2002 SUMMARY REPORT
of
BANGS LAKE

Lake County, Illinois

Prepared by the

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EXECUTIVE SUMMARY

Bangs Lake, located in Wauconda Township, is a glacial lake, created over 10,000 years ago by receding glaciers. It was dammed in the early to mid-1900's and served the resort community for many years. The lake has a surface area of 306.1 acres and a mean depth of 10.9 feet. It is located almost entirely within the Village of Wauconda (a small portion on the north end is unincorporated) and is used by the general public for swimming, boating and fishing. There are numerous beaches, parks and boat launches on the lake.

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 2002. Bangs Lake was stratified from June-August. Entrainment (the thermocline increases in depth, causing an increase in the volume of the epilimnion) occurred throughout those months, but dissolved oxygen (DO) concentrations remained high in the epilimnion through September. Phosphorus levels were very low throughout the summer, and the most likely source of phosphorus was internal phosphorus loading and entrainment. Low DO levels in the hypolimnion trigger chemical reactions that result in the release of phosphorus from the sediment. Entrainment of the epilimnion may have caused some of this phosphorus to enter the upper water layers, gradually increasing the phosphorus concentration and algae density. Total suspended solids (TSS) concentrations were very low and Secchi depths were high throughout the summer. The concentrations of many parameters in Bangs Lake has changed only slightly in the past 5-10 years. This is exceptional as it is unusual for a lake in Lake County, where residential and commercial land use is so prevalent, to maintain its TP levels over that period of time. This is a testimony to the high water quality in Bangs Lake and to efforts by the Village of Wauconda and other lake owners to prevent activities that might threaten water quality.

Eurasian watermilfoil (EWM) dominated the plant community in 2002. However, including EWM, twenty different plant species were found in Bangs Lake over the course of the summer. This very healthy plant community provided Bangs Lake with excellent fish habitat and kept water clarity high by reducing sediment resuspension in shallow areas and competed with planktonic algae for nutrients. There is currently a harvesting program in place to remove curly leaf pondweed and EWM. This program has been successful over the years in maintaining lanes and will continue into 2003 and beyond. The milfoil weevil is present in Bangs Lake, but does not appear to be controlling the EWM at this time.

The dominance of seawalls around Bangs Lake reduced the occurrence of erosion along the shoreline, but this is not an ideal shoreline type with regard to wildlife habitat. Although very little erosion was occurring around Bangs Lake, buckthorn, purple loosestrife and reed canary grass were present along 41% of the shoreline. These are exotic plant species that out-compete native vegetation and provide poor habitat for wildlife. A relatively large number of waterfowl and bird species were observed during the summer, despite the dominance of residential shoreline on Bangs Lake.

LAKE IDENTIFICATION AND LOCATION

Bangs Lake is located near the corner of Illinois State Route 176 and Main Street in the Village of Wauconda, Wauconda Township (T 44N, R 9E, S 24, 25, 26). A small portion of the northern shoreline is located in unincorporated Lake County. Bangs Lake has a surface area of 306.1 acres and mean and maximum depths of 10.9 feet and 32.0 feet, respectively. It has a volume of 3,323.6 acre-feet and a shoreline length of 6.32 miles (Figure 1, Appendix A). The immediate watershed of Bangs Lake encompasses approximately 2,762 acres, draining the Lakewood Forest Preserve and Broberg Marsh to the east, Wauconda Bog to the south, the downtown Wauconda business district east of Main Street to the west, and unincorporated and incorporated residential areas north of the lake. The watershed to lake surface area ratio of 9:1 is relatively small and may help prevent serious water quality problems that often accompany a larger watershed. The most recent land use survey of the Bangs Lake watershed was conducted in 1990. At that time, residential areas dominated the watershed, encompassing 26.6% of the total area. This percentage has certainly increased in the past 12 years, as two new residential subdivisions were being constructed during the summer of 2002. In 1990, 15% of the watershed was in agricultural land use. This percentage has likely decreased as agricultural areas continue to be residentially developed throughout the county. Other land uses included forest (16.9%) and wetland (19.3%). Water exits Bangs Lake over a culvert spillway and flows into Slocum Lake through the Bangs Lake Drain on the southeast shore. The lake is located in the Slocum Lake Drain sub basin, within the Fox River watershed.

BRIEF HISTORY OF BANGS LAKE

Bangs Lake is of glacial origin, created during the last ice age. In the early to mid-1900's, a dam culvert was installed at the lake's outlet. Prior to the 1830's, there were only a few white settlers in the county and the Potawatomis Indians dominated the region. The completion of the Erie Canal and a stagecoach road between Detroit and Chicago, along with a forced land cession, ensured that by 1835 the Native Americans were gone and that white settlers now controlled the region. The first settler in the Bangs Lake area was Justus Bangs, who arrived from Vermont in 1836 and built his log cabin home where the town hall now stands. Wauconda was established in 1849 and became incorporated by 1877. Although farming of grain and livestock was the main business, Wauconda also served as a resort community for Chicagoans, with resorts popping up along the shores of Bangs Lake. In 1913, the railroad connecting Wauconda to Chicago was built. This opened the way for business expansion and for tourists. On weekends in the summer, the population of Wauconda would triple to quadruple with the addition of those seeking a reprieve from the city life. Eventually these resorts were replaced by lake homes, cottages and condominium communities. Numerous lake associations exist around the lake and manage their own beaches and boat launches. However, large-scale management activities of the lake itself are controlled by the Village of Wauconda. The Bangs Lake Management Committee is a volunteer advisory committee to the village that meets once per month to discuss lake issues.

SUMMARY OF CURRENT AND HISTORICAL LAKE USES

Records of historical lake management techniques on Bangs Lake is limited. However, it is known that wide spread use of herbicides occurred prior to 1982. In 1974 the plant community was treated with Aquathol at a cost of $8,000. An aeration system was purchased in 1975 at an estimated cost of $7,500. However, information regarding where the units were installed, how many units were installed and when use of the aeration system was discontinued is not available. Harvesting of plants in the lake began in 1982 and good records were kept from 1982-1988. Harvesting continues on the lake today. Currently, access to Bangs Lake is open to the public through several beaches and boat launches, while access to other beach areas is limited to association members. Active lake associations with beaches and/or boat launches on the lake include the Bangs Lake Condo Association, Elmcrest Association, Harbour Club Condominiums, Lake Pointe Association, Lakeside Condominiums, Lakeview Villa Association, Lindy's Landing, Maiman's I and II, Spencer Highlands Association, Wauconda Boat and Wauconda Park District (Figure 2). The lake's main uses are boating and fishing. Boat restrictions on the lake include a 30 mph boat speed, a no wake ordinance between 8 p.m. and 10 a.m., and a counter clockwise boat traffic direction. Restrictions also exist for water skiers and personal watercraft operators with regard to safe distance. These restrictions are enforced by the Wauconda Police Marine Patrol Unit. Boat launch permit fees are based on horsepower, and approximately 666 permit stickers (approximately 2 boats per acre) were purchased in 2002. This is a 2% increase from 2001. Currently, the biggest management concerns expressed by the Bangs Lake Management Committee are low lake levels and weed growth. The lake level is currently being debated, as some want to add boards to the spillway in order to store more water during the spring, while some believe that the lake should remain at its natural level.

Licensed beaches on Bangs Lake (Elmcrest Subdivision, Lakeview Villa Subdivision, Lindy's Landing, Maiman's Lakeshore, Maiman's Lakeside Manor and Wauconda Park District) were sampled every two weeks by the Lake County Health Department to test for the presence of high *E. coli* counts. *E. coli* bacteria is found virtually everywhere, but is in very high numbers in the feces of warm-blooded animals and humans. The bacteria may indicate the presence of other pathogens such as *Giardia*, which can cause serious illness in humans. In 2002, Elmcrest Beach was closed on June 25th and August 7th, Lake View Villa Beach was closed on August 20th and Maiman's Lakeshore Beach was closed from August 6-8th and on August 20th due to *E. coli* concentrations that exceeded 235 colonies/100 mL. These high counts can be caused by a number of things, including a large number of waterfowl, rain and high wind and wave events. The presence of a large number of waterfowl in the vicinity of the beach area could cause problems because their feces contain *E. coli*. When these feces make their way into the water, they can cause high *E. coli* counts. Rain events can increase *E. coli* counts because as rain runs over the land, it picks up *E. coli* which are then washed into the lake. On all but one date during the summer of 2002, the high *E. coli* numbers appear to have been linked to rain. The closing at Elmcrest Subdivision Beach in June may have been due to a high number of geese or ducks along the beach area. Despite the beach closings this year, since testing began in 1988, Elmcrest Beach has only been closed four times, Lakeview

Villa Beach has been closed 5 times, Maiman's Lakeshore Beach has been closed nine times, Wauconda Park District has only been closed twice, and Lindy's Landing and Maiman's Lakeside Manor have never been closed. Based on this data, *E. coli* contamination does not appear to be a serious problem on Bangs Lake beaches.

In late July 2002, residents in the Circle Channel on the north side of Bangs Lake complained to the Village of Wauconda about perceived sewage discharge into the channel. They said that there was a very foul odor and large chunks of brown material floating in the water. The Village of Wauconda Public Works stated that no discharge of raw sewage into the channel had occurred. The Lakes Management Unit was also called and brought into the investigation. On July 22, 2002, all Bangs Lake beaches were tested for *E. coli* concentrations. The results for all beaches were below the 235 *E. coli* colonies/100 mL limit, indicating that no sewage had been discharged into Bangs Lake near these beaches. Two Lakes Management Unit staff were then sent to conduct a more thorough investigation of the channel on July 25, 2002. The entire surface water area of the channel was covered with duckweed (*Lemna* sp.) and watermeal (*Wolffia* sp.), two very small aquatic plants that cover the water surface in a thick green mat. Some decaying algae was noted at several places in the channel, especially in the north and western sections. The channel smelled of decaying organic matter, particularly the floating mats of brown, decaying algae. A submersed aquatic plant, coontail (*Ceratophyllum demersum*), was present in high densities below the water surface. Two sampling sites were selected for testing of dissolved oxygen and one site was selected for collection of water for fecal coliform testing. Fecal coliform tests include the *E. coli* bacteria and are also used as an indicator of pathogens found in human and animal waste. Dissolved oxygen readings at both sites were below 2 mg/L at the surface and were near zero at the bottom. The fecal coliform sample was taken near the mouth of the channel (on the north side) and tested well below levels that would indicate the presence of raw sewage. Two large flocks of Canada geese were observed in the channel during sample collection. No signs of sewage in the channel were observed and it was determined that the visual and olfactory indications of raw sewage were the result of decaying algae and low dissolved oxygen levels. Decaying algae and plants, as were observed in late July, can give off an odor that is similar to raw sewage and can be very unpleasant. Additionally, low dissolved oxygen concentrations near the sediment surface can cause hydrogen sulfide to be released into the water column. When the water is disturbed, the gas is released into the air and has the distinct smell of rotten eggs. Considering the smell associated with small brown mats of decaying algae, it is not hard to understand why residents along the channel might think that raw sewage had been discharged into Circle Channel. However, careful testing and investigation revealed that no raw sewage had entered the channel and that the smells and sights were the result of natural plant and algae decay in a relatively stagnant area of the lake. Management steps to alleviate some of the problems concerning residents in the Circle Channel are being investigated by the Village of Wauconda.

LIMNOLOGICAL DATA – WATER QUALITY

Water samples collected from Bangs Lake were analyzed for a variety of water quality parameters (See Appendix B for methodology). Samples were collected at 3 foot and 25-28 foot depths (depending on site water depth) from the deep hole location in the lake (Figure 2). Bangs Lake was thermally stratified from June-August. 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= 0 mg/l) by mid-summer. This phenomenon is a natural occurrence in deep lakes and is not necessarily a bad thing if enough of the lake volume remains oxygenated. During the summer, the depth of the area of strongest stratification (thermocline) in Bangs Lake increased, indicating that the epilimnion was increasing in volume throughout the summer. In June, the thermocline was located between 10-12 feet and hypoxia (DO<1.0 mg/l) began below 16 feet. In July, the thermocline was between 16-18 feet and hypoxia began below 16 feet. By August, the thermocline had moved to between 22-24 feet and hypoxia began below 18 feet. The movement of the thermocline throughout the summer is both good and bad. A deeper thermocline means a smaller volume of water in the hypolimnion. A smaller hypolimnion can be beneficial because less of the water column is being depleted of dissolved oxygen and phosphorus is being released from a smaller area of sediment into a smaller volume of water. If the volume of phosphorus-rich water in the hypolimnion is not large, less phosphorus will be distributed into the epilimnion during fall turnover, reducing the severity of fall algae blooms. The potentially bad news is that the movement of the thermocline to a deeper depth means that the epilimnion is extending to a deeper depth and may be incorporating some oxygen-depleted, phosphorus-rich water into its volume. This is called entrainment and it can have negative effects on the nutrient levels of the epilimnion. When the epilimnion dips down into what was the hypolimnion, typically through wind action, it incorporates the phosphorus-rich water of the hypolimnion into the surface waters. This increases the overall phosphorus concentration in the epilimnion and can increase the likelihood of algae blooms during the summer.

Although it appears that entrainment was occurring and that 21% of the lake volume was incorporated into the epilimnion over the course of the summer, the surface waters of Bangs Lake remained well oxygenated during the summer. Near surface dissolved oxygen (DO) concentrations did not fall below 5.0 mg/l (a level below which most aquatic organisms become stressed) at any time during the study period. For most of the summer 89% of the lake volume (the volume at 14 feet and above) had a dissolved oxygen concentration of at least 5.0 mg/l, and 94% of the lake volume (the volume at 16 feet and above) was oxic (DO>1.0 mg/l). As a result, there was no threat to aquatic life in the lake, as nearly all of the lake volume was inhabitable by fish and other aquatic organisms. Additionally, very little sediment surface area (16.3%) experienced anoxic conditions, reducing the amount of phosphorus potentially released from the sediment.

Phosphorus is a nutrient that can enter lakes through runoff or be released from lake sediment, and high levels of phosphorus typically trigger algal blooms or produce high plant density. The average epilimnetic phosphorus concentration in Bangs Lake was 0.027 mg/l, while the hypolimnetic average phosphorus concentration was 0.062 mg/l (Table 1, Appendix A). Both were two to three times lower than the county median epilimnetic and hypolimnetic phosphorus concentrations of 0.056 mg/l and 0.170 mg/l, respectively. The hypolimnetic phosphorus concentration was over twice as high as the epilimnetic concentration. This is expected in a stratified lake. 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, known as internal phosphorus loading. 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 of the epilimnion only during fall turnover. However, if entrainment (mentioned prior) occurs, some of the phosphorus-rich hypolimnetic water may reach the surface water prior to fall turnover, increasing phosphorus concentrations over the summer. (This may be one possible explanation for the gradual increase in total phosphorus (TP) from June-August in the epilimnion of Bangs Lake). Fall turnover will then distribute all of the hypolimnetic phosphorus 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. The epilimnetic TP concentration in Bangs Lake was highest in September after fall turnover, and the increase caused a slight algae bloom at the end of the summer.

The average epilimnetic phosphorus concentration in 1997 (0.026 mg/l) was nearly identical to the 2002 concentration, and the 1997 average hypolimnetic concentration (0.056 mg/l) was only slightly lower than in 2002 (Table 1, Appendix A). The similarity in the average TP concentrations between the two years is a testimony to the high water quality of Bangs Lake and to efforts by the Village of Wauconda and other lake owners to prevent activities that might threaten the water quality of Bangs Lake. It is also noteworthy that the 1990 epilimnetic TP concentration was 0.029 mg/l and the hypolimnetic TP concentration was 0.057 mg/l. It is very unusual for a lake in Lake County, where residential and commercial development is so prevalent and has had detrimental impacts on many lakes, to maintain its epilimnetic and hypolimnetic TP levels over 12 years. The glacial origin and morphometry of Bangs Lake is certainly contributing to this stability. However, as mentioned above, the effort to protect the lake ecosystem as much as possible by preventing large-scale chemical treatment of the plant community and, to some degree, protecting the lake from over-development is the primary factor in maintaining nutrient and suspended solids concentrations.

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 epilimnetic TSS concentration in Bangs Lake (3.4 mg/l) was nearly half the median value for Lake County Lakes (6.0 mg/l). The low TSS values resulted in high water clarity, as evidenced by higher than average Secchi depth measurements that coincided with low TSS concentrations (Figure 3). A strong relationship existed between total phosphorus (TP) and TSS concentrations (Figure 4). Since total volatile solids (TVS, a measure of organic matter, such as algae, in the water column) concentrations were not strongly correlated with TSS concentrations, the relationship between TP and TSS indicates that clay particles with attached TP may have been the primary component of the TSS in the water column and that algae may have been a secondary component.

The average epilimnetic TSS concentration (3.4 mg/l) has increased (24%) when compared to 1997 and 1990 sampling concentrations (which were identical at 2.6 mg/l). However, at these low concentrations, such an increase may not even be perceptible to those using the lake, and the increase does not appear to have negatively impacted either TP concentrations or water clarity.

As a result of the low TP and TSS concentrations throughout the summer, Secchi depth (water clarity) on Bangs Lake was higher than the county median (3.81 feet) every month during the summer of 2002, and reached a maximum of 15.26 feet in May. This high water clarity allowed a healthy and relatively diverse plant community to thrive in Bangs Lake and helped to prevent algae dominance. Secchi depth measurements were collected and recorded by volunteer lake monitors (VLMs) in 1995, 1999 and 2000, and our past studies were conducted in 1990 and 1997. Although data from these four years does not provide an adequate indication of changes in water clarity, in general, average Secchi depth has not changed substantially over the past 12 years and has remained between approximately 6.0 and 9.0 feet (Figure 5). Differences in Secchi depth from year to year can result from a number of things including rainfall amounts, external phosphorus loading, percent plant coverage, or water temperature (which affects algae growth). The absence of significant change in the water clarity of Bangs Lake is, again, a very positive indicator that development and other activities in the watershed, and management activities on the lake over the years have not had negative impacts on the overall water quality of the lake. Although we have data from the VLMs in 1999 and 2000, this data is not representative of conditions over the entire summer. Secchi depth measurements are to be taken at least once per month by a VLM. The current VLM took only one Secchi depth reading during the entire summer of 2000 and does not seem to have collected any data in 2001 or 2002. Additionally, we do not believe that the measurement at Site 1 (2000) was accurate. The measurement was taken in August and the VLM recorded the Secchi depth of 31 feet, which was probably the lake depth at that site. During sampling in 2002, the highest Secchi depth was recorded in May and was less than half of the August reading that the VLM took in 2000. The Secchi reading in August 2002 was only 3.94 feet. A difference of this magnitude is unlikely, especially in August, when algae densities are near their peak. One would expect the highest reading to occur in May, before algae density increases and heavy boat traffic potentially stirs sediment into the water column.

It is recommended that a new VLM be assigned to Bangs Lake. This could potentially be another officer of the Marine Patrol Unit. These officers are out on the lake every day during the summer and could take just one of those days each month to measure water clarity in three different areas of the lake. Having accurate and consistent VLM data is very important, especially for a lake like Bangs Lake. The water quality is currently very good. However, an increasing number of residential developments are popping up along the shores of Bangs Lake and in its immediate watershed. Collecting water clarity data before many of these developments are completed can give baseline information on water quality. Changes in water clarity and quality can then be tracked over time and can give early warning of problems in the watershed. The Lakes Management Unit will not perform a full water quality study on Bangs Lake again until 2007. Having a quality VLM program 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.

Epilimnetic and hypolimnetic total Kjeldahl nitrogen (TKN) concentrations (0.96 mg/l and 1.34 mg/l, respectively) were much lower than the respective county medians of 1.170 mg/l and 2.150 mg/l. TKN is a measure of organic nitrogen, which is typically tied up in algae cells. The low concentrations found in Bangs Lake are further indication that the lake is not algae-dominated and that TSS consists primarily of sediment particles. The average hypolimnetic ammonia-nitrogen (NH_3-N) concentration (<0.53 mg/l) was also much lower than the county median (1.250 mg/l). Ammonia-nitrogen is naturally formed during anaerobic (no oxygen) organic decomposition by bacteria in the hypolimnion. High levels of NH_3-N may indicate that a large amount of organic matter was present in the lake before stratification and that a great deal of decomposition was occurring in the hypolimnion after anoxic conditions had become established. Conversely, low NH_3-N concentrations, as were observed in Bangs Lake, indicate that the sediment of Bangs Lake was not highly organic in much of the deep area of the lake.

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. Bangs Lake had an average TN:TP ratio of 36:1. This indicates that the lake is highly 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 Bangs Lake, are typically more sensitive to increases or decreases in phosphorus, and algae could become a problem with relatively small increases in TP. The 1997 TN:TP ratio was the same as the 2002 ratio, further indicating that very little change has occurred in the nutrient concentrations in the lake over the past five years. This is exceptional, and care should be taken to ensure that the nutrient concentrations continue to remain low.

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=40-49) 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=50-69) to hypereutrophic (TSI $\geq$70) lake conditions, typically characterized by high nutrient concentrations, high algal biomass, low DO levels, a rough fish population, and low water clarity. Bangs Lake had an average phosphorus TSI (TSIp) value of 51.7, indicating slightly eutrophic conditions. Although the lake falls into the eutrophic category, it does not exhibit many of the characteristics of eutrophic lakes mentioned above. This is likely the result of a diverse and healthy plant community. When the Secchi depth TSI (TSIsd) is calculated (47.1), Bangs Lake falls into the mesotrophic category, indicating a moderately enriched system with relatively good water quality. Water quality on Bangs Lake is higher than average and the lake ranked 22nd out of 103 lakes studied in Lake County. This may 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 2, Appendix A).

Most of the water quality parameters just discussed can be used to analyze the water quality of Bangs Lake based on use impairment indices established by the Illinois Environmental Protection Agency (IEPA). According to this index, Bangs Lake provides *Full* support of aquatic life and swimming, and *Partial* support of recreational activities (such as boating) as a result of a 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 these data are purely observational). Light level was measured at one-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, it can be determined how much of the lake has the potential to support aquatic plant growth. Depth of light intensity decreased throughout the summer as water clarity decreased.

However, based on 1% light level in May, Bangs Lake could have supported plants over approximately 90**%** of the lake. In actuality, plants grew over 72% of the lake area during 2002 and were found at a maximum depth of 16.3 feet. This number indicates growth by depth measurements only and does not indicate the density of plants able to grow over 72% of the lake. The inability of aquatic plants to grow in all areas they could have as determined by percent light level may be explained by the presence of inadequate substrate in various parts of the lake. This estimate does take into account some of the sand and gravel areas where no plants were able to grow. Twenty different plant species were present in Bangs Lake during the summer of 2002 (Tables 3 & 4). Only two of these (Eurasian watermilfoil (EWM) and curly leaf pondweed) were exotic species. As a result of high water clarity, much of the EWM and curly leaf pondweed was found at the deepest sampling sites. However, the plants did not reach the water surface and did not impede recreation in any way. The very healthy plant community provided Bangs Lake with excellent fish habitat and kept water clarity high by reducing sediment resuspension in the littoral zone and competing with planktonic algae for resources.

The last plant survey conducted on Bangs Lake was in 1998. Twenty-four plant species were found, including small amounts of *Nitella*, variable pondweed, American pondweed and northern watermilfoil, which were not present in 2002. Leafy pondweed was the only species present in 2002 that was not observed in 1998. Most plant species found during both years had decreased in occurrence since 1998. The only plant species that had increased in occurrence since 1998 were Eurasian watermilfoil and curly leaf pondweed, the two exotic species present in Bangs Lake. All native species either decreased (some dramatically) or remained at approximately the same density (Table 5, Appendix A). However, this may be a function of plant sampling methodology. The 1998 survey was concentrated in shallow areas of the lake and average sample depth was 2 feet shallower than in 2002. Many of the plant beds that were monostands of EWM were found in deeper water. This could make it falsely appear that EWM density increased dramatically and native plant densities decreased dramatically. Additionally, in 1998, it was reported that only 40% of the lake area was covered in plants, while in 2002, an estimated 72% of the lake area was covered with plants. This may also be explained by methodology, as the 1998 survey only reported coverage in those areas where plants were at nuisance levels and did not include areas covered by *Chara* only. Although EWM densities may have increased somewhat since 1998, the difference in percent coverage should not be taken at face value.

Weed harvesting has been carried out for removal of EWM and curly leaf pondweed for the past 10 years and a new weed harvester was just purchased for the lake in 2002. Harvesting was to be concentrated in areas where EWM and curly leaf pondweed are the densest. Although harvesting has been shown to increase the spread of EWM in many lakes through fragmentation of the plant, this management practice allows the harvester operator to be relatively selective in where he/she is removing plants and what types of plants are being removed. Unlike most lakes that are dominated by EWM and curly leaf pondweed, Bangs Lake has a wide variety of native plants mixed in with these two plants throughout the lake. In order to be as selective as possible in plant removal, the Lakes Management Unit recommends that a member of our staff train the 2003 harvester operator to recognize different plant species and help him/her understand what is acceptable and unacceptable in terms of plant removal. Additionally, because there are so many native plants growing among and around the EWM in the lake, the Lakes Management Unit recommends that an area of mixed plant species serve as a test plot for a pilot herbicide application in locations where herbicides are already used. The point of this test is to determine whether native plants would begin to grow in an area where selective herbicide application had removed all of the EWM. Oftentimes, either EWM or another exotic species will take over an area that has been cleared of plants through herbicide application. However, the plant community in Bangs Lake may respond differently, and native plant growth may replace EWM in these treated areas. If this is the case, the village may want to consider other test plots in subsequent years to gradually replace the EWM with native plant growth in many areas of the lake.

As mentioned above, Eurasian watermilfoil was the dominant plant in the lake in 2002, occurring at 59% of the plant sampling sites throughout the summer. This exotic plant species invaded Bangs Lake prior to 1990 and has been a dominant species in the plant community. In 1998, the milfoil weevil (*Euhrychiopsis lecontei*) was first observed 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. In 1998, the weevil had caused minimal damage to the EWM in Bangs Lake. On one occasion during the summer of 2002, LMU staff snorkeled the EWM beds along Lindy's Landing and Maiman's I and II. On August 8, 2002, EWM dominated the area around and north of Lindy's Landing. There was relatively good plant diversity in these areas and a moderate number of adult weevils and weevil eggs were found. However, overall, the EWM looked very healthy and weevil density was low. Maiman's I and II were dominated by wild celery, but had large beds of EWM relatively far from shore. The EWM in this area was flowering, a sign that weevil density was not high. Only a few damaged stems were observed and there was no sign of either eggs or adults. EWM looked healthy here as well. Snorkeling surveys performed on June 29 and August 10, 2001 had revealed similar results. Plant diversity was relatively high, but weevil density was low and EWM dominated the areas surveyed. The reasons for weevil success or failure in controlling EWM are still being researched and there are no definite answers at this time. Research has shown that approximately 1-2 weevils per stem are needed in order to see significant damage and decline of a EWM bed. Weevil density in Bangs Lake has not been quantitatively analyzed, but qualitative surveys suggest that the weevil density is not at this level. Harvesting activities may be negatively impacting the weevil population by removing the weevils along with the plants. However, ceasing harvesting activities at this time is not recommended for Bangs Lake. It is possible that with time, the weevil population may increase in some shallow areas that the harvester should not impact and these areas should be monitored and protected. But, at this time, the milfoil weevil does not appear to be decreasing or controlling the EWM in Bangs Lake.

Of the thirty five emergent plant and trees species observed along the shoreline of Bangs Lake, four (teasel, purple loosestrife, reed canary grass, and buckthorn) are invasive species that do not provide ideal wildlife habitat and have the potential to dominate the emergent plant community.

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 2000-2002 Lake County lakes is 14.2. Bangs Lake has an FQI of 27.3, the 4^{th} highest of all county lakes studied since 2000. This is a slight improvement from 1998, when the FQI was 26.9. Despite the dominance by EWM, the high diversity of plant species places Bangs Lake well above the average lake, by Lake County standards.

Table 3. Aquatic and shoreline plants on Bangs Lake, May-September 2002.

Aquatic Plants	
Chara	*Chara* sp.
Coontail	*Ceratophyllum demersum*
Elodea	*Elodea canadensis*
Water Stargrass	*Heteranthera dubia*
Duckweed	*Lemna minor*
Eurasian Watermilfoil	*Myriophyllum spicatum*
Slender Naiad	*Najas flexilis*
Spatterdock	*Nuphar variegatta*
White Water Lily	*Nymphaea tuberosa*
Largeleaf Pondweed	*Potamogeton amplifolius*
Curlyleaf Pondweed	*Potamogeton crispus*
Leafy Pondweed	*Potamogeton foliosus*
Illinois Pondweed	*Potamogeton illinoensis*
Small Pondweed	*Potamogeton pusillus*
Flatstem Pondweed	*Potamogeton zosterifomis*
White Water Crowsfoot	*Ranunculus longirostris*
Grass-leaved Arrowhead	*Sagittaria graminea*
Sago Pondweed	*Potamogeton pectinatus*
Eel Grass	*Vallisneria americana*
Watermeal	*Wolffia columbiana*
Shoreline Plants	
Ragweed	*Ambrosia bidentata*
Big Bluestem	*Andropogon gerardii*
Marsh Milkweed	*Asclepaias incaruta*
Common Teasel	*Dipsacus sylvestris*
Joe-Pye Weed	*Eupatorium maculatum*

Table 3. Aquatic and shoreline plants on Bangs Lake, May-September 2002 (cont'd).

True Boneset	*Eupatorium perfoliatum*
Jewelweed	*Impatiens pallida*
Morningglory	*Ipomoea* spp.
Blue Flag Iris	*Iris hexagona*
Common Juniper	*Juniperus communis*
Purple Loosestrife	*Lythrum salicaria*
White Evening Primrose	*Oenothera nuttallii*
Reed Canary Grass	*Phalaris arundinacea*
Common Reed	*Phragmites australis*
Swamp Smartweed	*Polygonum coccineum*
Shoreline Plants	
Black-Eyed Susan	*Rudbeckia hirta*
Chairmaker's Rush	*Scirpus pungens*
Rigid Goldenrod	*Solidago rigida*
Prairie Cord Grass	*Spartina pectinata*
Common Cattail	*Typha latifolia*
Blue Vervain	*Verbena hastate*
Wild Grape	*Vitis aestivalis*
Trees/Shrubs	
Box Elder	*Acer negundo*
Silver Maple	*Acer saccharinum*
Birch	*Betula* sp.
Black Walnut	*Juglans nigra*
Mulberry	*Morus* sp.
Sycamore	*Platanus occidentalis*
Cottonwood	*Populus deltoides*
Poplar	*Populus* sp.
Wild Black Cherry	*Prunus serotina*
Common Buckthorn	*Rhamnus cathartica*
Weeping Willow	*Salix alba tristis*
Elderberry	*Sambucus* sp.
American Elm	*Ulmus Americana*

LIMNOLOGICAL DATA – SHORELINE ASSESSMENT

A shoreline assessment was conducted at Bangs Lake on September 5, 2002. 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 71% of Bangs Lake's shoreline is developed and the majority of the developed shoreline is comprised of seawall (30.5%) and buffer (21%) (Figure 6). The remainder of the developed shoreline consists of beach (19.8%), manicured lawn (15.5%), rip rap (6.9%), woodland (3.2%), shrub (1.7%) and wetland (1.3%). The undeveloped portions of the lake are made up of wetland, woodland and buffer. Manicured lawn is considered undesirable because it provides a poor shoreline-water interface due to the poor root structure of turf grasses. These grasses are incapable of stabilizing the shoreline and typically lead to erosion. 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 not an ideal shoreline type with regard to wildlife habitat, it can also help to prevent shoreline erosion. Woodland, wetland and buffer are the most desirable shoreline types, providing wildlife habitat and, typically, protecting the shore from excessive erosion. The high percentage of buffered shoreline is very encouraging and this type of practice among homeowners should continue to be encouraged as new developments are built along the shoreline. Although seawalled shoreline dominated the developed portions of the lake, the most prevalent overall shoreline type was wetland (28.3%). As a result of the dominance of wetland and buffered shorelines, 93.1% of Bangs Lake's shoreline exhibited no erosion. Slight erosion was occurring primarily along shrub dominated shoreline that had not been properly maintained, while beaches and manicured lawns exhibited much of the remainder of the erosion (Figure 7). Wetland, buffer and woodland shorelines should be maintained as much as possible, and the addition of manicured lawns, seawalls and rip rap should be discouraged.

The water level of Bangs Lake has been a hotly debated subject recently, as some members of the Bangs Lake Management Committee would like to add more boards across the current spillway to increase the amount of water that could be stored in Bangs Lake. Other members of the Committee would like to see the lake remain at its current level. Water level measurements were collected each week from June through October by a member of the Management Committee (Table 6, Appendix A). On June 1, 2002, the water level was at the top of the board that had been installed on top of the concrete spillway. Between June 1 and June 8, a total of 3.5-4.0 inches of rain fell, increasing the lake level by nearly ½ foot. It was two weeks before the water level returned to that level prior to the rain. After the heavy rain event in June, water levels fell gradually throughout the summer to a level approximately one foot below the top of the board (0.625 feet below the top of the spillway). A series of rain events toward the end of August caused another surge in water level by nearly ½ foot of the previous week's level. The concern of the Lake's Management Unit is in these relatively large surges in water level that occur with a moderate to large rain event and the amount of time it takes for the water level to return to its previous point. Although the gradual drop in water level over the course of the summer seems significant to some members of the Management Committee who want to store more water, many lakes in the county drop by a much larger amount (18-24 inches) over the course of the summer. The one foot drop only equals a decrease in surface area of about 5% over the entire lake. The greater concern may be in flooding of surrounding shorelines during wet summers. Depending on the

topography of the shoreline around the lake, the dramatic increases in water level observed during spring and summer rain events could result in flooding of park and beach areas, and possibly homes. It is recommended that, before any decisions are made to add more boards to the spillway structure of Bangs Lake, a topographic survey of the shoreline be conducted at one foot intervals up to a five foot elevation above the current water level. This will give an accurate indication of where flooding may occur if the lake level is artificially increased.

Although almost no erosion was occurring around Bangs Lake, invasive plant species, including reed canary grass, buckthorn and purple loosestrife were present along 40.5% of the shoreline. These plants are extremely invasive and exclude native plants from the areas they inhabit. Buckthorn provides very poor shoreline stabilization and may lead to increasing erosion problems in the future. Reed canary grass and purple loosestrife inhabit mostly wetland areas and can easily outcompete native plants. Additionally, they do not provide the quality wildlife habitat or shoreline stabilization that native plants provide. Purple loosestrife was the most abundant of these three species and occurred in many of the wetland areas. However, the relative density of these three invasive plants was not extremely high along most areas of Bangs Lake, and steps to eliminate these plants should be carried out before purple loosestrife escalates into a larger problem or reed canary grass or buckthorn become a nuisance.

LIMNOLOGICAL DATA – WILDLIFE ASSESSMENT

During the 1980’s, an extensive stocking program was carried out by various interests in the community. Stocking efforts from 1983-1990 included 2,070 large mouth bass between 1983 and 1985, 7,500 walleye between 1985 and 1989, 2,100 northern pike from 1986-1988 and 1,250 channel catfish in 1988. In the 1990’s, catfish and walleye continued to be stocked, along with northern pike. There were 700 northern pike stocked in 2001. No stocking occurred in 2002. Fisheries assessments have also been conducted on Bangs Lake for many years. The most recent assessments date back to 1990, when Max McGraw Wildlife Foundation conducted night electroshocking on June 18 and 19. Sixteen different fish species were found for a total of 367 fish. Bluegills were the most abundant species collected (72.5%), followed by largemouth bass (12.6%) and yellow bass (7.6%). The sample included only one walleye and no northern pike, as these are difficult to shock and may not be indicative of quantity. Overabundance of bluegill and limited natural reproduction in walleye and pike were the main problems noted. In 1992 and 1997, the Illinois Department of Natural Resources (IDNR) conducted a fish survey through electroshocking, gill nets and trap nets. In 1997, a total of 294 fish, comprising 16 species were collected. Compared to the 1992 survey, species number in 1997 declined from 23 species (absent from the 1997 survey were warmouth, channel catfish, brown and yellow bullheads, spotfin shiner, blackchin shiner, banded killifish and white sucker). The small number or size of the fish and the low water temperature at the time of the survey may explain these results. Bluegill was the dominant species in 1992 and 1997, although the population had experienced a decrease in abundance from 61% to 46%. Largemouth bass had increased substantially from 9% in 1992 to 21% in 1997.

The remainder of the fishery exhibited relatively stable to slight changes in abundance. The presence of two state threatened species, the blackchin shiner and banded killifish in 1992, and of one state endangered species, the blacknose shiner in 1997, was noted and it was recommended that the presence of these fish be considered in lake management decisions. In a fish survey conducted by the Illinois Natural History Survey and the Lakes Management Unit in 1998, 298 fish comprising 20 species were collected. All three threatened/endangered fish species were found, along with another state endangered species, the Iowa darter. Only seining nets were used in this survey and collection was concentrated in shallow areas. In 2002, another IDNR fish survey was performed using electroshocking, trapnets and gillnets. A total of 291 fish comprising 15 species were collected. Of the four threatened/endangered species, only the blacknose shiner was found in 2002. This is likely a function of the sampling technique used, which is not appropriate to sample very small fish in shallow areas. Largemouth bass and bluegill dominated the fish community. According to the survey, there has been no appreciable difference in the overall bass population in Bangs Lake relative to basic population analysis over the past 10 years. What has changed is that fewer age classes are present and older fish have dropped out of the population. There are strong year classes carrying through, which should provide both reproductive potential and catchability as they get older. Bluegill, black crappie and yellow perch were of similar size distribution and abundance as past surveys. The northern pike population appeared to be balanced and made up of a variety of age classes. Recommendations by the IDNR included a largemouth bass creel of 1-3 fish and 15 inch length limit, allowing the harvest of panfish in order to reduce overpopulation, and another fish survey in 2003 or 2004 to assess whether sampling error missed larger fish and the small threatened/endangered fish species.

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 high around Bangs Lake, a moderate number of wildlife species were observed, including the state endangered osprey (Table 7). A larger number of high quality songbirds and waterfowl would probably take advantage of the high water quality and plant community of Bangs Lake if the abundance of residential shoreline around the lake was lower. However, considering how developed the lake is, the number of wildlife species is encouraging. The maintenance of wetland and buffered shorelines and the establishment of additional buffer strips (especially along the shoreline of newly developed areas) is very important and strongly recommended to provide the appropriate habitat for birds and other animals in the future.

Table 7. Wildlife species observed at Bangs Lake, May-September 2002.

Birds	
Common Loon	*Gavia immer*
Canada Goose	*Branta canadensis*
Mallards	*Anas platyrhnchos*
Ring-billed Gull	*Larus delawarensis*
Herring Gull	*Larus argentatus*
Great Blue Heron	*Ardea herodias*
Cooper's Hawk	*Accipiter cooperii*
Osprey*	*Pandion haliaetus*
Common Flicker	*Colaptes auratus*
Eastern Kingbird	*Tyrannus verticalis*
Cliff Swallow	*Petrochelidon pyrrhonota*
Barn Swallow	*Hirundo rustica*
American Crow	*Corvus brachyrhynchos*
Blue Jay	*Cyanocitta cristata*
Red-eyed Vireo	*Vireo olivaceus*
Warbling Vireo	*Vireo gilvus*
Yellow Warbler	*Dendroica petechia*
Tennessee Warbler	*Vermivora peregrina*
Red-winged Blackbird	*Agelaius phoeniceus*
House Sparrow	*Passer domesticus*
Song Sparrow	*Melospiza melodia*
Amphibians	
Green Frog	*Rana clamitans melanota*

*Endangered in Illinois

EXISTING LAKE QUALITY PROBLEMS

- *Inadequate 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, 150-200 lakes (out of 3,041 lakes in Illinois) are sampled by approximately 250 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. Although Bangs Lake does participate in the VLMP, data collection has been sporadic and the quality of data collection is suspect. The high water quality of Bangs Lake and the increasing development along the lake and in the watershed makes the existence of a VLMP on the lake even more important. This will enable a water quality history beyond LMU data to be developed and tracked as time goes on and more development occurs.

- *Canada Geese*

  Large numbers of Canada Geese were observed on various areas of Bangs Lake throughout the summer. These birds, once heavily hunted by wolf, coyote and man, now experience a nearly predator-free environment on many of our lakes. They are drawn to the manicured lawns along many of our shorelines, as these provide easy access to the water and a clear view for sighting predators. Geese reproduce prolifically and flocks can number in the hundreds. They can tear up grassy areas through their feeding, causing erosion, and they can contribute a large amount of phosphorus to the water through their feces. Goose feces contains a very high concentration of phosphorus and one goose can produce 0.072 pounds of fecal matter per day. A flock of 100 geese can, therefore, produce over 7 pounds of feces per day on a lakeshore. This fecal matter (and the phosphorus it contains) will eventually end up in the lake by leaching into the soil and/or being carried into the water via runoff. Currently, an egg addling program is being carried out by the Lakeview Villa Association along their property. In 2002, 32-33 eggs were addled (100% of eggs per nest found). This is the eighth or ninth year that they have been conducting this activity and the feeling is that it is definitely working to reduce the population on their property. The Lakeview Villa Association has a permit to addle eggs and can perform this service on other properties if those property owners also obtain a permit.

- *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. Purple loosestrife is responsible for the "sea of purple" seen along roadsides and in wetlands during summer. It can quickly dominate a wetland or shoreline. Due in part to an extensive root system, large seed production (estimates range from 100,000 to 2.7 million per plant), and high seed germination rate, purple loosestrife spreads quickly. Buckthorn is an aggressive shrub species that grows along lake shorelines as well as most upland habitats. It shades out other plants and is quick to become established on disturbed soils. Purple loosestrife, buckthorn and reed canary grass (another exotic species) are present along 40.5% of the shoreline of Bangs Lake and attempts should be made to control their spread.

- *Limited Wildlife Habitat*

  Although a relatively large amount of shoreline is dominated by wetland and buffer, much of Bangs Lake's shoreline is dominated by residential homes, which do not always encourage a diverse bird and animal community. Additionally, new residential development is ongoing on Bang's Lake, and will soon replace much of the wetland areas noted during the 2002 survey. Many of the residents along Bangs Lake already have buffer strips in place along their property's shoreline. However, many of the residents also have seawalls 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 and the residents of homes currently being built on the lake consider planting 10-20 feet of native plants along their shoreline.

POTENTIAL OBJECTIVES FOR THE BANGS LAKE MANAGEMENT PLAN

I. Increase Participation in the Volunteer Lake Monitoring Program
II. Alleviate Excessive Numbers of Canada Geese (*Branta canadensis*)
III. Eliminate or Control Exotic Species
IV. Enhance Wildlife Habitat Conditions

Objective I: Increase 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, 150-200 lakes (out of 3,041 lakes in Illinois) are sampled by approximately 250 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.

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.

Bangs Lake currently has a VLMP. However, data collection during the past several years has been sporadic or non-existent. It is strongly recommended that the current VLMP be replaced by a lake resident or another member of the Wauconda Marine Unit who has made a commitment to collect data each month from May-September and to carry this task out consistently each year until he or she is not longer able. Additionally, a program should be implemented to train a new VLMP in an efficient manner once the current volunteer is no longer able to perform data collection.

For more information about the VLMP contact the VLMP Regional Coordinator:

Holly Hudson
Northeast Illinois Planning Commission
222 S. Riverside Plaza, Suite 1800
Chicago, IL 60606
(312) 454-0401 ext. 302

Objective II: Alleviate Excessive Numbers of Canada Geese (*Branta canadensis*)

Canada geese are migratory waterfowl common throughout North America. Geese in urban areas can be undesirable primarily due to the large amount of feces they leave behind. Recreational activities on lawns and parks are impeded due to goose feces. Large amounts of feces may end up in the water, either directly from geese on the water or rainwater runoff from lawns where feces have accumulated. Goose feces is high in organic phosphorus. High nutrient levels, particularly phosphorus, can contribute to excessive algae growth in lakes. This may inhibit other recreational activities such as boating or swimming, as well as create poor habitat for fish and wildlife, and possibly bad odors when the algae decays.

Geese become problematic for many reasons. They seek locations that have open water, adequate food supplies, and safety from predators. If these factors are present, geese may not migrate. Since geese exhibit a high level of site fidelity, they return to (or stay at) the same area each year. Thus, adults will likely come back to the same area year after year to nest. If conditions remain optimal, one pair of geese can quickly multiply, causing additional problems. Increased development in Lake County has inadvertently created ideal habitat for goose populations. Manicured lawns mowed to the edge of lakes and detention ponds provide geese with open areas with ample food and security. Other conditions that encourage goose residency include open water during winter (primarily the result of aerators in lakes and ponds), mild winters, and people feeding birds with bread or similar human food.

Large populations of geese pose a potential disease threat both to resident and wild populations of waterfowl. This problem may be more serious in residential populations since these birds stay in one area for long periods of time are more likely to transmit any disease to neighboring groups of geese. There is no threat of disease transmission to humans or domestic dogs and cats since most of the diseases are specific to birds.

Option 1: No Action

Pros

This option has no costs, however, increasing numbers of geese will most likely exacerbate existing problems and probably create new ones, which in the future may cost more than if the problems are addressed immediately.

Cons

If current conditions continue and no action is taken, numbers of Canada Geese and problems associated with them will likely increase. An increase of goose feces washed into a lake will increase the lake's nutrient load and eventually may have a detrimental impact on water quality through excessive algae growth. One study (Manny et al. 1975) documented that a goose excretes 0.072 lbs of feces per day. This may not seem like a significant amount, but if 100 geese are present (many lakes in the county can experience 1,000 or more at a time) that equates to over 7 lbs of feces per day! Algae blooms may negatively impact recreational uses such as swimming, boating, and fishing. In addition, when algae dies, odor problems and depleted oxygen levels in the water occur. Increased numbers of geese may also result in overgrazed areas of grass.

Costs

There are a few short-term financial costs with this option. Costs of cleaning feces off lawns or piers are probably more psychological or physical than financial. Long-term costs may be more indirect, including increased nutrient deposition into lakes, which may promote excessive algae and plants. Costs incurred may include money needed to control algae with algaecides.

Option 2: Removal

Since Canada Geese are considered migratory waterfowl, both state and federal laws restrict taking or harassing geese. Under the federal Migratory Bird Treaty Act, it is illegal to kill or capture geese outside a legal hunting season or to harass their nests without a permit. If removal of problematic geese is warranted or if nest and egg destruction is an option, permits need to be obtained from the Illinois Department of Natural Resources (217- 782-6384) and the U.S. Fish and Wildlife Service (217-241-6700).

Hunting is one of the most effective techniques used in goose management. However, since many municipalities have ordinances prohibiting the discharge of firearms, reduction of goose numbers by hunting in urban areas (i.e., lakes, ponds, and parks) may not be an option. Hunting does occur on many lakes in the county, but certain regulations apply (e.g., 100 yard minimum distance from any residential property). Contact the Illinois Department of Natural Resources for dates and regulations regarding the waterfowl hunting seasons. Also, contact local and county law enforcement agencies regarding any ordinances concerning hunting within municipal boundaries.

Egg addling, or destroying the egg by shaking, piercing, or freezing, can be used to reduce or eliminate a successful clutch. Eggs should be returned to the nest so the hen goose does not re-lay another clutch. However, if no eggs hatch, she may still lay another clutch. Leaving one or two eggs unaltered and allowing them to hatch may prevent another clutch from being laid and reduces the total year’s reproduction. Egg addling requires a state and federal permit. Currently, an egg addling program is being carried out by the Lakeview Villa Association along their property. In 2002, 32-33 eggs were addled (100% of eggs per nest found). This is the eighth or ninth year that they have been conducting this activity and the feeling is that it is definitely working to reduce the population on their property. The Lakeview Villa Association has a permit to addle eggs and can perform this service on other properties if those property owners also obtain a permit.

The capture and relocation of geese is no longer a desirable option. First, relocated geese may return to the same location where they were captured. Second, there is a concern over potential disease transmission from relocated geese to other goose populations. Finally, since goose numbers in Illinois are already high there is no need to supplement other populations in the area.

Pros
Removing a significant portion of a problem goose population can have a positive effect on the overall health of a lake. Reduction of feces on lawns and parks is beneficial to recreation users of all types. Less feces in the water means less phosphorus available for nuisance plant and algae growth. Thus, the overall water quality of the lake may be improved by this reduction in phosphorus.

Cons
If the habitat conditions still exist, more geese will likely replace any that were removed. Thus, money and time used removing geese may not be well spent unless there is a change in habitat conditions.

Costs
A Illinois residential waterfowl hunting license (including state and federal waterfowl stamps) is $39.00 for the 2001-2002 hunting season. For depredation permits, there is a $25 fee for the federal permit. Once the federal permit is issued the state permit can be obtained at no charge.

Option 3: Dispersal/Repellent Techniques

Several techniques and products are on the market that claim to disperse or deter geese from using an area. These techniques can be divided into two categories: harassment and chemical. With both types of techniques it is important to implement any action early in the season, before geese establish territories and begin nesting. Once established, the dispersal/repellant techniques may be less effective and geese more difficult to coerce into leaving.

The goal with harassment techniques is to frighten geese from an area using sounds or objects. Various products are available that simulate natural predators (i.e., plastic hawks and owls) or otherwise make geese nervous (i.e., balloons, shiny tape, and flags). Other products emit noises, such as propane cannons, which can be set on a timer to go off at programmed intervals (e.g., every 20-30 seconds), or recorded goose distress calls which can be played back over a loudspeaker or tape player. Over time these techniques may be ineffective, since geese become acclimated to these devices. Most of these products are more effective when used in combination with other techniques.

Another technique that has become popular is using dogs or swans to harass geese. Dogs can be used primarily in the spring and fall to keep birds from using an area by herding or chasing geese away from a particular area. Any dogs used for this purpose should be well trained and under the owners control at all times. Professional trainers can be contracted to use their dogs for this purpose. Dogs should not be used during the summer when geese are unable to fly due to molting. Swans are used because they are naturally aggressive in defending their territory, including chasing other waterfowl away from their nesting area. Since wild swans cannot be used for this technique, non-native mute swans are used. However, mute swans are not as aggressive and in some case are permissive of geese. Again, using a combination of techniques would be most effective.

Chemical repellents can be used with some effectiveness. New products are continually coming out that claim to rid an area of nuisance geese. Several products (ReJeX-iT® and GooseChase™) are made from methyl-anthranilate, a natural occurring compound, and can be sprayed on areas where geese are feeding. The spray makes the grass distasteful and forces geese to move elsewhere to feed. Another product, Flight Control™, works similarly, but has the additional benefit of absorbing ultra violet light making the grass appear as if it was not a food source. The sprays need to be reapplied every 14-30 days, depending upon weather conditions and mowing frequency.

Pros

With persistence, harassment and/or use of repellants can result in reduced or minimal usage of an area by geese. Fewer geese may mean less feces and cleaner yards and parks, which may increase recreational uses along shorelines. If large numbers of geese were once present, the reduction of fecal deposits into the lake may help minimize the amount of phosphorus entering the water. Less phosphorus in the water means less "food" available for plant and algae growth, which may have a positive effect of water quality. Finally, any areas overgrazed by geese may have a chance to recover.

Cons

The effectiveness of harassment techniques is reduced over time since geese will adapt to the devices. However, their effectiveness can be extended if the devices are moved to different locations periodically, or used in conjunction with other techniques.

Use of dogs can be time consuming, since the dog must be trained and taken care of. Dogs must also be used frequently in the beginning of the season to be effective at deterring geese. This requires time of the dog owner as well. Dogs (frequently herding dogs, like border collies) that are effective at harassing or herding geese are typically not the best pets for the average homeowner. They are bred as working dogs and consequently have high levels of energy that require the owner's attention.

Repelling or chasing away geese from an area only solves the goose problem for that area and most likely moves the geese (and the problem) to another area. As long as there is suitable habitat nearby, the geese will not wander very far.

Costs

Costs for the propane cannons are approximately $660 ($360 for the cannon, $300 for a timer), not including the propane tank. The cost of ReJeX-iT® is $70/gallon, GooseChase™ is $92/gallon, and Flight Control™ costs $200/gallon. One gallon covers one acre of turf using ReJeX-iT® and, GooseChase™, and two acres using Flight Control™.

Option 4: Exclusion

Erecting a barrier to exclude geese is another option. In addition to a traditional wood or wire fence, an effective exclusion control is to suspend netting over the area where geese are unwanted. Geese are reluctant to fly or walk into the area. A similar deterrent that is often used is a single string or wire suspended a foot or so above the ground along the length of the shoreline.

Pros

Depending on the type of barrier used, areas of exclusion will have less fecal mess and may have higher recreational uses. Vegetation that was overgrazed by geese may also be able to recover.

Cons

This technique will not be effective if the geese are using a large area. Also, use of the area by people is severely limited if netting is installed. Fences can also limit recreational uses. The single string or wire method may be effective at first, but geese often learn to go around, over, or under the string after a short period of time. Finally, excluding geese from one area will force them to another area on a different part of the same lake or another nearby lake. While this solves one property owners problem, it creates one (or makes one worse) for another. Also, problems associated with excess feces entering the lake (i.e., increased phosphorus levels) will continue.

Costs

The costs of these techniques are minimal, unless a wood or wire fence is constructed. String, wire, or netting can be purchased or made from materials at local stores.

Option 5: Habitat Alteration

One of the best methods to deter geese from using an area is through habitat alteration. Habitats that consist of mowed turfgrass to the edge of the shoreline are ideal for geese. Low vegetation near the water allows geese to feed and provides a wide view with which to see potential predators. In general, geese do not favor habitats with tall vegetation. To achieve this, create a buffer strip (approximately 10-20 feet wide) between the shoreline and any mowed lawn. Planting natural shoreline vegetation (i.e., bulrushes, cattails, rushes, grasses, shrubs, and trees, etc.) or allowing the vegetation to establish naturally can create buffer strips. Table 7 (Appendix A) has a list of native plants, seeding rates, and approximate costs that can be used when creating buffer strips.

Geese prefer ponds and lakes that have shorelines with gentle slopes to ones with steep slopes. While this alone will not prevent geese from using an area, steeper slopes used along with other techniques will be more effective. This option may not be practical for existing lake shorelines since any grading and/or filling would require permits and surveys, which would drive up the costs of redoing the shoreline considerably.

Aeration systems that run into the fall and winter prevent the lake from freezing, thus not forcing geese to migrate elsewhere. To alleviate this problem, turn aerators off during fall and early winter. Once the lake freezes over and the geese have left, wait a few weeks before turning the aerators on again if needed.

Pros

Altering the habitat in an area can not only make the habitat less desirable for geese, but may be more desirable for many other species of wildlife. A buffer strip has additional benefits by filtering run-off of nutrients, sediments, and pollutants and protecting the shoreline from erosion from wind, wave, or ice action. Finally, the more of the area that is in natural vegetation, the less turfgrass that needs to be constantly manicured and maintained.

Cons

Converting a portion or all of an area to tall grass or shrub habitat may reduce the lake access or visibility. However, if this occurs, a small path can be made to the lake or shorter plants may be used at the access location in the buffer strip.

Costs

If minimal amount of site preparation is needed to create a buffer strip, costs can be approximately $10 per linear foot, plus labor. The labor that is needed can be completed by the property owner in most cases, although consultants can be used to provide technical advice where needed. This cost will be higher if the area needs to be graded. If grading is necessary, appropriate permits and surveys are needed. If filling is required, additional costs will be incurred if compensatory storage is needed. Compensatory storage is the process of excavating in a portion of a property or floodplain to compensate for the filling in of another portion of the floodplain. The permitting process is costly, running as high as $1,000-2,000 depending on the types of permits needed.

Once established, a buffer strip of native plants needs little maintenance. If aerators are not run for several months, there will be a reduction in electrical costs.

<u>Option 6: Do Not Feed Waterfowl!</u>

There are few “good things”, if any, that come from feeding waterfowl. Birds become dependent on handouts, become semi-domesticated, and do not migrate. This causes populations to increase and concentrate, which may create additional problems such as diseases within waterfowl populations. The nutritional value in many of the “foods” (i.e., white bread) given to geese and other waterfowl are quite low. Since geese are physiologically adapted to eat a variety of foods, they can actually be harmed by filling-up on human food. Geese that are accustomed to hand feeding may become aggressive toward other geese or even the people feeding the geese.

Costs

There are no costs to this option, except the public education that is needed to encourage people not to feed waterfowl. In some cases, signs could be posted to discourage waterfowl feeding.

Reference:

Manny, B. A., R. G. Wetzel, and W. C. Johnson. 1975. Annual contribution of carbon, nitrogen, and phosphorus by migrant Canada geese to a hardwater lake. Verh. Internat. Verein. Limnol. 19:949-951.

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.

Purple loosestrife is responsible for the "sea of purple" seen along roadsides and in wetlands during summer. It can quickly dominate a wetland or shoreline. Due in part to an extensive root system, large seed production (estimates range from 100,000 to 2.7 million seeds per plant), and high seed germination rate, purple loosestrife spreads quickly. Buckthorn is an aggressive shrub species that grows along lake shorelines as well as most upland habitats. It shades out other plants and is quick to become established on disturbed soils. Reed canary grass is an aggressive plant that 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 purple loosestrife, 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*).

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. However, problems arise when plants are left to spread, many times to the point where treatment is difficult or cost prohibitive. A monitoring program should be established, problem areas identified, and control measures taken when appropriate. This is particularly important in remote areas of lake shorelines where the spread of exotic species may go unnoticed for some time.

Option 1: No Action

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 when possible. A table 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 zero 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 beetles (*Galerucella pusilla* and *G. calmariensis*) and two weevils (*Hylobius transversovittatus* and *Nanophyes marmoratus*) have offered some hope to control purple loosestrife by natural means. These insects feed on either the leaves or juices of purple loosestrife, eventually weakening or killing the plant. In large stands of loosestrife, the beetles and weevils naturally reproduce and in many locations, significantly retard 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.

Pros

Control of exotics by a natural mechanism if preferable to chemical treatments. Insects, being part of the same ecological system as the exotic (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 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 Department of Natural Resources at Cornell University (607-255-2821) sells overwintering adult beetles (which will lay eggs the year of release) for $2 per beetle and new generation beetles (which will lay eggs beginning the following year) at $0.25 per beetle. Some beetles may be available for free by contacting the Illinois Natural History Survey (217-333-6846).

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. 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 4: 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 unpractical (i.e., large expanses of a wetland or woodland), chemical treatments may not be an option due to the fact that in order to chemically treat the area a broadcast application would be needed. Since many of the herbicides that are used 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 a herbicide soaked device. Trees are normally treated by cutting a ring in the bark (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® or Round-up™), cost approximately $100 and $65 per gallon, 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.

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 effects 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 7, 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 the table in 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.