-

2004 SUMMARY REPORT
of
WOODLAND (HIGHLAND) LAKE

Lake County, Illinois

Prepared by the

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

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

January 2005

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Woodland Lake, also known as Highland Lake, is a private lake in unincorporated Wauconda Township. It is part of the Mutton Creek drainage of the Fox River watershed. The lake encompasses approximately 7.7 acres and has a shoreline length of 0.48 miles. The current maximum depth was determined to be 7.5 feet, as measured in June 2004.

Water clarity, as measured by Secchi disk transparency readings, averaged 1.72 feet for the season, which is well below the county median (where 50% of the lakes are above and below this value) of 3.08 feet. The poor clarity in the lake can be attributed to the high concentrations of total suspended solids (TSS), which reduced the transparency readings. The 2004 seasonal average TSS concentration was 21.2 mg/L, which is nearly three times the county median of 7.9 mg/L.

The 2004 average total phosphorus (TP) concentration in Woodland Lake was 0.099 mg/L. This is 57 % higher than the county median of 0.063 mg/L. Some of the TP probably came from the high TSS concentrations found in the water, since phosphorus binds to sediment particles.

Very few aquatic plants exist in the lake. Only three aquatic plant species (curlyleaf pondweed, leafy pondweed, and watermeal) and several emergent shoreline plants were found. Past herbicide treatments have caused poor water clarity that prohibits plant growth.

The entire shoreline of Woodland Lake was classified as developed. Buffer (which is a strip of unmowed vegetation preferably consisting of native plants located at the water's edge), lawn, and riprap habitats were the most common shoreline types consisting of 35%, 25% and 24% of the shoreline, respectively. The other shoreline types around the lake (seawall, beach, and shrub) make up the remaining 16% of the shoreline.

The shoreline was assessed for the degrees and types of shoreline erosion. Only 239 feet (10.0%) of the shoreline was classified as slightly eroding, and only one 28-foot section of the shoreline (1.2%), located on the southern shoreline, was classified as moderately eroding. There were no areas around the lake that were classified as severely eroding.

Several exotics were found growing along the shoreline, including buckthorn and reed canary grass. Removal or control of these exotic species is recommended.

LAKE IDENTIFICATION AND LOCATION

Woodland Lake (T44N, R9E, Section 21), also known as Highland Lake, is a private lake located west of Darrell Road and north of Meadow Lane Road in unincorporated Wauconda Township. It is part of the Mutton Creek drainage of the Fox River watershed. Woodland Lake's watershed is small, approximately 55 acres, and has a watershed to lake ratio of 7:1 (Figure 1). There are two inlets to the lake, two 12" culverts located at the west end of the lake that drain a residential area and a small creek that enters the lake along the northern shoreline. This creek drains a one-acre detention pond located approximately 640 feet northwest of the lake. The lake's outlet is a small ditch on the southeastern end of the lake. Water leaves the lake and flows overland northeast into Mutton Creek, then west into Island Lake and eventually into the Fox River.

Woodland Lake encompasses approximately 7.7 acres and has a shoreline length of 0.48 miles. The current maximum depth was determined to be 7.5 feet, as measured in June 2004. Since no bathymetric (depth contour) map of Woodland Lake is known to exist, the volume of the lake was estimated based on data from lakes with known depths and volumes. Mean depth was obtained by multiplying the maximum depth by 0.5. Volume was obtained by multiplying the mean depth by the lake surface area. Based on these calculations, Woodland Lake has an estimated mean depth of 3.75 feet and an estimated volume of 28.9 acre-feet. Lake elevation is approximately 785 feet above sea level.

BRIEF HISTORY OF WOODLAND LAKE

The exact origin of Woodland Lake is unknown, although a 1972 report by the Illinois Department of Natural Resources (IDNR) indicated that it is a dredged marsh, with a maximum depth of 6.5 feet. Figure 2 shows a 1939 aerial photograph of the lake with a shoreline that is nearly identical in size and shape to the current shoreline seen in this study.

SUMMARY OF CURRENT AND HISTORICAL LAKE USES

Woodland Lake is used primarily for the aesthetic enjoyment of the residents. There are currently 11 private homeowners around the lake, with each owning portions of the lake bottom. The lake has no public access. No gas-powered watercraft are permitted on the lake, although electric motors are allowed. Fishing and swimming are also popular activities.

The lake is treated with aquatic algicides on an annual basis. Details of these treatments will be addressed in the **Aquatic Plant Assessment** section of this report.

Figure 1. Watershed.

Figure 2. 1939 aerial

Figure 3. Land uses.

The composition of land uses within a lake's watershed often influences its water quality. The major land use in the Woodland Lake watershed (based on 2000 land use maps) is single family (Figure 3; 68.5%), followed by transportation (15.5%), water (14.4%), forest/grassland (1.2%), and public and private open space (0.4%). Based on the land uses in the watershed and the estimated volume of Woodland Lake, the approximate retention time of the lake is 245 days. Implications of the retention time will be addressed in the **Water Quality Assessment** section below.

LIMNOLOGICAL DATA – WATER QUALITY

Water samples were collected monthly from May - September at the deep-hole location in the lake (Figure 4). See Appendix B for water sampling methods.

Woodland Lake's water quality is poor, compared to many lakes in Lake County (Table 1 in Appendix A). Most of the water quality parameters measured were above the averages of other lakes that we have monitored. Several important findings were noted.

Water clarity, as measured by Secchi disk transparency readings, averaged 1.72 feet for the season, which is 44% below the county median (where 50% of the lakes are above and below this value) of 3.08 feet. The deepest reading was recorded in June (2.10 feet) and the shallowest reading in August (1.44 feet). The poor clarity in the lake can be attributed the high concentrations of total suspended solids (TSS), which reduced the transparency readings. The 2004 seasonal average TSS concentration was 21.2 mg/L, which is nearly three times the county median of 7.9 mg/L. In order to determine if the TSS was primarily organic or inorganic, we calculated the non-volatile suspended solids (NVSS) concentration, which indicates the inorganic portion in TSS. The average NVSS was 78% of the average TSS for the season indicating the TSS is primarily of inorganic substances, such as sediment. Supporting this is the average total volatile solid (TVS) concentrations of 63 mg/L, which is well below the county median of 132 mg/L. TVS is a measurement of the organic substances, such as algae. The exact source of the high TSS concentrations is unknown. External sources of sediment are probably minimal since the lake has a small watershed and no major inlets flowing into it, although a small stream does enter the lake from a small pond, as mentioned previously. Also, given that the lake has a relatively long calculated retention time (245 days) for such a small waterbody, it is likely that the sources of the TSS are internal. We did not notice large numbers of carp in the lake, although triploid grass carp (*Ctenopharyngodon idella*) were stocked into the lake approximately 18 years ago. It is possible some of these carp are still alive, but they would be near the end of their expected life span (approximately 20 years) and the lack of aquatic plants in the lake would also truncate their ability to survive. Common carp (*Cyprinus carpio*) may be present in the lake, although there is no apparent upstream or downstream source. In addition, the 1972 DNR report does not include carp in the fish found in the lake. To track future water quality trends, it is recommended that the lake become enrolled in the Volunteer Lake Monitoring Program (VMLP), which trains a

Figure 4. Sample location.

volunteer to measure the Secchi disk readings on a bimonthly basis from April to October. For more information see **Objective II: Illinois Volunteer Lake Monitoring Program.**

The 2004 average total phosphorus (TP) concentration in Woodland Lake was 0.099 mg/L. This is 57% higher than the county median of 0.063 mg/L. Values above 0.03 mg/L are considered sufficient enough to cause nuisance algae blooms. Algae, primarily planktonic, were seen throughout the sampling season. Some of the TP probably came from the high TSS concentrations found in the water, since phosphorus binds to sediment particles. The sources of the high TP could be numerous, including lake origin (i.e., underlying soils) and land uses. One of the largest threats to the lake is probably fertilizer (which is often high in phosphorus) applied to the lawns near the lake in the watershed. It is recommended that homeowners use a no-phosphorus fertilizer on their lawns.

Dissolved oxygen (DO) concentrations in Woodland Lake were stable during the season. Some fish species may become stressed when DO concentrations fall below 5 mg/L, but all DO concentrations at the lake's surface were above this value. Concentrations fell below 5 mg/L only in August below the five feet depth. The lake was well mixed, in terms of DO, due to the its shallow depth.

Due to its shallow nature, Woodland Lake did not strongly stratify during the season. It may exhibit polymictic tendencies, meaning stratification and turnover occur repeatedly over the year. This may have been the result of climatic factors (i.e., wind and wave action, temperature) and that the lake is small and shallow. The lake was stratified at approximately three feet from the June sampling date to the September visit, although the strength of the thermocline varied monthly. It is unlikely that this stratification had a significant impact on the water quality results. Impacts occur when a lake strongly stratifies, trapping nutrients under the thermocline. In addition, anoxic conditions (when DO concentrations fall below 1 mg/L) may occur below the thermocline and release additional nutrients from the sediment. Once the thermocline dissipates in the fall, the trapped nutrients are released into the water column. In Woodland Lake, these conditions likely did not occur since the thermocline was weak and the majority of the water column oxic (DO >1mg/L).

High nutrient concentrations are usually indicative of water quality problems. Algae need light and nutrients, most importantly carbon, nitrogen (N) and phosphorus (P), to grow. Light and carbon are not normally in short supply (limiting). This means that nutrients (N&P) are usually the limiting factors in algal growth. Nitrogen, as well as carbon, naturally occur in high concentrations and come from a variety of sources (soil, air, etc.) that are more difficult to control than sources of phosphorus. To compare the availability of these nutrients, a ratio of total nitrogen to total phosphorus is used (TN: TP). Ratios < 10:1 indicate nitrogen is limiting. Ratios of >15:1 indicate phosphorus is limiting. Ratios >10:1, <15:1 indicate that there is enough of both nutrients for excessive algal growth. The average ratio between total nitrogen and total phosphorus for Woodland Lake in 2004 was 14:1, indicating a "neutral" system. Lakes that are phosphorus-limited may be easier to manage, since controlling phosphorus is more feasible than controlling nitrogen or carbon.

Woodland Lake's average concentrations of total dissolved solids (TDS) and conductivity readings were lower than the county medians. These two parameters are correlated since the higher the concentrations of TDS in the water the higher the conductivity readings. The 2004 average for TDS was 253 mg/L, which is 79% lower than the county average of 454 mg/L. Similarly, the 2004 average conductivity reading was 0.453 milliSiemens/cm, which is 41% lower than the county median for oxic samples of 0.7652 milliSiemens/cm. Due to the close proximity of the lake to several roads, including Darrell Road that is located less than 10 feet from the lake, we expected TDS concentrations and conductivity readings to be higher. One of the most common dissolved solids is road salt used in winter road maintenance. While some road salt probably enters the lake from salt spreading and subsequent snow melt in the winter and spring, the impact is minimal since there is no direct runoff from Darrell Road into the lake. Road salt applied within the watershed does eventually enter the lake. Consequently, road salt usage should be considered when managing the lake. Some lakes in the county have seen a doubling of conductivity readings in the past 5-10 years. In a study by Environment Canada (equivalent to our USEPA), it was estimated that some aquatic species such as fish, zooplankton and benthic invertebrates would be affected by high chloride concentrations (found in road salt).

Water levels on Woodland Lake fluctuated throughout the season. The maximum one-month change, and the maximum change over the season, occurred between May and June when the lake level increased by 7.63 inches, due to the heavy rainfall in late-May. The water level declined after June and by September was at the same level as the May sample date. Significant changes in water levels may have a negative impact on water quality. In addition, lakes with fluctuating water levels potentially have more shoreline erosion problems. However, the fluctuating water levels in Woodland Lake appear to have had a minimal impact on the water quality parameters measured.

Rain events probably contribute additional sediment or nutrients (like phosphorus) to a lake, which may have influenced the water sample results. Rain occurred within 48 hours prior to water sampling in June (1.56 inches), July (0.11 inches), and September (0.05 inches) as recorded at the Lake County Stormwater Management Commission rain gages in Long Lake and Wauconda. The water quality parameters did not appear to be impacted by either of the rainfall events, however, the lake may be receiving nutrient inputs from stormwater from the adjacent landscape including residential lawns.

Based on data collected in 2004, standard classification indices compiled by the Illinois Environmental Protection Agency (IEPA) were used to determine the current condition of Woodland Lake. A general overall index that is commonly used is called a trophic state index or TSI. The TSI index classifies the lake into one of four categories: oligotrophic (nutrient-poor, biologically unproductive), mesotrophic (intermediate nutrient availability and biological productivity), eutrophic (nutrient-rich, highly productive), or hypereutrophic (extremely nutrient-rich productive). This index can be calculated using total phosphorus values obtained at or near the surface. The TSIp for Woodland Lake in 2004 classified it as a hypereutrophic lake (TSIp = 70.4). Eutrophic lakes are the most common types of lakes throughout the lower Midwest, and they are particularly common among manmade lakes. See Table 2 in Appendix A for a ranking of average TSIp values for Lake County lakes (Woodland Lake is currently #105 of 161). This ranking is only a relative assessment of the lakes in the county. The current rank of a lake is dependent upon many factors including lake origin, water source, nutrient loads, and morphometric features (volume, depth, substrate, etc.). Thus, a small shallow manmade lake with high nutrient loads could not expect to achieve a high ranking even with intensive management.

In Woodland Lake, the IEPA aquatic life impairment index indicating a partial degree of support for all aquatic organisms in the lake, based on the high trophic state, lack of aquatic plants and high NVSS concentrations. Similarly, due to the poor Secchi disk transparency readings in the lake the swimming index indicated only a partial degree of support. The recreation use index also was calculated to be a partial impairment due to the high trophic state and high NVSS concentrations. The overall use index for the lake was partial support.

We did not test for bacteria or other potentially harmful pathogens in the lake in 2004. However, since swimming is a popular activity on the lake, it is recommended that the residents engage in regular water sample testing for *E. coli* bacteria. *E.coli* is an indicator organism that can determine if other potentially harmful pathogens may be present. Residents can purchase sample bottles from one of the Lake County Health Department offices (Lake Villa, Wauconda, or Waukegan) at a cost of $15 (2004 price) per sample. At a minimum, one sample should be taken biweekly during the swimming season (typically Memorial Day to Labor Day).

LIMNOLOGICAL DATA – AQUATIC PLANT ASSESSMENT

Aquatic plant species presence and distribution in Woodland Lake were assessed monthly from May through September 2004 (see Appendix B for methods). Very few aquatic plants exist in the lake. Only three aquatic plant species and several emergent shoreline plants were found (see Table 3, below). Terrestrial shoreline plants were also noted, but not quantified.

Of the three species in the lake, curlyleaf pondweed (an exotic) was the only one that was found twice, at one location in May and at another location in September. Leafy pondweed was found at three locations in September and watermeal was found once in June.

A 1972 IDNR fisheries report indicated that approximately 15% of the lake was covered in yellow water crowfoot (*Ranunculus flabellaris*), and that milfoil was also present. It is unknown if the milfoil was the native northern water milfoil (*Myriophyllum sibiricum*) or the exotic Eurasian water milfoil (*Myriophyllum spicatum*). Current residents around the lake indicated that excessive aquatic plant populations in the lake were a problem for some time until recently. The lake was stocked with 30 triploid grass carp approximately 18 years ago. It is unknown if any of these carp are still alive due to the limited aquatic vegetation present in the lake and the natural life span of the fish (approximately 20 years).

The 1% light levels (the point where plant photosynthesis ceases) remained relatively consistent throughout the summer with the 1% level penetrating down to between four and six feet. Although no bathymetric map of Woodland Lake exists, depth soundings throughout the season indicate that most of the lake is between three and six feet deep. The Illinois Department of Natural Resources recommends 25-40% aquatic plant coverage to maintain ideal gamefish habitat conditions.

No herbicide or algicide treatments occurred in 2004, however the lake has had treatments in years past. The most recent treatment was for curlyleaf pondweed, which was treated with seven gallons of Reward® in 2001. The current minimal aquatic plant composition in the lake may be due to an ecological shift from a plant dominated lake to an algae/sediment dominated lake. This shift may have resulted from the 2001 herbicide treatment that occurred when aquatic plants were common in the lake. Once this shift occurred, the light penetration was reduced significantly to a point where the only areas of the lake receiving light levels conducive to plant growth were less than two or three feet. This is supported by the maximum depth at which plants were found was 1.6 feet. If water clarity improved, the potential aquatic plant coverage along the lake bottom is near 100%. Thus, an active management plan for Woodland Lake should be implemented.

It is recommended that some native aquatic plants be allowed to grow and expand, while controlling those that become invasive and interfere with the aesthetic qualities of the lake. This may be achieved by spot treating areas of the lake where problematic plants are occurring. Healthy plant populations in the lake may result in cost savings due to the need for less herbicides and algicides. Native aquatic plants infrequently grow to nuisance levels (with the exception of coontail) and will compete with algae for available nutrients, as well as stabilize lake bottom sediment. A healthy aquatic plant community will help improve water clarity and provide habitat for fish and wildlife species. In addition, swimming conditions will be improved with increased clarity. This is important as residents identified swimming as a major lake use. However, under the current lake conditions the IEPA swimming index was classified as having only a partial support. Improving water clarity may help the swimming index reach a degree of full support.

Floristic quality index (FQI; Swink and Wilhelm 1994) is an assessment tool designed to evaluate the closeness that the flora of an area is 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. Each aquatic plant in a lake is assigned a number between 1 and 10 (10 indicating the plant species most sensitive to disturbance). This is done for every floating and submersed plant species found in the lake. These numbers are averaged and multiplied by the square root of the number of species present to calculate an FQI. 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 counted in the FQI calculations for Lake County lakes. In 2004, Woodland Lake had a FQI of 8.1. The median FQI of lakes that we have studied from 2000-2004 is 12.1.

Table 3. Aquatic and shoreline plants on Woodland Lake, May - September 2004.

Aquatic Plants	
Curlyleaf Pondweed#	*Potamogeton crispus*
Leafy Pondweed	*Potamogeton foliosus*
Watermeal	*Wolffia columbiana*
Shoreline Plants	
Box Elder	*Acer negundo*
Silver Maple	*Acer saccharinum*
Shagbark Hickory	*Carya ovata*
Slender Spikerush	*Eleocharis acicularis*
Jewelweed	*Impatiens pallida*
Blue Lobelia	*Lobelia siphilitica*
Yellow Sweet Clover#	*Melilotus officinalis*
Peppermint	*Mentha spicata*
Virginia Creeper	*Parthenocissus quinquefolia*
Reed Canary Grass#	*Phalaris arundinacea*
Blue Spruce	*Picea pungens*
Smartweed	*Polygonum* sp.
Bur Oak	*Quercus macrocarpa*
Common Buckthorn#	*Rhamnus cathartica*
Common Arrowhead	*Sagittaria latifolia*
Willow	*Salix sp.*
Elderberry	*Sambucus* sp.
Softstem Bulrush	*Scirpus validus*
Bittersweet Nightshade#	*Solanum dulcamara*
Sow Thistle#	*Sonchus* sp.
Common Cattail	*Typha latifolia*
Blue Vervain	*Verbena hastata*
Wild Grape	*Vitis* sp.

 # Exotic species

LIMNOLOGICAL DATA – SHORELINE ASSESSMENT

A shoreline assessment was conducted in July 2004 to determine the condition of the lake shoreline (see Appendix B for methods). Of particular interest was the condition of the shoreline at the water/land interface.

The entire shoreline of Woodland Lake was classified as developed. Buffer (which is a strip of unmowed vegetation preferably consisting of native plants located at the water's edge), lawn, and riprap habitats were the most common shoreline types consisting of 35%, 25% and 24% of the shoreline, respectively (Figure 5). The other shoreline types around the lake (seawall, beach, and shrub) make up the remaining 16% of the shoreline. Buffer habitat should be expanded around the lake, particularly where manicured lawns are located. This habitat can help filter the nutrients and pollutants from the surrounding watershed before they enter the lake, as well as providing habitat that is favored by many wildlife species, but not favored by residential Canada geese.

The shoreline was assessed for the degrees and types of shoreline erosion. Only 239 feet (10.0%) of the shoreline was classified as slightly eroding, and only one 28-foot section of the shoreline (1.2%), located on the southern shoreline, was classified as moderately eroding (Figure 6). There were no areas around the lake that were classified as severely eroding. The slightly eroded areas should be monitored for future degradation. The moderately eroded area should be remediated immediately to prevent additional loss of shoreline and prevent continued degradation of the water quality through sediment inputs. When possible, the shorelines should be repaired using natural vegetation and not riprap or seawalls. More information can be found in **Objective III: Shoreline Erosion Control**.

Several exotics were found growing along the shoreline, including buckthorn and reed canary grass. Similar to aquatic exotics, these terrestrial exotics are detrimental to the native plant ecosystems around the lake. Removal or control of exotic species is recommended. More information can be found in **Objective IV: Eliminate or Control Exotic Species**.

LIMNOLOGICAL DATA – WILDLIFE ASSESSMENT

Fair numbers of wildlife, particularly birds, were noted on and around Woodland Lake. See Appendix B for methods. Several of the species listed in Table 5 (below) were seen during spring or fall migration and were assumed not to be nesting around the lake.

Habitat around Woodland Lake was fair. Since the entire shoreline is developed, minimal habitat exists for many species. The mature oak and hickory trees provide habitats where many of the bird species were observed. The buffer strips that do exist around the lake are minimal and, while providing some habitat, should be expanded to benefit more species. Additional habitat may be created around the lake, such as erecting birdhouses and planting native emergent and upland vegetation or allowing brush and trees that have

Figure 7. Shoreline types

Figure 8. Erosion.

falling into the water remain. More information can be found in **Objective V: Enhance Wildlife Habitat Conditions**.

We did not conduct any fish surveys in 2004. However, as mentioned previously, the IDNR completed a fisheries report on the lake in 1972. At the time, IDNR concluded that the lake's fishery was in poor condition consisting of small bass, green sunfish, and goldfish. An updated fish survey is recommended.

Table 5. Wildlife species observed on Woodland Lake, April – September 2004.

Birds	
Canada Goose	*Branta canadensis*
Mallard	*Anas platyrhnchos*
Wood Duck	*Aix sponsa*
Great Egret	*Casmerodius albus*
Great Blue Heron	*Ardea herodias*
Turkey Vulture	*Cathartes aura*
Mourning Dove	*Zenaida macroura*
Common Flicker	*Colaptes auratus*
Downy Woodpecker	*Picoides pubescens*
Barn Swallow	*Hirundo rustica*
Tree Swallow	*Iridoprocne bicolor*
American Crow	*Corvus brachyrhynchos*
Blue Jay	*Cyanocitta cristata*
Black-capped Chickadee	*Poecile atricapillus*
House Wren	*Troglodytes aedon*
Catbird	*Dumetella carolinensis*
American Robin	*Turdus migratorius*
Cedar Waxwing	*Bombycilla cedrorum*
Warbling Vireo	*Vireo gilvus*
Red-winged Blackbird	*Agelaius phoeniceus*
Common Grackle	*Quiscalus quiscula*
Starling	*Sturnus vulgaris*
House Sparrow	*Passer domesticus*
Northern Cardinal	*Cardinalis cardinalis*
House Finch	*Carpodacus mexicanus*
American Goldfinch	*Carduelis tristis*
Chipping Sparrow	*Spizella passerina*
Mammals	
Eastern Chipmunk	*Tamias striatus*
Gray Squirrel	*Sciurus carolinensis*

Table 5. Wildlife species observed on Woodland Lake, April – September 2004 (cont'd).

Amphibians	
American Toad	*Bufo americanus*
Bull Frog	*Rana catesbeiana*
Reptiles	
Painted Turtle	*Chrysemys picta*
Insects	
Cicadas	Cicadidae
Dragonfly	Anisoptera
Damselfly	Zygoptera

***Endangered in Illinois**
+Threatened in Illinois

EXISTING LAKE QUALITY PROBLEMS

- *Lack of a Quality Bathymetric Map*

  A bathymetric (depth contour) map is an essential tool for effective lake management since it provides critical information on the morphometric features of the lake (i.e., acreage, depth, volume, etc.). This information is particularly important when intensive management techniques (i.e., aeration, chemical treatments for plant or algae control, dredging, fish stocking, etc.) are part of the lake's overall management plan. Currently, no bathymetric map of Woodland Lake exists.

- *Poor Water Clarity and High Concentrations of Total Suspended Solids (TSS) and Total Phosphorus (TP)*

  Woodland Lake had a Secchi disk transparency reading of 1.72 feet, which is 44 % lower than the county median. Correlated with clarity was the seasonal average for TSS of 21.2 mg/l, which is nearly three times higher than the county median of 7.9 mg/L. The majority of the TSS is in inorganic forms, such as sediment. Due to the small watershed and current land uses around the lake, the source of the TSS is likely internal. The 2004 seasonal average for TP in Woodland Lake is 0.099 mg/L, which is 57% higher than the county median of 0.063 mg/L. A portion of the TP is probably attached to the sediment found in the water column.

- *Limited Aquatic Vegetation*

  Only three species of aquatic plants were found in Woodland Lake. The minimal aquatic plant populations contributed to the poor water quality and precipitated algae blooms. Beneficial native plants (both submersed and emergent) should be encouraged to expand to enhance habitats for fish and other wildlife and as well as improve water quality. A balanced aquatic plant management plan could address the aesthetic needs of the homeowners and the overall ecological health of the lake.

- *Shoreline Erosion*

  While most of the shoreline of Woodland Lake is currently experiencing no or minimal erosion, a 28-foot section of the shoreline located on the southern shoreline was classified as moderately eroding. There were no areas around the lake that were classified as severely eroding. The slightly eroded areas should be monitored for future degradation. The moderately eroded area should be remediated immediately to prevent additional loss of shoreline and prevent continued degradation of the water quality through sediment inputs. When possible, the shoreline should be repaired using natural vegetation and not riprap or seawalls.

- *Invasive Shoreline Plant Species*

  Numerous exotic plant species (i.e., buckthorn and reed canary grass) were found on the shores of Woodland Lake. These exotics are particularly problematic as they outcompete native plants and offer little value in terms of shoreline stabilization or wildlife habitat. These exotic plants should be removed and replaced with native shoreline plants.

POTENTIAL OBJECTIVES FOR THE WOODLAND LAKE MANAGEMENT PLAN

I. Create a Bathymetric Map Including a Morphometric Table
II. Illinois Volunteer Lake Monitoring Program
III. Shoreline Erosion Control
IV. Eliminate or Control Exotic Plant Species
V. Enhance Wildlife Habitat Conditions

Objective I: Create a Bathymetric Map Including a Morphometric Table

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

Objective II: 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, approximately 165 lakes (out of 3,041 lakes in Illinois) are sampled by approximately 300 citizen volunteers. The volunteers are primarily lake shore residents, lake owners/managers, members of environmental groups, public water supply personnel, and citizens with interest in a particular lake.

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.

For information, please contact:

VLMP Regional Coordinator:
Holly Hudson
Northeastern Illinois Planning Commission
233 S. Wacker Drive, Suite 880
Chicago, IL 60606
(312) 386-8700

Objective III: Shoreline Erosion Control

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.

Option 1: No Action

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: Install a Seawall

Seawalls are designed to prevent shoreline erosion on lakes in a similar manner they are used along coastlines to prevent beach erosion or harbor siltation. Today, seawalls are generally constructed of steel, although in the past seawalls were made of concrete or wood (frequently old railroad ties). Concrete seawalls cracked or were undercut by wave action requiring routine maintenance. Wooden seawalls made of old railroad ties are not used anymore since the chemicals that made the ties rot-resistant could be harmful to aquatic organisms. A new type of construction material being used is vinyl or PVC. Vinyl seawalls are constructed of a lighter, more flexible material as compared to steel. Also, vinyl seawalls will not rust over time as steel will.

Pros

If installed properly and in the appropriate areas (i.e., shorelines with severe erosion) seawalls provide effective erosion control. Seawalls are made to last numerous years and have relatively low maintenance.

Cons

Seawalls are disadvantageous for several reasons. One of the main disadvantages is that they are expensive, since a professional contractor and heavy equipment are needed for installation. Any repair costs tend to be expensive as well. If any fill material is placed in the floodplain along the shoreline, compensatory storage may also be 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. Permits and surveys are needed whether replacing and old seawall or installing a new one (see costs below).

Wave deflection is another disadvantage to seawalls. Wave energy not absorbed by the shoreline is deflected back into the lake, potentially causing sediment disturbance and resuspension, which in turn may cause poor water clarity and problems with nuisance algae, which use the resuspended nutrients for growth. If seawalls are installed in areas near channels, velocity of run-off water or channel flow may be accelerated. This may lead to flooding during times of high rainfall and run-off, shoreline erosion in other areas of the lake, or a resuspension of sediment due to the agitation of the increased wave action or channel flow, all of which may contribute to poor water quality conditions throughout the lake. Plant growth may be limited due to poor water clarity, since the photosynthetic zone where light can penetrate, and thus utilized by plants, is reduced. Healthy plants are important to the lake's overall water clarity since they can help filter some of the incoming sediment, prevent resuspension of bottom sediment, and compete with algae for nutrients. However, excessive sediment in the water and high turbidity may overwhelm these benefits.

Finally, seawalls provide no habitat for fish or wildlife. Because there is no structure for fish, wildlife, or their prey, few animals use shorelines with seawalls. In addition, poor water clarity that may be caused by resuspension of sediment from deflected wave action contributes to poor fish and wildlife habitat, since sight feeding fish and birds (i.e., bass, herons, and kingfishers) are less successful at catching prey. This may contribute to a lake's poor fishery (i.e., stunted fish populations).

Costs

Depending on factors such as slope and shoreline access, cost of seawall installation ranges from $85-100 per linear foot for steel and $95-110 per linear foot for vinyl. A licensed contractor installs both types of seawall. Additional costs may occur if the shoreline needs to be graded and backfilled, has a steep slope, or poor accessibility. Price does not include the necessary permits required. Additional costs will be incurred if compensatory storage is needed. Prior to the initiation of work, permits and/or surveys from the appropriate government agencies need to be obtained. For seawalls, a site development permit and a building permit are needed. Costs for permits and surveys can be $1,500-2,000 for installation of a seawall. Contact the Army Corps of Engineers, local municipality, or the Lake County Planning and Development Department.

Around Woodland Lake, the costs to install a seawall along the moderately eroded shoreline (28 feet) would cost approximately $2,380 – 2,800 for steel and $2,660 – 3,080 for vinyl, not including permits.

<u>Option 3: Install Rock Rip-Rap or Gabions</u>

Rip-rap is the term for using rocks to stabilize shorelines. Size of the rock depends on the severity of the erosion, distance to rock source, and aesthetic preferences. Generally, four to eight inch diameter rocks are used. Gabions are wire cages or baskets filled with rock. They provide similar protection as rip-rap, but are less prone to displacement. They can be stacked, like blocks, to provide erosion control for extremely steep slopes. Both rip-rap and gabions can be incorporated with other erosion control techniques such as plant buffer strips. If any plants will be growing on top of the rip-rap or gabions, fill will probably be needed to cover the rocks and provide an acceptable medium for plants to grow on. Prior to the initiation of work, permits and/or surveys from the appropriate government agencies need to be obtained (see costs below).

Pros

Rip-rap and gabions can provide good shoreline erosion control. Rocks can absorb some of the wave energy while providing a more aesthetically pleasing appearance than seawalls. If installed properly, rip-rap and gabions will last for many years. Maintenance is relatively low, however, undercutting of the bank can cause sloughing of the rip-rap and subsequent shoreline. Areas with severe erosion problems may benefit from using rip-rap or gabions. In all cases, a filter fabric should be installed under the rocks to maximize its effectiveness.

Fish and wildlife habitat can be provided if large boulders are used. Crevices and spaces between the rocks can be used by a variety of animals and their prey. Small mammals, like shrews can inhabit these spaces in the rock above water and prey upon many invertebrate species, including many harmful garden and lawn pests. Also, small fish may utilize the structure underwater created by large boulders for foraging and hiding from predators.

Cons
A major disadvantage of rip-rap is the initial expense of installation and associated permits. Installation is expensive since a licensed contractor and heavy equipment are generally needed to conduct the work. Permits are required if replacing existing or installing new rip-rap or gabions and must be acquired prior to work beginning. If any fill material is placed in the floodplain along the shoreline, compensatory storage may also be 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.

While rip-rap and gabions absorb wave energy more effectively than seawalls, there is still some wave deflection that may cause resuspension of sediment and nutrients into the water column.

Small rock rip-rap is poor habitat for many fish and wildlife species, since it provides limited structure for fish and cover for wildlife. As noted earlier, some small fish and other animals will inhabit the rocks if boulders are used. Smaller rip-rap is more likely to wash away due to rising water levels or wave action. On the other hand, larger boulders are more expensive to haul in and install.

Rip-rap may be a concern in areas of high public usage since it is difficult and possibly dangerous to walk on due to the jagged and uneven rock edges. This may be a liability concern to property owners.

Costs
Cost and type of rip-rap used depend on several factors, but average cost for installation (rocks and filter fabric) is approximately $35-50 per linear foot. Costs for gabions are approximately $70-100 per linear foot when filled with rocks. The steeper the slope and severity of erosion, the larger the boulders that will need to be used and thus, higher installation costs. In addition, costs will increase with poor shoreline accessibility and increased distance to rock source. Costs for permits and surveys can be $1,500-2,000 for installation of rip-rap or gabions, depending on the circumstances. Additional costs will be incurred if compensatory storage is needed. Contact the Army Corps of Engineers, local municipalities, and the Lake County Planning and Development Department.

Around Woodland Lake, the costs to install riprap along the moderately eroded shoreline (28 feet) would cost approximately $980 – 1,400, not including permits.

Option 4: 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. A table in 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.

A technique that is sometimes implemented along shorelines is the use of willow posts, or live stakes, which are harvested cuttings from live willows (*Salix* spp.). They can be planted along the shoreline along with a cover crop or native seed mix. The willows will resprout and begin establishing a deep root structure that secures the soil. If the shoreline is highly erodible, willow posts may have to be used in conjunction with another erosion control technique such as biologs, A-Jacks ®, or rip-rap.

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 a table in 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. Two invertebrates of particular importance for lake management, the water-milfoil weevils (*Euhrychiopsis lecontei* and *Phytobius leucogaster*), which have been shown to naturally reduce stands of exotic Eurasian water-milfoil (*Myriophyllum spicatum*). Weevils need proper over wintering habitat such as leaf litter and mud which are typically found on naturalized shorelines or shores with good buffer strips. Many species of amphibians, birds, fish, mammals, reptiles, and invertebrates have suffered precipitous declines in recent years primarily due to habitat loss. Buffer strips may help many of these species and preserve the important diversity of life in and around lakes.

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 $15 per linear foot, plus labor. Cost of installing willow posts is approximately $20-25 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 $1,500-2,000 depending on the types of permits needed.

Option 5: Install A-Jacks®
A-Jacks® are made of two pieces of pre-cast concrete when fitted together resemble a child's playing jacks. These structures are installed along the shoreline and covered with soil and/or an erosion control product. Native vegetation is then planted on the backfilled area. They can be used in areas where severe erosion does not justify a buffer strip alone.

Pros
The advantage to A-Jacks® is that they are quite strong and require low maintenance once installed. In addition, once native vegetation becomes established the A-Jacks® can not be seen. They provide many of the advantages that both rip-rap and buffer strips have. Specifically, they absorb some of the wave energy and protect the existing shoreline from additional erosion. The added benefit of a buffer strip gives the A-Jacks® a more natural appearance, which may provide wildlife habitat and help filter run-off nutrients, sediment, and pollutants. Less run-off entering a lake may have a positive effect on water quality.

Cons
The disadvantage is that installation cost can be high since labor is intensive and requires some heavy equipment. A-Jacks® need to be pre-made and hauled in from the manufacturing site. These assemblies are not as common as rip-rap, thus only a limited number of contractors may be willing to do the installation.

Costs

The cost of installation is approximately $50-75 per linear foot, but does not include permits and surveys, which can cost $1,500-2,000 and must be obtained prior to any work implementation. Additional costs will be incurred if compensatory storage is needed.

To repair the moderately eroding areas (28 feet) on Woodland Lake with A-Jacks® would cost approximately $1,400 – 2,100, not including permits.

<u>Option 6: Install Biolog, Fiber Roll, or Straw Blanket with Plantings</u>

These products are long cylinders of compacted synthetic or natural fibers wrapped in mesh. The rolls are staked into shallow water. Once established, a buffer strip of native plants can be planted along side or on top of the roll (depending if rolls are made of synthetic or natural fibers). They are most effective in areas where plantings alone are not effective due to already severe erosion. In areas of severe erosion, other techniques may need to be employed or incorporated with these products.

Pros

Biologs, fiber rolls, and straw blankets provide erosion control that secure the shoreline in the short-term and allow native plants to establish which will eventually provide long-term shoreline stabilization. They are most often made of bio-degradable materials, which break down by the time the natural vegetation becomes established (generally within 3 years). They provide additional strength to the shoreline, absorb wave energy, and effectively filter run-off from terrestrial sources. These factors help improve water quality in the lake by reducing the amount of nutrients available for algae growth and by reducing the sediment that flows into a lake.

Cons

These products may not be as effective on highly erodible shorelines or in areas with steep slopes, as wave action may be severe enough to displace or undercut these products. On steep shorelines grading may be necessary to obtain a 2:1 or 3:1 slope or additional erosion control products may be needed. If grading or filling is needed, the appropriate permits and surveys will have to be obtained.

Costs

Costs range from $40 to $45 per linear foot of shoreline, including plantings. This does not include the necessary permits and surveys, which may cost $1,500 – 2,000 depending on the type of earthmoving that is being done. Additional costs may be incurred if compensatory storage is needed.

Objective IV: 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, its roots exude a chemical that discourages other plant growth, and it is quick to become established on disturbed soils. Reed canary grass is an aggressive plant species that was introduced as a shoreline stabilizer. It is found on lakeshores, stream banks, marshes and exposed moist ground. Although it does serve to stabilize shorelines to some extent, it has low food value and does not provide winter habitat for wildlife. It is very successful in taking over disturbed areas and, if left unchecked, will dominate an area, particularly a wetland or shoreline, in a short period of time. Since it begins growing early in the spring, it quickly out-competes native vegetation that begins growth later in the year. Control of 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*).

The presence of exotic species along a lakeshore is by no means a death sentence for the lake or other plant and animal life. If controlled, many exotic species can perform many of the original functions that they were brought here for. For example, reed canary grass was imported for its erosion control properties. It still contributes to this objective (offering better erosion control than commercial turfgrass), but needs to be isolated and kept in control. Many exotics are the result of garden or ornamental plants escaping into the wild. One isolated plant along a shoreline will probably not create a problem by itself, but its removal early on is best. Problems arise when plants are left to spread, many times to the point where treatment is difficult or cost prohibitive. 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.

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

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

Pros

There are few advantages with this option. Some of the reasons exotics were brought into this country are no longer used or have limited use. However, in some cases having an exotic species growing along a shoreline may actually be preferable if the alternative plant is commercial turfgrass. Since turfgrass has shallow roots and is prone to erosion along shorelines, exotics like reed canary grass or common reed (*Phragmites australis*) will control erosion more effectively. Native plants should take precedent over exotics whenever possible. 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 zeroing initially, however, when control is eventually needed, costs will be substantially more than if action was taken immediately. Additionally, the eventual loss of ecological diversity is difficult to calculate financially.

<u>Option 2: Control by Hand</u>

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

Pros

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

Cons

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

Costs

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

Option 3: Herbicide Treatment

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

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

Pros

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

Cons

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

Costs

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

Objective V: Enhance Wildlife Habitat Conditions

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

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

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

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

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

Pros

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

Cons

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

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

Costs

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

Option 2: Increase Habitat Cover

This option can be incorporated with Option 3 (see below). One of the best ways to increase habitat cover is to leave a minimum 25-foot buffer between the edge of the water and any mowed grass. Allow native plants to grow or plant native vegetation along shorelines, including emergent vegetation such as cattails, rushes, and bulrushes (see the table in 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.

Option 5: Limit Disturbance

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

Pros

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

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

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

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

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