2004 SUMMARY REPORT
of
LUCY LAKE

Lake County, Illinois

Prepared by the

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EXECUTIVE SUMMARY

Lucy Lake is located in the Village of Deer Park with Charlie Brown Park bordering the lake on the west side. The lake has a surface area of 8.2 acres and mean and maximum depths of 13.5 feet and 27 feet, respectively. However, these numbers are deceptive, as the morphometry of Lucy Lake is quite unique. Approximately half of the lake is about two feet deep, while the other half ranges from about five feet to 27 feet in depth. Considering the data collected on various depths throughout Lucy Lake, the average depth is probably closer to nine feet. Lucy Lake is managed by the Village of Deer Park, who also owns Charlie Brown Park. The lake is used by residents and park visitors for non-motorized boating, fishing and aesthetics.

Water quality parameters, such as nutrients, suspended solids, oxygen, temperature and water clarity were measured and the plant community was assessed each month from May-September 2004. The deep half of Lucy Lake thermally stratified in 2004. The average epilimnetic phosphorus level was lower than the Lake County median, and concentrations fluctuated throughout the summer. The average hypolimnetic phosphorus concentration was much higher than the county median and increased dramatically all summer. Epilimnetic total suspended solids (TSS) concentrations were moderately high, and were closely related to total phosphorus (TP) concentrations. The main source of TP and TSS to the lake appears to be internal, and is likely a combination of resuspended sediment from common carp activities in the shallow section of the lake and chemical reactions that cause phosphorus to release from the sediment in the deep part of the lake. Secchi depths (water clarities) were moderate throughout the summer, and corresponded with increases and decreases in epilimnetic TSS concentrations. The conductivity level in May was the highest of all the months, indicating that the road salt concentration in spring runoff is high. Conductivity levels decreased from May to August, but increased again in September, suggesting that evaporation may be affecting levels later in the summer.

Few plant species are present in Lucy Lake. Curly leaf pondweed and sago pondweed dominated the plant community with water smartweed, *Chara sp.* and flatstem pondweed in small beds in the same areas of the lake all summer. The shallow part of the lake contained the majority of the plants throughout the summer. A large carp population exists in Lucy Lake, which may be preventing the establishment of higher quality plant species. Additionally, much of the lake bottom on the deep side is relatively hard and therefore may not support plants as well as more flocculent substrate.

Slight to moderate erosion was occurring along the manicured lawns and poorly maintained woodland around Lucy Lake. Additionally, buckthorn, honeysuckle, purple loosestrife and reed canary grass were present along the shoreline. These are exotic plant species that out-compete native vegetation and provide poor habitat for wildlife.

LAKE IDENTIFICATION AND LOCATION

Lucy Lake is located in the Village of Deer Park on Long Grove Rd, just east of Ela Rd. (T 43N, R 10E, S 32, 33). It has a surface area of 8.2 acres, mean and maximum depths of 13.5 feet and 27 feet, respectively, and a calculated volume of 111.0 acre-feet. However, these numbers are deceptive, as the morphometry of Lucy Lake is quite unique. Approximately half of the lake is about two feet deep, while the other half ranges from about five feet to 27 feet in depth. Considering the data collected on various depths throughout Lucy Lake, the average depth is probably closer to nine feet. The watershed of Lucy Lake encompasses approximately 124.2 acres, draining two small ponds, several residential areas and Charlie Brown Park (Figure 1). The watershed to lake surface area ratio of less than 15:1 is relatively small. This is positive in that it may help prevent serious water quality problems that often accompany a larger watershed to lake ratio. However, lakes with small ratios often experience more severe water level fluctuations throughout the summer as well as the accumulation of solids and nutrients because lake retention time (the time it takes all the water in the lake to be replaced) is high. Lucy Lake has a retention time of one and a half years. This can mean extended periods of poor water quality even if there are improvements to new water entering the lake. In 2004, we found that water level fluctuations from May to June were high, but the remainder of the summer, water level did not fluctuate more than a third of a foot on Lucy Lake. It is recommended that in the future, staff gauge be installed and readings be taken weekly or bi-weekly if possible. This will give lake managers a much better idea of lake level fluctuations relative to rainfall events and can aid in future management decisions.

Based on the most recent land use survey of the Lucy Lake watershed conducted in 2000, residential areas dominate the watershed (70%) (Figure 2). The lake and other ponds make up approximately 11% of the watershed, and other land uses together make up approximately 18% of the watershed (Table 1, Appendix A). The large amount of residential area that makes up the watershed can be good or bad, depending on the activities of homeowners that live around the lake. If homeowners are educated about how their daily activities affect the lake and take steps to prevent additional sediment and nutrients from entering the water, there could be some improvement in water quality over time. However, if residents go about their daily activities with no regard to how it may affect the lake, water quality could be degraded over time. Water exits Lucy Lake via an unnamed creek on the southeast end and flows into ADID 182 before eventually entering Buffalo Creek and then the Des Plaines River. The lake is located in the Buffalo Creek sub basin, within the Des Plaines River watershed.

Figure 1

Figure 2

BRIEF HISTORY OF LUCY LAKE

Construction of homes around Lucy Lake began in the 1970's and approximately 11 homes surround the lake on the south side. The lake is managed by the Village of Deer Park, who owns Charlie Brown Park located on the west side of the lake. There is no formal lake management association and the village does not actively manage the lake in any way.

LIMNOLOGICAL DATA – WATER QUALITY

Water samples collected from Lucy Lake were analyzed for a variety of water quality parameters (See Appendix B for methodology). Samples were collected approximately three feet below the surface and three feet off of the bottom from the deepest location in the lake (Figure 3). The lake was thermally stratified near the deep hole. Thermal stratification occurs when a lake divides into an upper, warm water layer (epilimnion) and a lower, cold water layer (hypolimnion). When stratified, the epilimnetic and hypolimnetic waters do not mix, and the hypolimnion typically becomes anoxic (dissolved oxygen (DO) <1 mg/L) by mid-summer. This phenomenon is a natural occurrence in nutrient enriched, deep lakes and is not necessarily a bad thing if enough of the lake volume remains oxygenated. DO concentrations fell below 5.0 mg/L (a level below which many warm-water fish become stressed) by a depth of six feet each month except August, when DO was less than 5.0 mg/L at the surface. Because a bathymetric map (which would indicate how much of the lake volume was experiencing low DO concentrations) does not exist for Lucy Lake, it is impossible to know the extent of low DO concentrations throughout the lake and how that might be affecting aquatic life in the lake. The near bottom water of the hypolimnion had become anoxic by May.

Phosphorus is a nutrient that can enter lakes through runoff or be released from lake sediment, and high levels of phosphorus typically cause algal blooms or produce high plant density. The 2004 average epilimnetic phosphorus concentration in Lucy Lake was 0.055 mg/L, while the average hypolimnetic phosphorus concentration was 0.565 mg/L (Table 2, Appendix A). The average epilimnetic total phosphorus (TP) concentration was just below the county median (0.063 mg/L), while the hypolimnetic TP concentration was over three times higher than the median (0.178 mg/L). Two factors likely contributed

Figure 3

to the high hypolimnetic total phosphorus (TP) concentration. The first is that the deepest part of the lake, where the water column thermally stratified, was very narrow. Therefore, the phosphorus released from the sediment was concentrated into a small volume of water compared to the rest of the lake. The second is that the lake originated as a wet area surrounded by agricultural land (Figure 4). Years of nutrient build-up from fertilizer and animal waste may have occurred, producing a nutrient-rich, highly organic lake bottom that continues to release phosphorus each year.

The hypolimnetic phosphorus concentration was tenfold higher than the epilimnetic concentration. This is typical in a stratified, nutrient-enriched lake, especially if stratification begins early in the summer like it did in Lucy 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, and are 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 only during fall turnover. At this time, the hypolimnetic phosphorus is distributed throughout the water column. The resulting increase in TP to the epilimnion can produce late season algal blooms. However, turnover had not yet occurred in Lucy Lake at the time of September sampling so TP levels in the upper water were still relatively low and algal density had not increased substantially. We revisited Lucy Lake in early October in an attempt to document fall turnover. The lake had begun to turnover, but near anoxia (<1 mg/L DO) still existed below a depth of 14-15 feet. No water sample was taken at this time.

The epilimnetic TP concentration increased substantially between July and August as a result of a break in the thermal stratification and the mixing of the water column. The average air temperature during the month of August was three degrees (Farenheit) lower than July and the air temperature on the day of sampling in August was 14 degrees lower than in July. This cooling trend in August caused a substantial decrease in surface water temperature of four degrees (Centigrade), which lead to a larger portion of the upper water column mixing (stratification began at a deeper depth) (Appendix C). This may have increased TP concentrations in the epilimnion in two ways. The first is that some of the phosphorus-rich water that had previously been isolated in the hypolimnion may have become incorporated into the surface waters because a greater portion of the water column was mixed. The second is that the change in water temperature may have shifted the phytoplankton (algae) community dynamics. It is likely that the algal community was dominated by blue-green algae during July, when the surface water temperature was just over 80^0F, but that the community shifted to a dominance by green algae when the water cooled. This likely resulted in a relatively large die-off of blue-green algae, which cannot tolerate lower water temperatures like those experienced in August. The decomposition of these algal cells lowered the DO and released phosphorus into the surface waters from those cells.

Total suspended solids (TSS) is a measure of the amount of suspended material, such as algae or sediment, in the water column. High TSS values are typically correlated with poor water clarity and can be detrimental to many aspects of the lake ecosystem, including the plant and fish communities. A large amount of material in the water column can inhibit successful predation by sight-feeding fish, such as bass and pike, or settle out and smother fish eggs. High turbidity caused by sediment or algae can shade out native aquatic plants, resulting in their reduction or disappearance from the littoral zone. This eliminates the benefits provided by plants, such as habitat for many fish species and stabilization of the lake bottom. The average 2004 epilimnetic TSS concentration in Lucy Lake (12.4 mg/L) was higher than the median value for Lake County lakes (7.9 mg/L). As with TP, there was a large increase in the epilimnetic TSS concentration between July and August (Figure 5). This increase was probably caused by a combination of decomposing blue-green algae and a growing density of green algae, as mentioned above.

As a result of the moderately low TP and TSS concentrations from May-July, Secchi depth (water clarity) of Lucy Lake was higher than the county median (3.08 feet) during those months and reached a maximum of 3.9 feet in June. Secchi depth decreased with increasing TP and TSS concentrations in August and September (Figure 6). It is recommended that the Village of Deer Park delegate a member to become part of the Illinois Volunteer Lake Management Program (VLMP). This person would take monthly Secchi depth measurements to determine water clarity, as well as record data on other important details. Having accurate and consistent VLMP data is very important, as any changes in water clarity and quality that may occur from changes in the watershed in the future can be tracked over time and can give early warning of problems in the watershed. Having a quality VLMP in place in the meantime can help provide valuable information to lake managers who may be able to take action on certain issues before they become irreversible problems. VLMP data can also be used to give accurate historical data about the lake, water quality and management activities so that variations such as those mentioned above can be more readily and accurately explained.

Conductivity is the measure of different chemical ions in solution. As the concentration of these ions increases, conductivity increases. The conductivity of a lake is dependent on the lake and watershed geology, the size of the watershed flowing into the lake, the land uses within that watershed, evaporation and bacterial activity. Conductivity has been shown to be highly correlated (in urban areas) with chloride ions found in road salt mixtures. Water bodies most subject to the impacts of road salts are streams, wetlands or lakes draining major roadways and large parking lots. The average 2004 epilimnetic conductivity (1.1296 mS/cm) in Lucy Lake was much higher than the county median (0.7652 mS/cm) throughout the summer. Epilimnetic total dissolved solids (TDS) concentrations, which have also been shown to be correlated with conductivity were also well above the county median (454 mg/l) during every month of the study (Table 2, Appendix A). That the highest conductivity levels were observed in May, during the greatest amount of rainfall, is an indication that road salt in runoff makes up a major component of the dissolved ions in the lake early in the summer. The gradual increase throughout the rest of the summer after the decrease in conductivity from May to June indicates that other factors are contributing to the conductivity levels in the lake after the initial pulse of road salt in the spring.

Conductivity changes can occur seasonally and even with depth, but over the long term, increased conductivity can be an indicator of potential watershed or lake problems and an increase in pollutants entering the lake. High conductivity (which often indicates an increase in sodium or potassium chloride) can eventually change the plant and algal community, as more salt tolerant plants and algae take over. Sodium, potassium and chloride ions can bind substances in the sediment, preventing uptake by plants and reducing native plant densities. Additionally, juvenile aquatic organisms may be more susceptible to high chloride concentrations. The high conductivity levels are cause for concern, however, non-point runoff picks up road salt which enters the lake during rain events and this is very difficult, if not impossible, to control.

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 algal 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. Lucy Lake had a 2004 average TN:TP ratio of 22:1. Typically, this means that an increase in the phosphorus concentration could result in more planktonic algae in the future.

Figure 4

Figure 5

Figure 6

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* (algal biomass) levels and Secchi depth to classify and compare lake trophic states using just one value. The TSI is set up so that an increase in phosphorus concentration is related to an increase in algal biomass and a corresponding decrease in Secchi depth. A moderate TSI value (TSI $\geq 40 < 50$) indicates mesotrophic conditions, typically characterized by relatively low nutrient concentrations, low algal biomass, adequate DO concentrations and relatively good water clarity. High TSI values indicate eutrophic (TSI $\geq 50 < 70$) to hypereutrophic (TSI ≥ 70) lake conditions, typically characterized by high nutrient concentrations, high algal biomass, low DO concentrations, a rough fish population, and low water clarity. Lucy Lake had an average phosphorus TSI (TSIp) value of 62, indicating eutrophic conditions. When compared to other lakes in the county, Lucy Lake ranks 66th out of 161 lakes studied with regard to total phosphorus concentration (Table 3, Appendix A).

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

LIMNOLOGICAL DATA – AQUATIC PLANT ASSESSMENT

Aquatic plant surveys were conducted every month for the duration of the study (See Appendix B for methodology). Shoreline plants of interest were also recorded. However, no quantitative surveys were made of these shoreline plant species and 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, the lake area that has the potential to support aquatic plant growth can be determined. Depth of 1% percent light intensity was approximately eight feet from May to July and then decreased throughout the rest of the summer as water clarity decreased (Appendix C). Based on 1% light level in June, Lucy Lake could have supported plants in a little over half the lake. However, no plants were found at a depth greater than 5.5 feet. Therefore, plants were able to and did grow in the shallow half of the lake, but did not grow in all potential areas of the deep half of the lake. The inability of aquatic plants to grow in all areas as determined by percent light level may be explained by the presence of inadequate substrate in many parts of the lake (hard, rocky bottom in some areas), the steep slope of the lake bottom in the deep half of the lake and the presence of common carp, which can disturb plants with their feeding activities. Four submersed and one emergent plant species were present in Lucy Lake at moderate densities during the summer of 2004 (Tables 4 & 5). Curlyleaf pondweed and sago pondweed dominated the plant community. Curlyleaf pondweed, an exotic species that usually dies back near the end of June due to high water temperatures, was present all summer. Overall, the submersed plant community was not highly diverse.

Of the 21 plant and trees species observed along the shoreline of Lucy Lake, seven (yarrow, chicory, purple loosestrife, yellow sweet clover, reed canary grass, honeysuckle and buckthorn) are invasive species that do not provide ideal wildlife habitat and have the potential to dominate the emergent plant community. Their removal is always recommended.

FQI (Floristic Quality Index) is a rapid assessment tool designed to evaluate the closeness of the flora of an area to that of undisturbed conditions. It can be used to: 1) identify natural areas, 2) compare the quality of different sites or different locations within a single site, 3) monitor long-term floristic trends, and 4) monitor habitat restoration efforts (Nichols, 1999). Each floating or submersed aquatic plant is assigned a number between 1 and 10 (10 indicating the plant species most sensitive to disturbance). An FQI is calculated by multiplying the average of these numbers by the square root of the number of these plant species found in the lake. A high FQI number indicates that there are a large number of sensitive, high quality plant species present in the lake. Non-native species were also included in the FQI calculations for Lake County lakes. The average FQI for 2000-2004 Lake County lakes is 14.3. Lucy Lake has an FQI of 8.5 and ranked 120th out of 150 county lakes we have studied since 2000.

Table 4. Aquatic and shoreline plants on Lucy Lake, May-September 2004.

Aquatic Plants	
Chara	*Chara* sp.
Water Smartweed	*Polygonum amphibium*
Curlyleaf Pondweed^	*Potamogeton crispus*
Sago Pondweed	*Potamogeton pectinatus*
Flatstem Pondweed	*Potamogeton zosteriformis*
Shoreline Plants	
Yarrow^	*Achillea millefolium*
Water Plantain	*Alisma plantago-aquatica*
Swamp Milkweed	*Asclepias incarnata*
Common Milkweed	*Asclepias syriaca*
Deadly Nightshade	*Atropa belladonna*
Sedge	*Carex* sp.
Chicory^	*Cichorium intybus*
Spikerush	*Eleocharis* sp.
Jewelweed	*Impatiens pallida*
Purple Loosestrife^	*Lythrum salicaria*
Yellow Sweet Clover^	*Melilotus officinalis*
Reed Canary Grass^	*Phalaris arundinacea*
Canada Bluegrass	*Poa compressa*
Tall Goldenrod	*Solidago gigantia*

Goldenrod	*Solidago* sp.
Common Cattail	*Typha latifolia*
Wild Grape	*Vitis* sp.
Trees/Shrubs	
Silver Maple	*Acer saccharinum*
Honeysuckle^	*Lonicera* sp.
Common Buckthorn^	*Rhamnus cathartica*
Willow	*Salix* sp.

^Exotic plant or tree species

LIMNOLOGICAL DATA – SHORELINE ASSESSMENT

A shoreline assessment was conducted at Lucy Lake on June 23, 2004. The shoreline was assessed for a variety of criteria (See Appendix B for methods), and based on this assessment, several important generalizations could be made. Approximately 57% of Lucy Lake's shoreline is developed with the majority of the developed shoreline composed of manicured lawn (59%). The remainder of the developed shoreline consists of buffer (25.9%) and beach (1.3%) (Figure 7). Manicured lawn is considered undesirable because it provides a poor shoreline-water interface due to the short root structure of turf grasses. These grasses are incapable of stabilizing the shoreline and will typically lead to erosion. In fact, 78% of the manicured lawn along Lucy Lake was exhibiting slight erosion. The undeveloped portions of the lake are made up of wetland, buffer and woodland. Woodland, wetland and buffer are the most desirable shoreline types, providing wildlife habitat and, typically, protecting the shore from excessive erosion. However, if they are not maintained properly, woodland and buffer shorelines can become highly degraded. The high percentage of wetland and woodland shoreline along Lucy Lake is very encouraging and these shorelines should be protected from new development or degradation. However, moderate erosion was occurring primarily along woodland dominated shoreline that had not been properly maintained (Figure 8). Wetland, buffer and, especially, woodland shorelines should be improved and maintained or added as much as possible, and the addition of manicured lawns should be discouraged.

Although almost no erosion was occurring around Lucy Lake, invasive plant species, including yellow sweet clover, chicory, purple loosestrife, reed canary grass, honeysuckle and buckthorn were present along much 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 along already eroded shoreline 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. Although most of the exotic plant occurrences were along non-developed shoreline, steps to eliminate these plants should be carried out in order to improve the wildlife habitat and overall aesthetics of Lucy Lake.

LIMNOLOGICAL DATA – WILDLIFE ASSESSMENT

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, buffer and woodland areas was relatively high around Lucy Lake, a moderate number of wildlife species were observed (Table 6). Considering that Lucy Lake is a partially developed lake, the number of wildlife species is encouraging. The maintenance of wetland, wooded and buffered shorelines and the establishment of additional buffer strips (especially along the shoreline of developed areas) is very important and strongly recommended to continue to provide the appropriate habitat for birds and other animals in the future.

Figure 7

Figure 8

Table 6. Wildlife species observed at Lucy Lake, April-September 2004.

Birds	
Double crested Cormorant	*Phalacroxorax auritus*
Canada Goose	*Branta canadensis*
Mallard	*Anas platyrhnchos*
Wood Duck	*Aix sponsa*
Ring-billed Gull	*Larus delawarensis*
Great Blue Heron	*Ardea herodias*
Green Heron	*Butorides striatus*
Cooper’s Hawk	*Accipiter cooperii*
Red-tailed Hawk	*Bueto jamaicensis*
Mourning Dove	*Falco sparverius*
Common Flicker	*Colaptes auratus*
Barn Swallow	*Hirundo rustica*
Blue Jay	*Cyanocitta cristata*
Black-capped Chickadee	*Poecile atricapillus*
American Robin	*Turdus migratorius*
Red-winged Blackbird	*Agelaius phoeniceus*
Common Grackle	*Quiscalus quiscula*
Northern Cardinal	*Cardinalis cardinalis*
American Goldfinch	*Carduelis tristis*
Mammals	
Fox Squirrel	*Sciurus niger*
Amphibians	
American Toad	*Bufo americanus*
Bull Frog	*Rana catesbeiana*
Reptiles	
Painted Turtle	*Chrysemys picta*

EXISTING LAKE QUALITY PROBLEMS

- *Lack of a Quality Bathymetric Map*

  A bathymetric (depth contour) map is an essential tool in effective lake management, especially if the long term lake management plan includes intensive treatments, such as fish stocking, dredging, chemical application or alum application. No bathymetric map currently exists for Lucy Lake, which has a very unique morphology. Morphometric data obtained in the creation of a bathymetric map is necessary for calculation of equations for correct application of many types of treatments. It is also necessary to determine the volume of water affected by low DO levels.

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

  In 1981, the Illinois Volunteer Lake Monitoring Program (VLMP) was established by the Illinois Environmental Protection agency (Illinois EPA) to gather fundamental information on Illinois inland lakes, and to provide an educational program for citizens. Annually, 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 establishment of a VLMP on Lucy Lake would provide valuable historical data and enable lake managers to create baseline information and then track the improvement or decline of lake water quality over time.

- *Invasive Shoreline Plant Species*

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

- *Limited Wildlife Habitat and Shoreline Erosion*

  Although much of Lucy Lake's shoreline is dominated by woodland or buffer, these areas are relatively degraded, harboring exotic plant and tree species and slight to moderate erosion. While some buffer strips exist along the developed shore, most of the residents have manicured lawn. It is recommended that any residents that already have buffer consider widening their strips and do their best to encourage neighboring properties to establish buffers. It is also recommended that those residents that do not have a buffer strip or are experiencing erosion consider planting at least a 10-20 foot wide strip of native plants along their shoreline. This could increase wildlife habitat, reduce the amount of nutrients and soil particles entering the lake, deter geese and decrease shoreline erosion. Pathways through these buffers could accommodate lake access for homeowners without reducing the integrity of the buffer. Slight to moderate erosion is occurring along 28% of the shoreline, especially along areas dominated by manicured lawn.

POTENTIAL OBJECTIVES FOR THE LUCY LAKE MANAGEMENT PLAN

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

OPTIONS FOR ACHIEVING THE LAKE MANAGEMENT PLAN OBJECTIVES

Objective I: Create a Bathymetric Map, Including a Morphometric Table

A bathymetric (depth contour) map is an essential tool in effective lake management since it provides information on the morphometric features of the lake, such as depth, surface area, volume, etc. The knowledge of this morphometric information would be necessary if lake management treatments such as fish stocking, dredging, alum application or aeration were part of the overall lake management plan. Lucy Lake does not currently have a bathymetric map. Maps can be created by the Lake County Health Department – Lake Management Unit or other agencies for costs that vary from $3,000-$10,000, depending on lake size.

Objective II: Participate 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 photic 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.

For more information about the VLMP contact:

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Objective III: Eliminate or Control Invasive 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*), honeysuckle (*Lonicera* sp.) and reed canary grass (*Phalaris arundinacea*) are four examples. The outcome is a loss of plant and animal diversity. This section will address terrestrial shoreline exotic species.

Buckthorn and honeysuckle are aggressive shrub species that grow along lake shorelines as well as most upland habitats. They shade out other plants and are quick to become established on disturbed soils. Reed canary grass 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. Although exotic species were found along about much of the shoreline of Lucy Lake, the density of the plant species in these areas was not extremely high. Therefore, control measures should be carried out while these exotics would still be relatively easy to control.

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. Tables 7 & 8, 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: 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 before seed heads appear, 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. Due to the low density of exotic plants, this option is probably the most cost effective.

Pros

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

Cons

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

Costs

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

Option 3: Herbicide Treatment

Chemical treatments can be effective at controlling exotic plant species. However, chemical treatment works best on individual plants or small areas already infested with the plant. In some areas where individual spot treatments are prohibitive or 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 unless it is a monocrop of a specific plant species. Native species are likely to be killed inadvertently and replaced by other non-native species. Off target injury/death may result from the improper use of herbicides. If herbicides are applied in windy conditions, chemicals may drift onto desirable vegetation. Care must also be taken when wicking herbicides as not to drip on to non-targeted vegetation such as native grasses and wildflowers. Another drawback to herbicide use relates to their ecological soundness and the public perception of them. Costs may also be prohibitive if plant stands are large. Depending on the device, cost of the application equipment can be high.

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

Objective IV: Enhance Wildlife Habitat Conditions

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

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

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

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

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

Pros

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

Cons

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

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

Costs

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

<u>Option 2: Increase Habitat Cover</u>

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 (see Table 7 & 8, 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. Because of the turbidity in Island Lake, it would be best to start with planting of emergent species and most toward submersed species as water clarity improves.

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 or lower growing species (1.5-2.0 feet tall) can be planted). Composition and density of aquatic and shoreline vegetation are important. If vegetation consists of non-native species such as or Eurasian water milfoil or purple loosestrife, or in excess amounts, undesirable conditions may result. A shoreline with excess exotic plant growth may result in a poor fishery (exhibited by stunted fish) and poor recreation opportunities (i.e., boating, swimming, or wildlife viewing).

Costs

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

Option 3: Increase Natural Food Supply

This can be accomplished in conjunction with Option 2. Habitats with a diversity of native plants will provide an ample food supply for wildlife. Food comes in a variety of forms, from seeds to leaves or roots to invertebrates that live on or are attracted to the plants. Plants found in Table 7, 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.

<u>Option 4: Increase Nest Availability</u>

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.

Objective V: Control Shoreline Erosion

Erosion is a potentially serious problem to lake shorelines and occurs as a result of wind, wave, or ice action or from overland rainwater runoff. While some erosion to shorelines is natural, human alteration of the environment can accelerate and exacerbate the problem. Erosion not only results in loss of shoreline, but negatively influences the lake's overall water quality by contributing nutrients, sediment, and pollutants into the water. This effect is felt throughout the food chain since poor water quality negatively affects everything from microbial life to sight feeding fish and birds to people who want to use the lake for recreational purposes. The resulting increased amount of sediment will over time begin to fill in the lake, decreasing overall lake depth and volume and potentially impairing various recreational uses. Lucy Lake has slight to moderate erosion along 28% of its shoreline, concentrated along woodland and manicured lawn. The residents around the lake should address those small areas that are eroded or could become eroded in the future.

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

Pros

There are no short-term costs to this option. However, extended periods of erosion may result in substantially higher costs to repair the shoreline in the future.

Eroding banks on steep slopes can provide habitat for wildlife, particularly bird species (e.g. kingfishers and bank swallows) that need to burrow into exposed banks to nest. In addition, certain minerals and salts in the soils are exposed during the erosion process, which are utilized by various wildlife species.

Cons

Taking no action will most likely cause erosion to continue and subsequently may cause poor water quality due to high levels of sediment or nutrients entering a lake. This in turn may retard plant growth and provide additional nutrients for algal growth. A continual loss of shoreline is both aesthetically unpleasing and may potentially reduce property values. Since a shoreline is easier to protect than it is to rehabilitate, it is in the interest of the property owner to address the erosion issue immediately.

Costs

In the short-term, cost of this option is zero. However, long-term implications can be severe since prolonged erosion problems may be more costly to repair than if the problems were addressed earlier. As mentioned previously, long-term erosion may cause serious damage to shoreline property and in some cases lower property values.

Option 2: Create a Buffer Strip

Another effective method of controlling shoreline erosion is to create a buffer strip with existing or native vegetation. Native plants have deeper root systems than turfgrass and thus hold soil more effectively. Native plants also provide positive aesthetics and good wildlife habitat. Cost of creating a buffer strip is quite variable, depending on the current state of the vegetation and shoreline and whether vegetation is allowed to become established naturally or if the area needs to be graded and replanted. Allowing vegetation to naturally propagate the shoreline would be the most cost effective, depending on the severity of erosion and the composition of the current vegetation. Non-native plants or noxious weedy species may be present and should be controlled or eliminated.

Stabilizing the shoreline with vegetation is most effective on slopes no less than 2:1 to 3:1, horizontal to vertical, or flatter. Usually a buffer strip of at least 25 feet is recommended, however, wider strips (50 or even 100 feet) are recommended on steeper slopes or areas with severe erosion problems. Areas where erosion is severe or where slopes are greater than 3:1, additional erosion control techniques may have to be incorporated such as biologs, A-Jacks®, or rip-rap.

Buffer strips can be constructed in a variety of ways with various plant species. Generally, buffer strip vegetation consists of native terrestrial (land) species and emergent (at the land and water interface) species. Terrestrial vegetation such as native grasses and wildflowers can be used to create a buffer strip along lake shorelines. Table 7, Appendix A gives some examples, seeding rates and costs of grasses and seed mixes that can be used to create buffer strips. Native plants and seeds can be purchased at regional nurseries or from catalogs. When purchasing seed mixes, care should be taken that native plant seeds are used. Some commercial seed mixes contain non-native or weedy species or may contain annual wildflowers that will have to be reseeded every year. If purchasing plants from a nursery or if a licensed contractor is installing plants, inquire about any guarantees they may have on plant survival. Finally, new plants should be protected from herbivory (e.g., geese and muskrats) by placing a wire cage over the plants for at least one year.

Emergent vegetation, or those plants that grow in shallow water and wet areas, can be used to control erosion more naturally than seawalls or rip-rap. Native emergent vegetation can be either hand planted or allowed to become established on its own over time. Some plants, such as native cattails (*Typha* sp.), quickly spread and help stabilize shorelines, however they can be aggressive and may pose a problem later. Other species, such as those listed in Table 7, Appendix A should be considered for native plantings.

Pros

Buffer strips can be one of the least expensive means to stabilize shorelines. If no permits or heavy equipment are needed (i.e., no significant earthmoving or filling is planned), the property owner can complete the work without the need of professional contractors. Once established (typically within 3 years), a buffer strip of native vegetation will require little maintenance and may actually reduce the overall maintenance of the property, since the buffer strip will not have to be continuously mowed, watered, or fertilized. Occasional high mowing (1-2 times per year) for specific plants or physically removing other weedy species may be needed.

The buffer strip will stabilize the soil with its deep root structure and help filter run-off from lawns and agricultural fields by trapping nutrients, pollutants, and sediment that would otherwise drain into the lake. This may have a positive impact on the lake's water quality since there will be less "food" for nuisance algae. Buffer strips can filter as much as 70-95% of sediment and 25-60% of nutrients and other pollutants from runoff.

Another benefit of a buffer strip is potential flood control protection. Buffer strips may slow the velocity of flood waters, thus preventing shoreline erosion. Native plants also can withstand fluctuating water levels more effectively than commercial turfgrass. Many plants can survive after being under water for several days, even weeks, while turfgrass is intolerant of wet conditions and usually dies after several days under water. This contributes to increased maintenance costs, since the turfgrass has to be either replanted or replaced with sod. Emergent vegetation can provide additional help in preserving shorelines and improving water quality by absorbing wave energy that might otherwise batter the shoreline. Calmer wave action will result in less shoreline erosion and resuspension of bottom sediment, which may result in potential improvements in water quality.

Many fish and wildlife species prefer the native shoreline vegetation habitat. This habitat is an asset to the lake's fishery since the emergent vegetation cover may be used for spawning, foraging, and hiding. Various wildlife species are even dependent upon shoreline vegetation for their existence. Certain birds, such as marsh wrens (*Cistothorus palustris*) and endangered yellow-headed blackbirds (*Xanthocephalus xanthocephalus*) nest exclusively in emergent vegetation like cattails and bulrushes. Hosts of other wildlife like waterfowl, rails, herons, mink, and frogs to mention just a few, benefit from healthy stands of shoreline vegetation. Dragonflies, damselflies, and other beneficial invertebrates can be found thriving in vegetation along the shoreline as well.

In addition to the benefits of increased fish and wildlife use, a buffer strip planted with a variety of native plants may provide a season long show of various colors from flowers, leaves, seeds, and stems. This is not only aesthetically pleasing to people, but also benefits wildlife and the overall health of the lake's ecosystem.

Cons

There are few disadvantages to native shoreline vegetation. Certain species (i.e., cattails) can be aggressive and may need to be controlled occasionally. If stands of shoreline vegetation become dense enough, access and visibility to the lake may be compromised to some degree. However, small paths could be cleared to provide lake access or smaller plants could be planted in these areas.

Costs

If minimal amount of site preparation is needed, costs can be approximately $10 per linear foot, plus labor. Cost of installing willow posts is approximately $15-20 per linear foot. 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. The permitting process is costly, running as high as $1,000-2,000 depending on the types of permits needed.