be apparent. Additionally, the highly residential shoreline of Sand Lake does not provide the ideal overwintering habitat for weevils and they do not appear to be surviving in large numbers during the winter months. At this time, weevils do not appear to be a viable management option for Sand Lake.

One of the main concerns of Sand Lake residents is aquatic plant density in the lake, especially that of EWM. The plant management history on Sand Lake has been explained in detail in a previous section of this report. The most recent and newest management step that has been taken is a planting program to reintroduce native plants (both emergent and submersed) to the lake to achieve two results: stabilize shoreline and re-establish native plant populations to create diversity in the overall plant community. In 2003, three different plants species were planted along approximately 70 feet of shoreline at the Lake Villa Township Park in late August. Two (pickerelweed and blue flag iris) were emergent species and one (*Vallisneria* sp.) was submerged. Plantings were surrounded by cages to prevent any herbivory by waterfowl. The two emergent species were very successful in surviving, establishing and spreading during the summer of 2004. The *Vallisneria* sp. plants did not become established in 2004. The plants had been planted as root plugs and it is likely that larger rootstock is needed for this plant to become successfully established. In 2004, the same three plant species were planted to the south of the spillway. Cages also surrounded these plants. This area has a much rockier substrate and the relative success of that planting project will be determined in

2005. The next recommended location is along the Forest Preserve-owned shoreline on the west end of the lake.

The other option is to conduct a fall/winter treatment using fluridone, which is sold under the brand names Sonar® or Avast®. Because the density and diversity of native aquatic plants was relatively high, it is very likely that these plants would grow and compete with EWM if given the opportunity (This was actually observed in 2003 on the east shore, where Illinois pondweed held back the expansion of EWM until August.) EWM is one of the only aquatic plants that can survive very cold water and it is often seen growing under the ice during the winter. This gives it the advantage of already being established in the spring, and it can take over a lake very early in the season before the native plants have a chance to become established. A fall/winter fluridone treatment would kill the EWM before the spring, giving the native plants an opportunity to grow. By the time the EWM recovers, it will be competing with native plants for space and light, and will likely not reach nuisance levels throughout the summer. The down side to this is that native plants will become denser than they have been in past years. The upside is that native plants typically do not grow to nuisance levels and may not top out at the water surface, preventing recreational discord among boat users. Additionally, a healthy native plant community will likely improve the health of the fish community, which is not in very good condition at this time. The cost of this treatment cannot be determined without creating a new bathymetric (depth) map with morphometric data, which enables an applicator to calculate accurate water volume. Water volume is essential for any fluridone treatment, as it is a whole lake treatment and overdosing can very easily occur without proper calculations. A bathymetric map created by our unit in 1987 does exist. However, the morphometric data essential for any volume calculations does not exist. It is recommended that the Sand Lake Homeowners Association and Lake Villa Township find the funding to have a bathymetric map created. If the current lake volume (based on the 1988 map) is used, the cost of a fluridone treatment would be $7,780, plus labor. However, it is very possible that Sand Lake could get two year of control with this treatment, bringing the annual cost to $3,890.

Of the sixteen emergent plant and trees species observed along the shoreline of Sand Lake, five (Canada Thistle, Purple Loosestrife, Reed Canary Grass, Multiflora Rose and Buckthorn) are invasive species that do not provide ideal wildlife habitat and have the potential to dominate the emergent plant community. Their removal is always recommended.

FQI (Floristic Quality Index) is a rapid assessment tool designed to evaluate the closeness of the flora of an area to that of undisturbed conditions. It can be used to: 1) identify natural areas, 2) compare the quality of different sites or different locations within a single site, 3) monitor long-term floristic trends, and 4) monitor habitat restoration efforts (Nichols, 1999). Each floating or submersed aquatic plant is assigned a number between 1 and 10 (10 indicating the plant species most sensitive to disturbance). An FQI is calculated by multiplying the average of these numbers by the square root of the number of these plant species found in the lake. A high FQI number indicates that there are a large number of sensitive, high quality plant species present in the lake. Non-native species were also included in the FQI calculations for Lake County lakes. The average FQI for 2000-2003 Lake County lakes is 14.3. Sand Lake has an FQI of 12.5. However, this number can be deceiving, as it only indicates the relative quality of the plants found and does not take into account plant density. Besides EWM, the plants found in Sand Lake were at very low densities in only a handful of places in the lake. This is not reflected in the FQI number, and the plant community is actually below average when the density of plants (besides EWM is considered). The lake ranks 83rd out of 150 lakes studied since 2000.

LIMNOLOGICAL DATA – SHORELINE ASSESSMENT

A shoreline assessment was conducted at Sand Lake on June 29, 2004. The shoreline was assessed for a variety of criteria (See Appendix B for methods), and based on these assessments, several important generalizations could be made. Approximately 86% of Sand Lake's shoreline is developed and the majority of the developed shoreline is comprised of an even amount of rip rap (31%) and seawall (31%), as well as buffer (8.4%), lawn (8.4%) and beach (7.4%) (Figure 8). A very small portion consists of shrub (<1%). The undeveloped portions of the lake are made up mostly of buffer, but also include shrub, wetland, woodland, rip rap, seawall and lawn. Seawall is not an ideal shoreline type unless used solely for erosion control. Seawalls do not provide any wildlife habitat and can often increase sediment resuspension as waves are reflected back into the lake by the seawall. Although rip rap is also not an ideal shoreline type with regard to wildlife habitat, it can also help to prevent shoreline erosion. Manicured lawn is considered undesirable because it provides a poor shoreline-water interface due to the short root structure of turf grasses. These grasses are incapable of stabilizing the shoreline and typically lead to erosion on most lakes. Beaches will always erode into the water and the sand will need replaced each year. This can change the composition of the bottom sediment in these areas and effect plant density and species type, as well as the aquatic organisms that utilize the area. Wetland and buffer are the most desirable shoreline types, providing wildlife habitat and, typically, protecting the shore from excessive erosion. The relatively small percentage of buffered shoreline (13%) along Sand Lake is very discouraging, and more of this type of shoreline should be encouraged among shoreline residents. As a result of the dominance of seawall and rip rap shorelines, 87% of Sand Lake's shoreline exhibited no erosion. Slight to moderate erosion was occurring along buffer and rip rap, and moderate to severe erosion was occurring along manicured lawns. Buffered shorelines should be maintained or added as much as possible, and the addition of manicured lawns, seawalls and rip rap should be discouraged.

Although almost no erosion was occurring around Sand Lake, invasive plant species, including Canada Thistle, Purple Loosestrife, Reed Canary Grass, Multiflora Rose and Buckthorn were present along 23% of the shoreline. These plants are invasive and exclude native plants from the areas they inhabit. Buckthorn provides very poor shoreline stabilization and may lead to increasing erosion problems along already eroded shoreline in the future. Reed Canary Grass and Purple Loosestrife inhabit mostly wet areas and can easily outcompete native plants. Additionally, they do not provide the quality wildlife habitat or shoreline stabilization that native plants provide. Although

FIGURE 8

most of the exotic plant occurrences were along non-developed buffered and shrub shoreline, some of the areas occurred along buffered shorelines on residential property. Steps to eliminate these plants should be carried out by homeowners in order to improve the wildlife habitat and overall aesthetics of Sand Lake.

LIMNOLOGICAL DATA – WILDLIFE ASSESSMENT

The Illinois Department of Natural Resources (IDNR) first conducted a fish survey on Sand Lake in 1964. Subsequent surveys include collection through electroshocking, gill nets and trap nets and occurred 1968, 1972, 1977 and 1983. In 1968, 205 fish comprising 12 species were collected. Bluegill, pumpkinseed and yellow perch dominated the fish community, which was not healthy. In 1972, 362 fish representing 13 species were collected. The panfish population was overabundant and stunted. YOY largemouth bass were also stunted, as they were competing with the sunfish for food, but larger largemouth bass were of average size. In 1972, 147 fish representing 12 species were collected. Sunfish remained overabundant and stunted and the largemouth bass population appeared to have had poor spawning success in the two previous years. Common carp were relatively abundant. A winterkill in 1978 decimated all species. However, a few common carp breeders remained and experienced tremendous spawn. A rotenone treatment and subsequent stocking of desirable species was recommended. The most recent survey was conducted by the IDNR on June 11, 2002 and included electrofishing, gillnets and trapnets. A total of 158 fish from 10 species were collected. Bluegills were the most abundant species, followed by pumpkinseed, carp and largemouth bass. The largemouth bass collected indicates that the population is made up of larger size fish and that there is a problem with reproduction or survival. The presence of larger bluegill suggests that stunting is not an issue with this species. Carp were a relatively large component of the Sand Lake fishery and should be targeted and removed by fisherman whenever possible. Recommendations from the 2002 survey included developing a reasonable vegetation management plan with the help of our staff, reducing harvest of largemouth bass during spawning season, establishing creel limits for largemouth bass and northern pike and stocking northern pike and walleye every other year. Walleye (4-6 inches) were stocked in Sand Lake in November 2004, at a rate of 20 per acre. It is recommended that in the future, the SLPOA stock 8-10 inch walleye. We have found (based on the experience of other stocking programs in the county) that stocking 4-6 inch fish can be a waste of money, as fish this small are typically consumed by larger fish shortly after being stocked.

Wildlife observations were made on a monthly basis during water quality and plant sampling activities (See Appendix B for methodology). Because the abundance of wildlife habitat in the form of wetland and buffer areas was relatively low around Sand Lake, a relatively small number of wildlife species were observed. However, the state endangered osprey (non-nesting) was observed in September (Table 7). The maintenance of buffered shorelines and the establishment of additional buffer strips (especially along the shoreline of developed areas) is very important and strongly recommended to continue to provide the appropriate habitat for birds and other animals in the future.

Table 7. Wildlife species observed at Sand Lake, April-September 2004.

Birds	
Canada Goose	*Branta canadensis*
Mallard	*Anas platyrhnchos*
Ring-billed Gull	*Larus delawarensis*
Great Blue Heron	*Ardea herodias*
Osprey*	*Pandion haliaetus*
Turkey Vulture	*Cathartes aura*
American Kestrel	*Falco sparverius*
Belted Kingfisher	*Megaceryle alcyon*
Rough-wing Swallow	*Stelgidopteryx ruficollis*
American Crow	*Corvus brachyrhynchos*
Blue Jay	*Cyanocitta cristata*
Red-winged Blackbird	*Agelaius phoeniceus*
Northern Cardinal	*Cardinalis cardinalis*
American Goldfinch	*Carduelis tristis*
Chipping Sparrow	*Spizella passerina*

*Endangered in Illinois

EXISTING LAKE QUALITY PROBLEMS

- *Need for an Updated Quality Bathymetric Map*

A bathymetric (depth contour) map is an essential tool in effective lake management, especially if the long term lake management plan a fluridone application. Sand Lake currently has a bathymetric map, created by our unit in 1988. However, it does not provide the detail that we are now capable of providing for these types of maps. In the past 14 years, technology has improved dramatically and a map created now would be much more accurate and would include the morphometric data necessary to calculate lake volume.

- *Lack of Participation in the Volunteer Lake Monitoring Program (VLMP)*

In 1981, the Illinois Volunteer Lake Monitoring Program (VLMP) was established by the Illinois Environmental Protection agency (Illinois EPA) to gather fundamental information on Illinois inland lakes, and to provide an educational program for citizens. Annually, approximately 165 lakes (out of 3,041 lakes in Illinois) are sampled by approximately 300 citizen volunteers. The volunteers are primarily lake shore residents, lake owners/managers, members of environmental groups, public water supply personnel, and citizens with interest in a particular lake. Sand Lake does not currently participate in the VLMP. The relatively high water quality of Sand Lake makes the existence of a consistent VLMP on the lake even more important. This will enable a water quality history beyond our data to be developed and tracked as time goes on and more development occurs.

- *Invasive Shoreline Plant Species*

Numerous exotic plant species have been introduced into our local ecosystems. Some of these plants are aggressive, quickly out-competing native vegetation and flourishing in an environment where few natural predators exist. The outcome is a loss of plant and animal diversity. Buckthorn and honeysuckles are aggressive shrub species that grow along lake shorelines as well as most upland habitats. They shade out other plants and are quick to become established on disturbed soils. Reed canary grass and common reed are present in wetland areas and can very quickly outcompete cattails and other native wetland plants. Reed canary grass, buckthorn, purple loosestife, Canada thistle, and multiflora rose are present along 23% of the shoreline of Sand Lake and attempts should be made to control their spread.

- *Limited Wildlife Habitat*

Very little of Sand Lake's shoreline consists of wetland, buffer or woodland and most is dominated by residential homes, which do not always encourage a diverse bird and animal community. Some of the residents along Sand Lake already have buffer strips in place along their shoreline property. However, many of the residents also have seawalls, rip rap and beaches along their shoreline. It is recommended that those residents that already have buffer consider widening their strips to a width of at least 20 feet, and that those residents that do not have a buffer strip consider planting 10-20 feet of native plants along their shoreline.

POTENTIAL OBJECTIVES FOR THE SAND LAKE MANAGEMENT PLAN

I. Create a Bathymetric Map, Including a Morphometric Table
II. Participation in the Volunteer Lake Monitoring Program
II. Eliminate or Control Exotic Species
IV. Enhance Wildlife Habitat Conditions

Objective I: Create a Bathymetric Map Including a Morphometric Table

A bathymetric map (depth contour) map is an essential tool for effective lake management since it provides critical information about the physical features of the lake, such as depth, surface area, volume, etc. This information is particularly important when intensive management techniques (i.e., chemical treatments for plant or algae control, dredging, fish stocking, etc.) are part of the lake's overall management plan. Some bathymetric maps for lakes in Lake County do exist, but they are frequently old, outdated and do not accurately represent the current features of the lake. Sand Lake currently has a bathymetric map, but it lacks morphometric data that is essential in most calculations of volume, area and depth. Maps can be created by agencies like the Lake County Health Department - Lakes Management Unit or other companies. Costs vary, but can range from $3,000-10,000 depending on lake size.

Objective II: Participation in the Volunteer Lake Monitoring Program

In 1981, the Illinois Volunteer Lake Monitoring Program (VLMP) was established by the Illinois Environmental Protection agency (Illinois EPA) to gather fundamental information on Illinois inland lakes, and to provide an educational program for citizens. Annually, approximately 165 lakes (out of 3,041 lakes in Illinois) are sampled by approximately 300 citizen volunteers. The volunteers are primarily lakeshore residents, lake owners/managers, members of environmental groups, public water supply personnel, and citizens with interest in a particular lake.

The VLMP relies on volunteers to gather a variety of information on their chosen lake. The primary measurement is Secchi disk transparency or Secchi depth. Analysis of the Secchi disk measurement provides an indication of the general water quality condition of the lake, as well as the amount of usable habitat available for fish and other aquatic life.

Microscopic plants and animals, water color, and suspended sediments are factors that interfere with light penetration through the water column and lessen the Secchi disk depth. As a rule, one to three times the Secchi depth is considered the lighted or euphotic zone of the lake. In this region of the lake there is enough light to allow plants to survive and produce oxygen. Water below the lighted zone can be expected to have little or no dissolved oxygen. Other observations such as water color, suspended algae and sediment, aquatic plants, and odor are also recorded. The sampling season is May through October with volunteer measurements taken twice a month. After volunteers have completed one year of the basic monitoring program, they are qualified to participate in the Expanded Monitoring Program. In the expanded program, selected volunteers are trained to collect water samples that are shipped to the Illinois EPA laboratory for analysis of total and volatile suspended solids, total phosphorus, nitrate-nitrite nitrogen and ammonia nitrogen. Other parameters that are part of the expanded program include dissolved oxygen, temperature, and zebra mussel monitoring. Additionally, chlorophyll *a* monitoring has been added to the regiment of selected lakes. These water quality parameters are routinely measured by lake scientists to help determine the general health of the lake ecosystem.

Currently the number of volunteers in the six county northeast Illinois region has reached its limit with regard to how many volunteers NIPC can handle. New volunteers wishing to be part of the VLMP will be trained by the Lake County Health Department Lakes Management Unit (LMU). If Sand Lake would like to be placed on this training list or would simply like more information, contact the Lakes Management Unit Local Coordinator:

VLMP Regional Coordinator:
Holly Hudson
Northeast Illinois Planning Commission
222 S. Riverside Plaza, Suite 1800

Chicago, IL 60606
(312) 454-0400

Objective III: Eliminate or Control Exotic Species

Numerous exotic plant species have been introduced into our local ecosystems. Some of these plants are aggressive, quickly out-competing native vegetation and flourishing in an environment where few natural predators exist. Plants such as purple loosestrife (*Lythrum salicaria*), buckthorn (*Rhamnus cathartica*), and reed canary grass (*Phalaris arundinacea*) are three examples. The outcome is a loss of plant and animal diversity. This section will address terrestrial shoreline exotic species.

Buckthorn is an aggressive shrub species that grows along lake shorelines as well as most upland habitats. It shades out other plants, its roots exude a chemical that discourages other plant growth, and it is quick to become established on disturbed soils. Reed canary grass is an aggressive plant species that was introduced as a shoreline stabilizer. It is found on lakeshores, stream banks, marshes and exposed moist ground. Although it does serve to stabilize shorelines to some extent, it has low food value and does not provide winter habitat for wildlife. It is very successful in taking over disturbed areas and, if left unchecked, will dominate an area, particularly a wetland or shoreline, in a short period of time. Since it begins growing early in the spring, it quickly out-competes native vegetation that begins growth later in the year. Control of buckthorn, and reed canary grass are discussed below. However, these control measures can be similarly applied to other exotic species such as garlic mustard (*Allilaria officianalis*) or honeysuckle (*Lonicera* spp.) as well as some aggressive native species, such as box elder (*Acer negundo*).

The presence of exotic species along a lakeshore is by no means a death sentence for the lake or other plant and animal life. If controlled, many exotic species can perform many of the original functions that they were brought here for. For example, reed canary grass was imported for its erosion control properties. It still contributes to this objective (offering better erosion control than commercial turfgrass), but needs to be isolated and kept in control. Many exotics are the result of garden or ornamental plants escaping into the wild. One isolated plant along a shoreline will probably not create a problem by itself, but its removal early on is best. Problems arise when plants are left to spread, many times to the point where treatment is difficult or cost prohibitive. The length of shoreline on Sand Lake inhabited by exotic species is 55% of the total shoreline. They occur mostly along wetland, shrub and buffered shorelines, and many areas are along developed parcels. The largest area is the wetland and buffered area along the southeast shore. A monitoring program should be established, problem areas specifically identified, and control measures taken. This is particularly important in remote areas of lake shorelines where the spread of exotic species has gone unmanaged for some time.

<u>Option 1: No Action</u>

No control will likely result in the expansion of the exotic species and the decline of native species. This option is not recommended if possible.

Pros

There are few advantages with this option. Some of the reasons exotics were brought into this country are no longer used or have limited use. However, in some cases having an exotic species growing along a shoreline may actually be preferable if the alternative plant is commercial turfgrass. Since turfgrass has shallow roots and is prone to erosion along shorelines, exotics like reed canary grass or common reed (*Phragmites australis*) will control erosion more effectively. Native plants should take precedent over exotics whenever possible. Table 6 in Appendix A lists several native plants that can be planted along shorelines.

Cons

Native plant and wildlife diversity will be lost as stands of exotic species expand. Exotic species are not under the same stresses (particularly diseases and predators) as native plants and thus can out-compete the natives for nutrients, space, and light. Few wildlife species use areas where exotic plants dominate. This happens because many wildlife species either have not adapted with the plants and do not view them as a food resource, the plants are not digestible to the animal, or their primary food supply (i.e., insects) are not attracted to the plants. The result is a monoculture of exotic plants with limited biodiversity.

Recreational activities, especially wildlife viewing, may be hampered by such monocultures. Access to lake shorelines may be impaired due to dense stands of non-native plants. Other recreational activities, such as swimming and boating, may not be affected.

Costs

Costs with this option are zeroing initially, however, when control is eventually needed, costs will be substantially more than if action was taken immediately. Additionally, the eventual loss of ecological diversity is difficult to calculate financially.

Option 2: Biological Control

Biological control (bio-control) is a means of using natural relationships already in place to limit, stop, or reverse an exotic species' expansion. In most cases, insects that prey upon the exotic plants in its native ecosystem are imported. Since there is a danger of bringing another exotic species into the ecosystem, state and federal agencies require testing before any bio-control species are released or made available for purchase.

Recently two leaf beetles (*Galerucella pusilla* and *G. calmariensis*) and two weevils, one a root-feeder (*Hylobius transversovittatus*) and one a flower-feeder (*Nanophyes marmoratus*) have offered some hope to control purple loosestrife by natural means. These insects feed on the leaves, roots, or flowers of purple loosestrife, eventually weakening and killing the plant or, in the case of the flower-feeder, prevent seeding. In large stands of loosestrife, the beetles and weevils naturally reproduce and in many locations, significantly reduce plant densities. The insects are host specific, meaning that they will attack no other plant but purple loosestrife. Currently, the beetles have proven to be most effective and are available for purchase. There are no designated stocking rate recommendations, since using bio-control insects are seen as an inoculation and it may take 3-5 years for beetle populations to increase to levels that will cause significant damage. Depending on the size of the infested area, it may take 1,000 or more adult beetles per acre to cause significant damage. The Lake County Forest Preserve District has stocked these beetles in the nearby Fourth Lake Fen and have had tremendous success. It is recommended that Lake Villa Township inquire with the Forest Preserve about obtaining beetles to address the wetland area along the southeast shore of Sand Lake.

Pros

Control of exotics by a natural mechanism is preferable to chemical treatments. Insects, being part of the same ecological system as the exotic plant (i.e., the beetles and weevils and the purple loosestrife) are more likely to provide long-term control. Chemical treatments are usually non-selective while bio-control measures target specific plant species. This technique is beneficial to the ecosystem since it preserves, even promotes, biodiversity. As the exotic plant dies back, native vegetation can reestablish the area.

Cons

Few exotics can be controlled using biological means. Currently, there are no bio-control techniques for plants such as buckthorn, reed canary grass, or a host of other exotics. One of the major disadvantages of using bio-control is the costs and labor associated with it.

Use of biological mechanisms to control plants such as purple loosestrife is still under debate. Similar to purple loosestrife, the beetles and weevils that control it are not native to North America. Due to the poor historical record of introducing non-native species, even to control other non-native species, this technique has its critics.

Costs

The New York Department of Natural Resources at Cornell University (email: bb22@cornell.edu, 607-255-5314, or visit the website: www.invasiveplants.net) sells overwintering adult leaf beetles (which will lay eggs the year of release) for $1 per beetle and new generation leaf beetles (which will lay eggs beginning the following year) at $0.25 per beetle. The root beetles are sold for $5 per beetle. Some beetles may be available for free by contacting the Illinois Natural History Survey (INHS; 217-333-6846). The INHS also conducts a workshop each spring at Volo Bog for individuals and groups interested in learning how to rear their own beetles.

Option 3: Control by Hand

Controlling exotic plants by hand removal is most effective on small areas (< 1 acre) and if done prior to heavy infestation. Some exotics, such as purple loosestrife and reed canary grass, can be controlled to some degree by digging, cutting, or mowing if done early and often during the year. Digging may be required to ensure the entire root mass is removed. Spring or summer is the best time to cut or mow, since late summer and fall is when many of the plant seeds disperse. Proper disposal of excavated plants is important since seeds may persist and germinate even after several years. Once exotic plants are removed, the disturbed ground should be planted with native vegetation and closely monitored since regrowth is common. Many exotic species, such as purple loosestrife, buckthorn, and garlic mustard are proficient at colonizing disturbed sites.

Pros

Removal of exotics by hand eliminates the need for chemical treatments. Costs are low if stands of plants are not too large already. Once removed, control is simple with yearly maintenance. Control or elimination of exotics preserves the ecosystem's biodiversity. This will have positive impacts on plant and wildlife presence as well as some recreational activities.

Cons

This option may be labor intensive or prohibitive if the exotic plant is already well established. Costs may be high if large numbers of people are needed to remove plants. Soil disturbance may introduce additional problems such as providing a seedbed for other non-native plants that quickly establish disturbed sites, or cause soil-laden run-off to flow into nearby lakes or streams. In addition, a well-established stand of an exotic like purple loosestrife or reed canary grass may require several years of intense removal to control or eliminate.

Costs

Cost for this option is primarily in tools, labor, and proper plant disposal.

Option 3: Herbicide Treatment

Chemical treatments can be effective at controlling exotic plant species. However, chemical treatment works best on individual plants or small areas already infested with the plant.   In some areas where individual spot treatments are prohibitive or impractical (i.e., large expanses of a wetland or woodland), chemical treatments may not be an option because in order to chemically treat the area, a broadcast application would be needed. Because many of the herbicides are not selective, meaning they kill all plants they contact, this may be unacceptable if native plants are found in the proposed treatment area.

Herbicides are commonly used to control nuisance shoreline vegetation such as buckthorn and purple loosestrife. Herbicides are applied to green foliage or cut stems. Products are applied by either spraying or wicking (wiping) solution on plant surfaces. Spraying is used when large patches of undesirable vegetation are targeted. Herbicides are sprayed on growing foliage using a hand-held or backpack sprayer. Wicking is used when selected plants are to be removed from a group of plants. The herbicide solution is wiped on foliage, bark, or cut stems using an herbicide-soaked device. Trees are normally treated by cutting off a ring of bark around the trunk (called girdling). Herbicides are applied onto the ring at high concentrations. Other devices inject the herbicide through the bark. It is best to apply herbicides when plants are actively growing, such as in the late spring/early summer, but before formation of seed heads. Herbicides are often used in conjunction with other methods, such as cutting or mowing, to achieve the best results. Proper use of these products is critical to their success. Always read and follow label directions.

Pros

Herbicides provide a fast and effective way to control or eliminate nuisance vegetation. Unlike other control methods, herbicides kill the root of the plant, which prevents regrowth. If applied properly, herbicides can be selective. This allows for removal of selected plants within a mix of desirable and undesirable plants.

Cons

Since most herbicides are non-selective, they are not suitable for broadcast application. Thus, chemical treatment of large stands of exotic species may not be practical. Native species are likely to be killed inadvertently and replaced by other non-native species. Off target injury/death may result from the improper use of herbicides. If herbicides are applied in windy conditions, chemicals may drift onto desirable vegetation. Care must also be taken when wicking herbicides as not to drip on to non-targeted vegetation such as native grasses and wildflowers. Another drawback to herbicide use relates to their ecological soundness and the public perception of them. Costs may also be prohibitive if plant stands are large. Depending on the device, cost of the application equipment can be high.

Costs

Two common herbicides, triclopyr (sold as Garlon ™) and glyphosate (sold as Rodeo®, Round-up™, Eagre™, or AquaPro™), are sold in 2.5 gallon jugs, and cost approximately $200 and $350, respectively. Only Rodeo® is approved for water use. A Hydrohatchet®, a hatchet that injects herbicide through the bark, is about $300.00. Another injecting device, E-Z Ject® is $450.00. Hand-held and backpack sprayers costs from $25-$45 and $80-150, respectively. Wicking devices are $30-40. A girdling tool costs about $150.

Objective IV: Enhance Wildlife Habitat Conditions

The key to increasing wildlife species in and around a lake can be summed up in one word: habitat. Wildlife need the same four things all living creatures need: food, water, shelter, and a place to raise their young. Since each wildlife species has specific habitat requirements, which fulfill these four basic needs, providing a variety of habitats will increase the chance that wildlife species may use an area. Groups of wildlife are often associated with the types of habitats they use. For example, grassland habitats may attract wildlife such as northern harriers, bobolinks, meadowlarks, meadow voles, and leopard frogs. Marsh habitats may attract yellow-headed blackbirds and sora rails, while manicured residential lawns attract house sparrows and gray squirrels. Thus, in order to attract a variety of wildlife, a mix of habitats are needed. In most cases quality is more important than quantity (i.e., five 0.1-acre plots of different habitats may not attract as many wildlife species than one 0.5 acre of one habitat type).

It is important to understand that the natural world is constantly changing. Habitats change or naturally succeed to other types of habitats. For example, grasses may be succeeded by shrub or shade intolerant tree species (e.g., willows, locust, and cottonwood). The point at which one habitat changes to another is rarely clear, since these changes usually occur over long periods of time, except in the case of dramatic events such as fire or flood.

In all cases, the best wildlife habitats are ones consisting of native plants. Unfortunately, non-native plants dominate many of our lake shorelines. Many of them escaped from gardens and landscaped yards (i.e., purple loosestrife) while others were introduced at some point to solve a problem (i.e., reed canary grass for erosion control). Wildlife species prefer native plants for food, shelter, and raising their young. In fact, one study showed that plant and animal diversity was 500% higher along naturalized shorelines compared to shorelines with conventional lawns (University of Wisconsin – Extension, 1999).

<u>Option 1: No Action</u>

This option means that the current land use activities will continue. No additional techniques will be implemented. Allowing a field to go fallow or not mowing a manicured lawn would be considered an action.

Pros

Taking no action may maintain the current habitat conditions and wildlife species present, depending on environmental conditions and pending land use actions. If all things remain constant there will be little to no effect on lake water quality and other lake uses.

Cons

If environmental conditions change or substantial land use actions occur (i.e., development) wildlife use of the area may change. For example, if a new housing development with manicured lawns and roads is built next to an undeveloped property, there will probably be a change in wildlife present.

Conditions in the lake (i.e., siltation or nutrient loading) may also change the composition of aquatic plant and invertebrate communities and thus influence biodiversity. Siltation and nutrient loading will likely decrease water clarity, increase turbidity, increase algal growth (due to nutrient availability), and decrease habitat for fish and wildlife.

Costs
The financial cost of this option may be zero. However, due to continual loss of habitats many wildlife species have suffered drastic declines in recent years. The loss of habitat affects the overall health and biodiversity of the lake's ecosystems.

Option 2: Increase Habitat Cover

This option can be incorporated with Option 3 (see below). One of the best ways to increase habitat cover is to leave a minimum 25-foot buffer between the edge of the water and any mowed grass. Allow native plants to grow or plant native vegetation along shorelines, including emergent vegetation such as cattails, rushes, and bulrushes (Table 6, Appendix A for costs and seeding rates). This will provide cover from predators and provide nesting structure for many wildlife species and their prey. It is important to control or eliminate non-native plants such as buckthorn, purple loosestrife, garlic mustard, and reed canary grass, since these species outcompete native plants and provide little value for wildlife.

Occasionally high mowing (with the mower set at its highest setting) may have to be done for specific plants, particularly if the area is newly established, since competition from weedy and exotic species is highest in the first couple years. If mowing, do not mow the buffer strip until after July 15 of each year. This will allow nesting birds to complete their breeding cycle.

Brush piles make excellent wildlife habitat. They provide cover as well as food resources for many species. Brush piles are easy to create and will last for several years. They should be place at least 10 feet away from the shoreline to prevent any debris from washing into the lake.

Trees that have fallen on the ground or into the water are beneficial by harboring food and providing cover for many wildlife species. In a lake, fallen trees provide excellent cover for fish, basking sites for turtles, and perches for herons and egrets.

Increasing habitat cover should not be limited to the terrestrial environment. Native aquatic vegetation, particularly along the shoreline, can provide cover for fish and other wildlife.

Pros

Increased cover will lead to increased use by wildlife. Since cover is one of the most important elements required by most species, providing cover will increase the chances of wildlife using the shoreline. Once cover is established, wildlife usually have little problem finding food, since many of the same plants that provide cover also supply the food the wildlife eat, either directly (seeds, fruit, roots, or leaves) or indirectly (prey attracted to the plants).

Additional benefits of leaving a buffer include: stabilizing shorelines, reducing runoff which may lead to better water quality, and deterring nuisance Canada geese. Shorelines with erosion problems can benefit from a buffer zone because native plants have deeper root structures and hold the soil more effectively than conventional turfgrass. Buffers also absorb much of the wave energy that batters the shoreline. Water quality may be improved by the filtering of nutrients, sediment, and pollutants in run-off. This has a "domino effect" since less run-off flowing into a lake means less nutrient availability for nuisance algae, and less sediment means less turbidity, which leads to better water quality. All this is beneficial for fish and wildlife, such as sight-feeders like bass and herons, as well as people who use the lake for recreation. Finally, a buffer strip along the shoreline can serve as a deterrent to Canada geese from using a shoreline. Canada geese like flat, open areas with a wide field of vision. Ideal habitat for them are areas that have short grass up to the edge of the lake. If a buffer is allowed to grow tall, geese may choose to move elsewhere.

Cons

There are few disadvantages to this option. However, if vegetation is allowed to grow, lake access and visibility may be limited. If this occurs, a small path can be made to the shoreline. Composition and density of aquatic and shoreline vegetation are important. If vegetation consists of non-native species such as or Eurasian water milfoil or purple loosestrife, or in excess amounts, undesirable conditions may result. A shoreline with excess exotic plant growth may result in a poor fishery (exhibited by stunted fish) and poor recreation opportunities (i.e., boating, swimming, or wildlife viewing).

Costs

The cost of this option would be minimal. The purchase of native plants can vary depending upon species and quantity. Based upon 100 feet of shoreline, a 25-foot buffer planted with a native forb and grass seed mix would cost between $165-270 (2500 sq. ft. would require 2.5, 1000 sq. ft. seed mix packages at $66-108 per package). This does not include labor that would be needed to prepare the site for planting and follow-up maintenance. This cost can be reduced or minimized if native plants are allowed to grow. However, additional time and labor may be needed to insure other exotic species, such as buckthorn, reed canary grass, and purple loosestrife, do not become established.

Option 3: Increase Natural Food Supply

This can be accomplished in conjunction with Option 2. Habitats with a diversity of native plants will provide an ample food supply for wildlife. Food comes in a variety of forms, from seeds to leaves or roots to invertebrates that live on or are attracted to the plants. Plants found in Table 6, Appendix A should be planted or allowed to grow. In addition, encourage native aquatic vegetation, such as water lily (*Nuphar* spp. and *Nymphaea tuberosa*), sago pondweed (*Stuckenia pectinatus*), largeleaf pondweed (*Potamogeton amplifolius)*, and wild celery (*Vallisneria americana*) to grow. Aquatic plants such as these are particularly important to waterfowl in the spring and fall, as they replenish energy reserves lost during migration.

Providing a natural food source in and around a lake starts with good water quality. Water quality is important to all life forms in a lake. If there is good water quality, the fishery benefits and subsequently so does the wildlife (and people) who prey on the fish. Insect populations in the area, including beneficial predatory insects, such as dragonflies, thrive in lakes with good water quality.

Dead or dying plant material can be a source of food for wildlife. A dead standing or fallen tree will harbor good populations of insects for woodpeckers, while a pile of brush may provide insects for several species of songbirds such as warblers and flycatchers.

Supplying natural foods artificially (i.e., birdfeeders, nectar feeders, corn cobs, etc.) will attract wildlife and in most cases does not harm the animals. However, “people food” such as bread should be avoided. Care should be given to maintain clean feeders and birdbaths to minimize disease outbreaks.

Pros

Providing food for wildlife will increase the likelihood they will use the area. Providing wildlife with natural food sources has many benefits. Wildlife attracted to a lake can serve the lake and its residents well, since many wildlife species (i.e., many birds, bats, and other insects) are predators of nuisance insects such as mosquitoes, biting flies, and garden and yard pests (such as certain moths and beetles). Effective natural insect control eliminates the need for chemical treatments or use of electrical “bug zappers” that have limited effect on nuisance insects.

Migrating wildlife can be attracted with a natural food supply, primarily from seeds, but also from insects, aquatic plants or small fish. In fact, most migrating birds are dependent on food sources along their migration routes to replenish lost energy reserves. This may present an opportunity to view various species that would otherwise not be seen during the summer or winter.

Cons

Feeding wildlife can have adverse consequences if populations become dependent on hand-outs or populations of wildlife exceed healthy numbers. This frequently happens when people feed waterfowl like Canada geese or mallard ducks.

Feeding these waterfowl can lead to a domestication of these animals. As a result, these birds do not migrate and can contribute to numerous problems, such as excess feces, which is both a nuisance to property owners and a significant contribution to the lake's nutrient load. Waterfowl feces are particularly high in phosphorus. Since phosphorus is generally the limiting factor for nuisance algae growth in many lakes in the Midwest, the addition of large amounts of this nutrient from waterfowl may exacerbate a lake's excessive algae problem. In addition, high populations of birds in an area can increase the risk of disease for not only the resident birds, but also wild bird populations that visit the area.

Finally, tall plants along the shoreline may limit lake access or visibility for property owners. If this occurs, a path leading to the lake could be created or shorter plants may be used in the viewing area.

Costs

The costs of this option are minimal. The purchase of native plants and food and the time and labor required to plant and maintain would be the limit of the expense.

Option 4: Increase Nest Availability

Wildlife are attracted by habitats that serve as a place to raise their young. Habitats can vary from open grasslands to closed woodlands (similar to Options 2 and 3).

Standing dead or dying trees provide excellent habitat for a variety of wildlife species. Birds such as swallows, woodpeckers, and some waterfowl need dead trees to nest in. Generally, a cavity created and used by a woodpecker (e.g., red-headed or downy woodpecker, or common flicker) in one year, will in subsequent years be used by species like tree swallows or chickadees. Over time, older cavities may be large enough for waterfowl, like wood ducks, or mammals (e.g., flying squirrels) to use. Standing dead trees are also favored habitat for nesting wading birds, such as great blue herons, night herons, and double-crested cormorants, which build stick nests on limbs. For these birds, dead trees in groups or clumps are preferred as most herons and cormorants are colonial nesters.

In addition to allowing dead and dying trees to remain, erecting bird boxes will increase nesting sites for many bird species. Box sizes should vary to accommodate various species. Swallows, bluebirds, and other cavity nesting birds can be attracted to the area using small artificial nest boxes. Larger boxes will attract species such as wood ducks, flickers, and owls. A colony of purple martins can be attracted with a purple martin house, which has multiple cavity holes, placed in an open area near water.

Bat houses are also recommended for any area close to water. Bats are voracious predators of insects and are naturally attracted to bodies of water. They can be enticed into roosting in the area by the placement of bat boxes. Boxes should be constructed of rough non-treated lumber and placed >10 feet high in a sunny location.

Pros
Providing places were wildlife can rear their young has many benefits. Watching wildlife raise their young can be an excellent educational tool for both young and old.

The presence of certain wildlife species can help in controlling nuisance insects like mosquitoes, biting flies, and garden and yard pests. This eliminates the need for chemical treatments or electric "bug zappers" for pest control.

Various wildlife species populations have dramatically declined in recent years. Since, the overall health of ecosystems depend, in part, on the role of many of these species, providing sites for wildlife to raise their young will benefit not only the animals themselves, but the entire lake ecosystem.

Cons
Providing sites for wildlife to raise their young have few disadvantages. Safety precautions should be taken with leaving dead and dying trees due to the potential of falling limbs. Safety is also important when around wildlife with young, since many animals are protective of their young. Most actions by adult animals are simply threats and are rarely carried out as attacks.

Parental wildlife may chase off other animals of its own species or even other species. This may limit the number of animals in the area for the duration of the breeding season.

Costs
The costs of leaving dead and dying trees are minimal. The costs of installing the bird and bat boxes vary. Bird boxes can range in price from $10-100.00. Purple martin houses can cost $50-150. Bat boxes range in price from $15-50.00. These prices do not include mounting poles or installation.

Option 5: Limit Disturbance
Since most species of wildlife are susceptible to human disturbance, any action to curtail disturbances will be beneficial. Limiting disturbance can include posting signs in areas of the lake where wildlife may live (e.g., nesting waterfowl), establish a "no wake" area, boat horsepower or speed limits, or establish restricted boating hours. These are examples of time and space zoning for lake usage. Enforcement and public education are needed if this option is to be successful. In some areas, off-duty law enforcement officers can be hired to patrol the lake.

Pros
Limiting disturbance will increase the chance that wildlife will use the lake, particularly for raising their young. Many wildlife species have suffered population declines due to loss of habitat and poor breeding success. This is due in part to their sensitivity to disturbance.

This option also can benefit the lake in other ways. Limited boat traffic may lead to less wave action to batter shorelines and cause erosion, which results in suspension of nutrients and sediment in the water column. Less nutrients and sediment in the water column may improve water quality by increasing water clarity and limiting nutrient availability for excessive plant or algae growth.

Recreation activities such as canoeing and paddleboating may be enhanced by the limited disturbance.

Cons
One of the strongest oppositions to this option would probably be from the powerboat users and water skiers. However, this problem may be solved if a significant portion of the daylight hours and the use of the middle part of the lake (assuming the lake is deep enough) are allowed for powerboating. For example, powerboating could be allowed between 9 AM and 6 PM within the boundaries established by “no wake” restricted area buoys.

Costs
The costs of this option include the purchase and placement of signs and public educational materials as well as enforcement. Off-duty law enforcement officers usually charge $25/hour to enforce boating laws or local ordinances.

Objective V: Conduct a Fisheries Assessment

Many lakes in Lake County have a fish stocking program in which fish are stocked every year or two to supplement fish species already occurring in the lake or to introduce additional fish species into the system. However, very few lakes that participate in stocking check the progress or success of these programs with regular fish surveys. Lake managers should have information about whether or not funds delegated to fish stocking are being well spent, and it is very difficult to determine how well stocked fish species are surviving and reproducing or how they are affecting the rest of the fish community without a comprehensive fish assessment. Sand Lake has not had a fishery assessment conducted since 1995. In order to determine the current status of the fishery, it is highly recommended that a fish assessment is carried out.

A simple, inexpensive way to derive direct information on the status of a fishery is to sample anglers and evaluate the types, numbers and sizes of fish caught by anglers actively involved in recreational fishing on the lake. Such information provides insight on the status of fish populations in the lake, as well as a direct measure of the quality of fishing and the fishing experience. However, the numbers and types of fish sampled by anglers are limited, focusing on game and large, catchable-sized fish. Thus, in order to obtain a comprehensive assessment of the fish community status, including non-game fish species, more quantitative methods must be employed. These include gill netting, trap netting, seining, trawling, angling (hook and line fishing) and electroshocking. Each method has its advantages and limitations, and frequently multiple gear and approaches are employed. The best gear and sampling methods depend on the target fish species and life stage, the types of information desired and the environment to be sampled. The table below lists examples of suitable sampling gear for collecting adults and young of the year (YOY) of selected fish species in lakes.

Typically, fish populations are monitored at least annually. The best time of year depends on the sampling method, the target fish species and the types of data to be collected. In many lakes and regions, the best time to sample fish is during the fall turnover period after thermal stratification breaks down and the lake is completely mixed because (1) YOY and age 1+ (one year or older) fish of most target species should be present and vulnerable to most standard collection gear, including seines, trap nets and electroshockers; (2) species that dwell in the hypolimnion during the summer may be more vulnerable to capture during fall overturn; and (3) lower water temperatures in the fall can help reduce sampling-related mortality. Sampling locations are also species-, life stage-, and gear-dependent. As with sampling methods and time, locations should be selected to maximize capture efficiency for the target species of interest and provide the greatest gain in information for the least amount of sampling effort.

The Illinois Department of Natural Resources (IDNR) will perform a fish survey at no charge on most public and some private water bodies. In order to determine if your lake is eligible for a survey by the IDNR, contact Frank Jakubecik, Fisheries Biologist at (815) 675-2319. If a lake is not eligible for an IDNR fish survey, or if a more comprehensive survey is desired, two known consulting firms have previously conducted fish surveys in Lake County: EA Engineering, Deerfield, IL, (847) 945-8010 and Richmond Fisheries, Richmond, IL, (815) 675-6545.

		GEAR[a]	
TAXON	**FISH LIFE STAGE**	**STANDARD**	**SUPPLEMENTAL**
Trout, salmon, whitefish, char (except lake trout)	YOY	Electrofishing	Gill nets, trawls, seine
	Adult	Trap nets	Gill nets, electrofishing (F)
Lake trout	YOY	Electrofishing (F)	Seine (F), trawls
	Adult	Trap nets (F)	
Pike, pickerel, muskellange	YOY	Seine (Su)	
	Adult	Trap nets (S), gill nets (S,F)	
Catfish, bullheads	YOY	Seine	Baited traps
	Adult	Gill nets, trap nets[b]	Slat nets, angling
Bass, sunfish, crappie	YOY	Seine, electrofishing	
	Adult	Electrofishing	Trap nets, angling
Minnows, carp, dace, chub, shiners	YOY	Electrofishing	Seine
	Adult	Electrofishing	Seine
Yellow perch	YOY	Seine (Su), electrofishing	Trawls (S)
	Adult	Gill net, trap net	
Walleye	YOY	Seine (S), electrofishing	Trawls (S)
	Adult	Trap nets (S), gill nets (S, F), electrofishing (S, F)	

[a]Letter codes indicate seasonal restrictions on gear use to the spring (S), summer (Su), or fall (F).
[b]Bullheads only.