2003 SUMMARY REPORT
of
NORTH CHURCHILL
and
SOUTH CHURCHILL

Lake County, Illinois

Prepared by the

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EXECUTIVE SUMMARY

North Churchill Lake (NCL) and South Churchill Lake (SCL) are located within the property of Saddlebrook Farms, a retirement community in Round Lake Park. These lakes are connected to each other by a short channel and drain into Squaw Creek at the northwest corner of NCL via a spillway. Residents of the community use these lakes for non-motorized boating, fishing and aesthetics.

In comparison to other lakes throughout Lake County, the water quality in these two lakes is poor. Both lakes have poor water clarity of less than one foot deep. High total suspended solids, most of which was sediment particles, clouded the water in both lakes.

Both lakes have high nitrogen and phosphorus concentrations. NCL has total phosphorus concentrations 48% higher than the Lake County median. Nitrate nitrogen is also high in NCL; the seasonal average was more than 12 times higher than the Lake County median. In SCL, total phosphorus averaged nearly 53% higher than the median for Lake County, and nitrate nitrogen seasonal average was 47 times higher than the Lake County median. The sample concentrations for nitrate in SCL fluctuated greatly, with a range from 0.372 mg/L to 9.67 mg/L. The 9.67 mg/L concentration is the highest value for nitrate ever recorded for our database. After collecting stormwater samples from a nearby inflow, it was determined that a local greenhouse was the source of the nitrate. This inflow from the greenhouse will be curtailed according to Illinois EPA statutes.

Aquatic plants were found in very few sample sites. American pondweed was found along a few places near the west shore of NCL and in two locations next to the island. In SCL only one location, the northeast corner adjacent to the wetland shoreline, supported plants. To support a healthy warm water fishery, the optimal aquatic plant coverage is 30% to 40% of the lake bottom. In each lake, the aquatic plants covered less than 1% of the lake bottom, offering little in terms of food, shelter and nursery habitat for aquatic life.

Approximately 40% of the shoreline along NCL is eroding to some degree, which does not include the eroding shoreline behind the seawalls. The seawalls, poorly constructed from wooden slats, are failing in several locations. The most common shoreline types were seawall and buffer. Approximately 62% of the shoreline along SCL is eroding to some degree, with the two most common shoreline types classified as buffer and prairie.

Based on 2000 data compiled by Northeastern Illinois Planning Commission, the largest percent of land that drains into these lakes is categorized as agricultural, which comprises approximately 42% of the total watershed. Residential land use encompasses approximately 22% of the watershed. Both of these land uses can be sources of nutrients and sediment to lakes.

The narrow strip of land between the two lakes and Squaw Creek offers some prairie habitat for wildlife. Very little habitat is offered along the east shoreline as it consists mostly of lawns, houses and seawall. Neither lake has had a fishery survey by the Illinois Department of Natural Resources (IDNR), so the conditions of the fish populations are unknown. The Saddlebrook Farms Fishing Club stocks the lakes yearly for the enjoyment of "put-and-take" fishing.

However, only apex predators are stocked, not a combination of predators and forage fish. Continually stocking the lakes in this manner can lead to an imbalanced fishery, especially since the balance of the species' populations are unknown. In addition, the poor habitat within the lake, e.g., poor water clarity and virtually no aquatic plants, will not support some of the species that have been stocked.

LAKE IDENTIFICATION AND LOCATION

North Churchill Lake (NCL) is a 62.1-acre manmade lake in central Lake County (T44, R10E, Sections 4 and 9), with a maximum depth of 11 feet. The lake has an estimated average depth of 5.5 feet, with a volume of 342 acre-feet. The length of shoreline is 2.4 miles. The lake lies within the municipal boundaries of Round Lake Park. The lake drains from a spillway to Squaw Creek, which flows directly adjacent to the lake, eventually flowing into Long Lake before reaching the Fox River/Chain O'Lakes.

South Churchill Lake (SCL) is 24.8 acres and is connected to NCL by a small channel. South Churchill has a maximum depth of 9 feet, with an approximate average depth of 4.5 feet. The lake volume is approximated at 112 acre-feet. Neither lake has had a recent, accurate bathymetric (depth contour) map made with volume calculations, so the average depths and volumes are approximated.

BRIEF HISTORY OF NORTH AND SOUTH CHURCHILL LAKES

NCL and SCL were built for the Saddlebrook Farms development. The area was farmland prior to construction. SCL began its construction in about 1993, and NCL was completed afterward, sometime prior to 1997.

Saddlebrook Farms has its own wastewater treatment facility less than one mile east of the lakes. The facility uses a spray irrigation system to discharge its effluent onto fields to the south of the facility. The facility is required to submit reports to the Illinois Environmental Protection Agency.

SUMMARY OF CURRENT AND HISTORICAL LAKE USES

NCL and SCL are generally used for stormwater inputs from the development, aesthetics and fishing. Most of the fishing pressure is catch and release. The Saddlebrook Farms Fishing Club periodically stocks the lakes with a variety of predators such as largemouth bass, smallmouth bass, walleye, northern pike and muskellunge. Stocking only apex predators such as these can lead to an imbalance of the fishery. In addition, some of these species will not thrive in NCL and SCL because of the high turbidity. A survey of the fishery should be done to determine what types of fish should be stocked instead of only adding predators to the lake. Some residents have also tried installing some aquatic plants, but with limited success.

LIMNOLOGICAL DATA - WATER QUALITY

Water samples were collected each month, from May through September 2003, at the deepest location (see Figure 1 and 2) in each lake. All samples were analyzed for a variety of parameters. The water quality data can be found in Table 1, Appendix A. See Appendix B for water quality sampling and laboratory methods.

Thermal stratification occurs when a lake divides into warm water layer near the surface (epilimnion) and a cold-water layer near the bottom (hypolimnion). When stratified, the epilimnetic and hypolimnetic waters do not mix, and the hypolimnion typically becomes anoxic (dissolved oxygen = 0 mg/L) by mid-summer in nutrient-enriched lakes. This is typical of deep lakes. Some shallow lakes remain unstratified throughout the growing season, resulting in similar concentrations of most water quality parameters throughout the water column. Because this is the case for both lakes, the discussion of the water quality parameters will focus on samples from the (near surface) epilimnion. During most of the 2003 sampling season, both NCL and SCL had at least 5.0 mg/L of dissolved oxygen (DO) throughout the water column. A concentration of 5.0 mg/L is considered adequate to support a warm water fishery. Many desirable warm water fish such as largemouth bass and bluegill can suffer from oxygen stress below this amount. During June 2003, DO concentrations in SCL were less than 5.0 mg/L below 7 feet deep, which is close to the bottom. Similarly in August, DO concentrations in NCL were less than 5.0 mg/L below 5 feet deep. Because both lakes are shallow, the DO concentrations should be adequate for aquatic life in both lakes. However, since there is no recent, accurate bathymetric map, we cannot calculate the amount of lake volume that had a good DO supply.

One concern some residents have about the lakes was the low water clarity, which averaged only 0.61 feet in NCL and 0.73 feet in SCL during 2003. Water clarity is usually the first thing people notice about a lake, and typifies the overall lake quality. The Lake County median clarity for 130 lakes throughout Lake County is 3.41 feet deep. The poor water clarity in both lakes is a result of the high total suspended solids (TSS) concentrations throughout the water column. The seasonal TSS averages of 77.2 mg/L in NCL and 43.6 mg/L in SCL are 10 times and nearly six times more than the Lake County median, respectively. TSS is composed of nonvolatile suspended solids (NVSS) such as non-organic clay or sediment materials, and volatile suspended solids (VSS) such as algae and other organic matter. The sediment may be disturbed from the bottom from wind and wave action and carp activity. Another source of sediment to the water column is from the eroding shoreline, as soil washes into the water.

Two important nutrients for algae growth, nitrogen and phosphorus, were in high concentrations in NCL. Total phosphorus (TP) averaged 0.087 mg/L in NCL and 0.090 mg/L in SCL, which are nearly 48% and 53% higher, respectively, than the Lake County TP median of 0.059 mg/L. Generally, nuisance algae blooms can occur with TP concentrations of 0.05 mg/L. Although the TP concentrations were high, NCL did not experience nuisance algal blooms during 2003. We did see some nuisance algal growth of *Chladophora* at the south end of SCL, which can also contribute to poor water clarity. However, algae growth appeared to be limited in both lakes. One reason is that phosphorus can adhere to clay particles, which were prevalent in the lake,

INSERT FIGURE 1, NORTH SAMPLING POINT

INSERT FIGURE 2 SOUTH SAMPLING POINT

making this nutrient unavailable for algae use. Also, the sediment in the water may have blocked some of the available sunlight needed for algal growth, since most of the light was extinguished between 1-2 feet deep from May through September. TP concentrations are used to determine the trophic state index (TSI), which classifies lakes according to the overall level of nutrient enrichment. Using the total phosphorus concentration, the TSI score can be calculated. The score falls within the range of one of four categories: oligotrophic mesotrophic, eutrophic and hypereutrophic. Mesotrophic and oligotrophic lakes are those with low and poor nutrient levels, respectively. These are very clear lakes, with little or no plant and/or algae growth. Most lakes in Lake County are classified as eutrophic or nutrient rich, and are productive lakes in terms of aquatic plants and/or algae and fish. Hypereutrophic lakes are those that have excessive nutrients, with nuisance algae growth reminiscent of "pea soup" and have a score greater than 70. The TSIs of NCL and SCL in terms of their phosphorus concentrations during 2003 were eutrophic, bordering hypereutrophic, with scores of 68.6 and 69.0, respectively. NCL ranked 80th and SCL 82nd out of 130 Lake County lakes based on average total phosphorus concentrations (See Table 3 in Appendix A). Sources of phosphorus include stormwater runoff that has washed fertilizers from the watershed, from soils eroding along the shoreline and soils washing into the lake from construction activities. In addition, the lakes maybe receiving some nutrients from the spray irrigation of the Saddlebrook Farms waste treatment facility since the irrigation fields are within the NCL and SCL watershed. However, the exact impact of the irrigation effluent is unknown.

The other nutrient critical for algae growth is nitrogen. Total Kjeldahl nitrogen (TKN) is a measure of organic nitrogen, and is typically bound up in algal cells. TKN concentrations averaged of 1.49 mg/L in NCL and 1.42 mg/L in SCL, which are 22% higher 17% higher than the Lake County median, respectively. Nitrate nitrogen (NO_3-N) was extremely high in SCL; the seasonal average of 4.99 mg/L is **47 times higher** than the Lake County median of 0.106 mg/L. The sample concentrations in SCL fluctuated greatly, with a range from 0.372 mg/L to 9.67 mg/L. In only one month the concentration dropped from 9.67 mg/L (June) to 3.86 mg/L (July). The 9.67 mg/L concentration is the highest value for nitrate ever recorded for our database. To show an example of the severity, the next highest value concentration in our database is 2.96 mg/L. Nitrogen can come from a variety of external sources, including rain, fertilizer, the atmosphere and other non-point sources, but with extreme cases such as SCL, these "everyday" sources are only a small fraction of the nitrogen that has entered this lake. In the spring of 2004, stormwater sampling of a southern inlet revealed that the source was from a local green house. This inflow from the greenhouse will be curtailed according to Illinois EPA statutes. NO_3-N was also high in NCL; the seasonal average of 1.288 mg/L is more than 12 times higher than the Lake County median. Ammonia, the most available form of nitrogen for algae growth, was detected in only two epilimnetic samples in NCL during 2003. However in SCL, ammonia was detected in all but the September sample, with an average of 0.138 mg/L for the 2003 season. Like the nitrate, the ammonia is likely entering the lake through external sources. This is because algae were using this nutrient as quickly as it was available for use, and because ammonia also converts to other nitrogen forms in the presence of dissolved oxygen. Common sources for nitrogen and phosphorus include watershed inputs from the surrounding neighborhood, and wind, wave and carp action that sweeps sediment and any phosphorus bound to the sediment into the water column. NCL most likely receives some of its high nutrient load from SCL. SCL is receiving very high concentrations of nitrate from a local greenhouse.

The ratio of total nitrogen to total phosphorus (TN:TP) indicates if the amount of phosphorus or nitrogen would limit algae and/or plant growth in the lake. Lakes with TN:TP ratios of more than 15:1 are usually limited by phosphorus. Those with ratios less than 10:1 are usually limited by nitrogen. Although TP is high in NCL, the high nitrogen concentrations caused the TN:TP ratio to be 32:1, indicating that the lake is limited by phosphorus. In NCL the ratio was 71:1.

The Illinois Environmental Protection Agency (IEPA) has indices to classify Illinois lakes for their ability to support aquatic life, swimming, or recreational uses. The guidelines consider several aspects, such as phosphorus concentrations, water clarity and aquatic plant coverage. Both NCL and SCL partially support aquatic life according to these guidelines. The lakes do not fully support aquatic life because of the low water clarity, high phosphorus concentrations and a lack of aquatic vegetation. If the lakes were used for swimming, they would also be classified as partially impaired because of the low water clarity and high phosphorus concentrations. The low water clarity and high NVSS concentrations placed the lakes in the nonsupport category for in-lake recreational uses. The overall use support category for NCL and SCL is that of partial support.

Conductivity is a measurement of water's ability to conduct electricity via total dissolved solids (TDS), which are dissolved ions (i.e., chlorides) or salts in the water column. Because of the use of road salts, lakes with residential and/or urban land uses are often noted to have higher conductivity readings and higher total dissolved solids concentrations than lakes that are not surrounded by development. Stormwater runoff from impervious surfaces such as asphalt and concrete can deliver high concentrations of these salts to nearby lakes and ponds. The Lake County average conductivity reading of water near the surface is 0.7907 mS/cm. During 2003, the conductivity readings in NCL and SCL were lower, averaging 0.6773 mS/cm and 0.6905 mS/cm, respectively, near the surface. Because TDS concentrations are related to conductivity measurements, concentrations of TDS in samples collected in during 2003 in the epilimnion were also lower than the Lake County median (451 mg/L), and averaged 430 mg/L in NCL and 441 mg/L in SCL. With no historical water quality information available on the lakes, it is unclear if the conductivity measurements are increasing. However, many lakes in the county have experienced conductivity increases in the last 10 years. An increase in development within its watershed could increase the stormwater volume to the lake, which in turn could add more dissolved salts to the water column. Increased concentrations in certain ions (i.e., chlorides) may have negative impacts on aquatic life.

During 2003, we measured water elevation of the lake each month. The fluctuations we noted were not unusual, with a net loss of 11.3 inches of water elevation for the season. This was due to evaporation over the summer, especially between the July and September sampling dates, when the water elevation dropped by 10.1 inches, and a total of only 3.1 inches of rain was recorded at the Round Lake Park rain gage within this same time frame. Water was not flowing over the spillway during these sampling dates, so no water loss could be attributed to the outflow.

LIMNOLOGICAL DATA – AQUATIC PLANT ASSESSMENT

We randomly sampled locations in both NCL and SCL each month for aquatic plants. Four species were identified in NCL, and two were identified in SCL. Shoreline plants were also noted around both lakes. Table 4 lists the shoreline plants that were identified by their common and scientific names. Tables 5 (NCL) and 6 (SCL) in Appendix A lists the aquatic plant species and the frequency that they were found.

Table 4. Aquatic and shoreline plant species on North and South Churchill Lakes, May – September 2003.

<u>*Aquatic Plants*</u>	
American Pondweed	*Potamogeton americanus*
Flatstem Pondweed*	*Potamogeton zosteriformis*
Sago Pondweed	*Stuckinia pectinatus*
Horned Pondweed*	*Zannichellia palustris*
<u>*Shoreline Plants*</u>	
Common Ragweed	*Ambrosia artemisiifolia*
Giant Ragweed	*Ambrosia trifida*
Common Milkweed	*Asclepias syriaca*
^Canada Thistle	*Cirsium arvense*
^Queen Anne's Lace	*Daucus carota*
^Teasel#	*Dipsacus sylvestris*
<u>*Shoreline Plants, con't.*</u>	
Purple Prairie Coneflower#	*Echinacea purpurea*
Spike Rush	*Eleocharis* sp.
^Purple Loosestrife	*Lythrum salicaria*
^White Sweet Clover	*Melilotus alba*
^Reed Canary Grass	*Phalaris arundinacea*
^Common Reed	*Phragmites australis*
Obedient Plant#	*Physostegia virginiana*
Softstem Bulrush	*Scirpus validus*
Foxtail	*Setaria* sp.
Goldenrod	*Solidago* sp.
Showy Goldenrod#	*Solidago speciosa*
^Sow Thistle	*Sonchus* sp.
Cattail	*Typha* sp.
<u>*Trees/Shrubs*</u>	
River Birch#	*Betula nigra*
Red Osier Dogwood#	*Cornus sericea*
Red Mulberry#	*Morus rubra*

Table 4. Aquatic and shoreline plant species on North and South Churchill Lakes, May – September 2003 (cont'd).

Buckthorn	*Rhamnus sp.*
Willow	*Salix sp.*

*NCL only
#SCL only
^ Exotic species

The aquatic plants were found in very few sample sites. American pondweed was found along a few places near the west shore of NCL and in two locations next to the island. In SCL only one location, the northeast corner adjacent to the wetland shoreline, supported plants. To support a healthy warm water fishery, the optimal aquatic plant coverage is 30% to 40% of the lake bottom. In each lake, the aquatic plants covered less than 1% of the lake bottom, offering little in terms of food, shelter and nursery habitat for aquatic life. Plantings of additional aquatic plants would benefit these lakes, but because of the low water clarity, submerged aquatic plants may not thrive as well as emergent species, such as rushes. Some submergent species are tolerant of turbid conditions, but emergent species would be the best types to start with. More information about this type of management plan can be found in **Objective IV. Reestablish Native Vegetation.**

Floristic quality index is a measurement designed to evaluate the closeness of the flora (plants species) of an area to that with 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 floating and submersed aquatic plant in a lake is assigned a number between 1 and 10 (10 indicating the plant species most sensitive to disturbance). These numbers are then used to calculate the floristic quality index (FQI). A high FQI number indicates that there are a large number of sensitive, high quality plant species present in the lake, and better plant diversity. Nonnative species are included in the FQI calculations for Lake County lakes. The FQI scores of 118 lakes measured from 2000 through 2003 ranges from 0 to 37.2, with an average of 14.7. NCL has a floristic quality of 15, indicating a slightly higher than average aquatic plant diversity, based on the 118 lakes measured. SCL has a floristic quality of 8.5, indicating a lower than average aquatic plant diversity. However, these numbers can be deceiving, as it only indicates the quality of the plants found and does not take into account plant density. The plants found in both lakes were at very low densities and were present as very small, distinctive beds in only a few places. This is not reflected in the FQI number, and the plant community is actually below average when plant density is considered.

Aquatic plants will not photosynthesize in water depths with less than 1% of the available surface sunlight. Water clarity and depth are the major limiting factors in determining the maximum depth at which aquatic plants will grow in a specific lake. During 2003, the 1% light level in both lakes reached a maximum depth of about two feet deep from May through

September. This is why the use of emergent plant species for initially revegetating these lakes would be better than submersed aquatic plants.

LIMNOLOGICAL DATA – SHORELINE ASSESSMENT

In September 2003, we assessed the shoreline of both lakes. See Appendix B for a discussion of the methods used. Along NCL, approximately 90% (11,512 feet) of the shoreline is classified as developed. Figure 3 shows the two most common shoreline types: seawall (45%), and buffer (34%). The third most common was riprap, covering about 9% of the total shoreline. Construction of the seawall was very poor. Wooden slats approximately 18 inches wide were pounded down horizontally between two grooved metal posts. Frequently, we saw that some of the slats were not hammered all the way down, and soil was pushing through the cracks. Many sections of the seawall were placed up to 18 inches away from the shoreline, which was severely eroding behind it. This shoreline was not graded back before the installation of the seawall, which should have been done if this seawall was expected to last more than a year or two. Much of the shoreline in these locations was so steep it looked unsafe to approach. Because of the poor construction, several sections were failing from the extreme weight of the slumping shoreline falling against the wooden slats. Proper seawall installation not only includes the proper grading of the slope, but also includes placing the seawall directly against the shoreline, not out in front of it. The riprap around the shoreline was also installed incorrectly. Concrete chunks of what appeared to be construction waste were randomly placed along the north shore and against an east lot of NCL. No filter fabric, which is used in proper riprap installation, was placed beneath the concrete chunks. The filter fabric is necessary to prevent undercutting beneath the riprap, which protects the shoreline from further erosion. Although it looks well armored, these areas will most likely experience some erosion from future undercutting due to the lack of filter fabric underneath the riprap.

The protocol for assessing the shoreline was to classify the land/water interface from a boat, which unfortunately did not address the eroding shoreline *behind* the sections of failing seawall. Therefore, Figure 4 only shows the erosion along the west and south shoreline, and along a portion of the island. Approximately 40% of this shoreline is eroding to some degree, not including the eroding shoreline behind the seawall. Buffer comprised 77% of the eroding shoreline. Although buffer strips are usually touted as being able to withstand erosion, these shorelines have not been properly maintained, and may have been either improperly graded or not graded at all, both of which will lead to an eroding shoreline. It is important that shoreline erosion is repaired not only along the areas shown in Figure 4, but behind the seawall as well. The present seawall is not a permanent solution to protecting this shoreline; its poor construction makes it seem as if it is a temporary fix for the problem. This shoreline needs to be graded and erosion control measures need to be *properly* installed. Options for shoreline erosion control can be found in **Objective III: Shoreline Erosion Control.**

Along SCL, approximately 66% (6,155 feet) of the shoreline is classified as developed. Figure 5 shows the two most common shoreline types: buffer (40%), and prairie (25%). The third most common was lawn, covering about 19% of the total shoreline. However, the area classified a "buffer" along the east shoreline does ***not*** constitute a true buffer, which has a minimum width of 30 feet. These areas were categorized as buffer simply because the shoreline is too steep for

Figure 3.

Figure 4.

Figure 5.

personnel to safely mow the plants to the water's edge, and were left to grow. Approximately 62% of the shoreline is eroding in some degree (Figure 6), the majority classified as buffer. Like the buffer areas along NCL, these shorelines have not been properly maintained, and may not have been properly graded, both of which will lead to an eroding shoreline. It may be difficult to properly grade some of the eroding shoreline along the east side of the lake because of the close proximity of the houses to the shoreline. In this case, other erosion control techniques may be needed in conjunction with the buffer strip. Options for shoreline erosion control can be found in **Objective III: Shoreline Erosion Control.**

We also noticed the presence of aggressive exotic shoreline plant species around both lakes (Figures 7 and 8). The exotic species are listed in Table 2 above and include buckthorn, reed canary grass, common reed, and purple loosestrife. These species are especially detrimental, as they can crowd out native, beneficial plants used by wildlife. Their removal is recommended.

Figure 6.

Figure 7.

Figure 8

LIMNOLOGICAL DATA – LAND USES FOR NORTH AND SOUTH CHURCHILL LAKES

The watershed feeding NCL and SCL is small, consisting of 663 acres, 86.9 acres of which are NCL and SCL themselves (Figure 9). The watershed was delineated using ARCView, a geographic information software (GIS), topography information and groundtruthing. A small watershed is generally beneficial for lakes, and the quality of the stormwater entering a lake depends on the land uses within that watershed. Developed land can deliver more pollutants such as sediment and nutrients than undeveloped areas such as prairies or forests. Table 7 lists the land uses within the NCL and SCL watershed. The map shown in Figure 10 is based on 2000 data compiled by Northeastern Illinois Planning Commission. The largest landuse that drains into these lakes is categorized as agricultural, which comprises approximately 42% of the total watershed. Residential land use follows, with approximately 22% of the watershed. Both of these land uses can be sources of nutrients and sediment to lakes, but in the case of nitrate nitrogen inputs, one of the smallest land uses (retail/commercial) was most likely the largest contributor.

As mentioned previously, the Saddlebrook Farms wastewater facility discharges its effluent by spray irrigation onto fields to the south of the facility. These fields are within the watershed of NCL and SCL and may contribute additional nutrients to the lakes.

Table 7. Land use within the North and South Churchill Lakes watershed, based on 2000 land use data.

Type	Acres	% Total
Agricultural	267.70	42.1%
Disturbed Land	18.96	3.0%
Forest and Grassland	5.46	0.9%
Public and Private Open Space	35.05	5.5%
Retail/Commercial	6.21	1.0%
Single Family	140.49	22.1%
Transportation	8.59	1.4%
Utility and Waste Facilities	77.93	12.3%
Water	89.38	14.1%
Wetlands	12.75	2.0%
	662.52	

INSERT FIGURE 9. WATERSHED

INSERT FIGURE 10. WATERSHED & LAND USES

LIMNOLOGICAL DATA – WILDLIFE ASSESSMENT

Table 8 lists the wildlife species staff noted around both lakes. The narrow strip of land between the two lakes and Squaw Creek offers some prairie habitat for wildlife. Very little habitat is offered along the east shoreline as it consists mostly of lawns, houses and seawall. If shoreline erosion restoration techniques incorporating native plants are used, this would not only assist in protecting the shoreline, but add habitat for wildlife. Neither lake has had a known formal fishery survey, so the conditions of the fish populations are unknown. The Saddlebrook Farms Fishing Club stocks the lakes yearly for the enjoyment of "put-and-take" fishing. However, only apex predators are stocked, not a combination of predators and forage fish. Continually stocking the lakes in this manner is not recommended since it can lead to an imbalanced fishery, especially since the balance of the species' populations are unknown. In addition, the poor habitat within the lake (e.g., poor water clarity and virtually no aquatic plants) will not support some of the species that have been stocked. Smallmouth bass, northern pike, walleye, and muskellunge prefer clean, clear, deep lakes (at least 20 feet deep) of about 40 acres or larger. These habitat requirements do not exist in NCL or SCL. The best step to take would be to enlist the assistance of the Illinois Department of Natural Resources (IDNR) to schedule a fisheries survey for these lakes to determine what the existing fishery is like. Stocking with a combination of predators and forage fish suited for these types of lakes should proceed from there. In addition, emergent aquatic plants could be planted to introduce habitat needed for these fish.

Residents have expressed concern over the number of carp present in the lakes and the number of Canada geese that frequent the area. Depending on the outcome of the fisheries assessment, there are options for controlling carp, which can be found in **Objective VI: Control Excessive Numbers of Carp**. Although we did not see excessive numbers of Canada geese on our field visits, residents still may want to take measures to discourage them from congregating since their abundant feces add more phosphorus to the lake.

Both lakes would also benefit from the addition of properly installed buffer strips along the entire shorelines. Buffer strip provide need habitat for many species of wildlife and are not preferred habitat of resident Canada geese, which are prevalent in the county. In addition, buffer strips help stabilize the soils along the shoreline, preventing erosion and the addition of sediment and nutrients into the lake.

Table 8. Wildlife species observed on North and South Churchill Lakes, May – September 2003.

Birds	
Canada Goose	*Branta canadensis*
Mallard	*Anas platyrhnchos*
Ring-billed Gull	*Larus delawarensis*
Great Blue Heron	*Ardea herodias*
Sandhill Crane+	*Grus canadensis*
Solitary Sandpiper	*Tringa solitaria*
Red-tailed Hawk	*Buteo jamaicensis*
Barn Swallow	*Hirundo rustica*
Tree Swallow	*Iridoprocne bicolor*
American Crow	*Corvus brachyrhynchos*
Marsh Wren	*Cistothorus palustris*
American Robin	*Turdus migratorius*
Yellow Warbler	*Dendroica petechia*
Common Yellowthroat	*Geothlypis trichas*
Red-winged Blackbird	*Agelaius phoeniceus*
Eastern Meadowlark	*Sturnella magna*
Starling	*Sturnus vulgaris*
American Goldfinch	*Carduelis tristis*
Song Sparrow	*Melospiza melodia*
Savannah Sparrow	*Passerculus sandwichensis*
Amphibians	
Western Chorus Frog	*Pseudacris triseriata triseriata*

EXISTING LAKE QUALITY PROBLEMS

- *Lack of a Bathymetric Map*

  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 practices such as fish stocking, aquatic herbicide use, dredging, an alum treatment or aeration were part of a future overall lake management plan. Neither lake has a recent bathymetric map. Maps can be created by the Lake County Health Department – Lakes Management Unit or other agencies for costs that vary from $3,000-$10,000, depending on lake size.

- *Poor Water Clarity*

  Both lakes suffer from poor water clarity that is caused by the high total suspended solids in the water, most of which is sediment. Wind, wave and carp action also add to the solids in the water by disturbing the bottom. In addition, the eroding shorelines contribute sediment and nutrients to the water, further degrading water quality.

- *High Nutrient Concentrations*

  Both lakes have high nutrient concentrations. NCL has total phosphorus concentrations 48% higher than the Lake County median. SCL has total phosphorus concentrations 53% higher than the Lake County median. Nitrate nitrogen is in extremely high concentrations, 12 times higher than the Lake County median in NCL and **47 times** higher than the Lake County median in SCL. The concentrations in SCL ranged from 0.372 mg/L to 9.67 mg/L. The 9.67 mg/L concentration is the highest value for nitrate ever recorded for our database. Further investigation revealed the source was from a local greenhouse. This inflow from the greenhouse will be curtailed in accordance with Illinois EPA statutes.

- *Shoreline Erosion*

  Nearly 40% of the total shoreline around NCL and 62% of the total shoreline of SCL is eroding to some degree. The majority of the eroding shoreline along both lakes is classified as buffer. Some of this area, such as the buffer along the eastern shoreline of South Churchill, does not constitute a true buffer, which has a minimum width of 30 feet. In all other areas, the shoreline is mowed to the edge. Most of the buffer shoreline around both lakes has not been properly maintained, and may not have been properly graded, both of which will lead to an eroding shoreline. These shorelines will continue to erode if protective measures are not taken. This can add sediment to the water and result in a loss of shoreline property. The construction of the seawalls on NCL is poor, and looks as if it is only a temporary measure. Shoreline is eroding behind the seawall in several locations, slumping into the boards and causing them to fail. These seawalls should be replaced, possibly with a different method of shoreline protection, and properly installed. Immediate action is recommended on the severely eroded areas.

- *Lack of Aquatic Plants*

  Both lakes have few aquatic plants, and a low diversity of plant species. This results in a lack of habitat for aquatic life. The root systems of aquatic plants can assist in stabilizing the sediment, making it less likely that it will be swept into the water column from wind and wave action. In order to revegetate NCL and SCL, emergent aquatic plants would be the best to begin with.

- *Limited Wildlife Habitat*

  Because of the residential setting on the east shorelines, both lakes have limited habitat to support wildlife, except for the small buffer area along the immediate western shoreline where prairie plant species have been allowed to grow. Improvements such as the addition of a buffer zone of native vegetation in other areas could increase the amount of habitat for wildlife. The limited habitat also exists within the lakes, because of the general lack of vegetation. The frequent stocking of only apex predators by the Fishing Club may cause an imbalance of the fishery. Also, some of the species that have been stocked such as smallmouth bass and walleye have habitat requirements that these lakes do not provide.

- *Invasive Shoreline Plant Species*

  Invasive shoreline plants around NCL and SCL are not in large populations at this time. However, they can cause problems if they expand. Their removal now would curtail their expansion.

- *Canada Geese*

  Residents have expressed concern over the number of Canada geese that frequent the lake. Although we did not see excessive numbers on our field visits, residents still may want to take measures to discourage them from congregating since their abundant feces add more phosphorus to the lake, including the installation of native buffer strips around the shoreline and the discouragement of people feeding the birds.

POTENTIAL OBJECTIVES FOR NORTH AND SOUTH CHURCHILL LAKES MANAGEMENT PLAN

I. Create a Bathymetric Map, Including a Morphometric Table
II. Participate in the Illinois Volunteer Lake Monitoring Program
III. Shoreline Erosion Control
IV. Reestablish Native Aquatic Vegetation
V. Conduct a Fisheries Assessment
VI. Control Excessive Numbers of Carp
VII. Enhance Wildlife Habitat Conditions
VIII. Eliminate or Control Exotic Species
IX. Canada Geese Management

OPTIONS FOR ACHIEVING THE NORTH AND SOUTH CHURCHILL LAKES MANAGEMENT PLAN OBJECTIVES

Objective I: Create a Bathymetric Map Including a Morphometric Table

No recent, accurate bathymetric map with volume calculations exists for NCL or SCL. 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. 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 Illinois 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 about 300 citizen volunteers. The volunteers are primarily lakeshore residents, lake owners/managers, members of environmental groups, public water supply personnel, and citizens with interest in a particular lake.

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

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

NCL and SCL are not currently participating in the VLMP at this time, and 2003 marks the only year in which any water quality information has been collected. It would be beneficial for these lakes to obtain more water quality information such as the data gathered for the VLMP program. The VLMP Regional Coordinator is:

Holly Hudson
Northeast Illinois Planning Commission
222 S. Riverside Plaza, Suite 1800
Chicago, IL 60606
(312) 454-0400

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 also 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. Nearly 40% of the total shoreline around NCL and 62% of the total shoreline of SCL is eroding to some degree. The construction of the seawalls on NCL is poor, and looks as if it is only a temporary measure. Shoreline is eroding behind the seawall in several locations, slumping into the boards and causing them to fail. We noted intense wave action on some windy days along these shores; these seawalls should be replaced, if possible with a different method of shoreline protection, and properly installed. Immediate action is recommended on the severely eroded areas.

<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.

<u>Option 2: Install a Seawall</u>

Seawalls are designed to prevent shoreline erosion on lakes in a similar manner that 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 required 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. The seawalls that have been placed along the shorelines of NCL and SCL are poorly constructed, with many areas that are failing. They need to be replaced as soon as possible.

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 an 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.

Option 3: Install Rock Riprap or Gabions

Riprap 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 riprap, but are less prone to displacement. They can be stacked, like blocks, to provide erosion control for extremely steep slopes. Both riprap 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 riprap 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). Along NCL and SCL where the present seawall is failing, the shoreline could be properly graded and riprap properly installed. A buffer strip behind the riprap would be an additional benefit.

Pros

Riprap 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, riprap and gabions will last for many years. Maintenance is relatively low, however, undercutting of the bank can cause sloughing of the riprap and subsequent shoreline. Areas with severe erosion problems may benefit from using riprap 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 riprap 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 riprap 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 riprap 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 riprap 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 riprap 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.

Riprap 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 riprap 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 riprap 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.

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 riprap.

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 9 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 riprap.

Emergent vegetation, or those plants that grow in shallow water and wet areas, can be used to control erosion more naturally than seawalls or riprap. 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 9 should be considered for native plantings. Along NCL and SCL, areas with mowed lawn to the edge would benefit from the installation of a buffer strip to provide erosion control and additional wildlife habitat. In areas that receive heavy wave action, a buffer strip may need to be augmented with A-Jacks®, willow posts, or even be placed behind riprap or seawall.

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*), 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 the areas on the Churchill lakes 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. This does not include grading work.

Option 6: Install Biolog, Fiber Roll, or Straw Blanket with Plantings

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. This does not include grading work.

Objective IV: Reestablish Native Aquatic Vegetation

Both NCL and SCL lack a healthy population of aquatic plants. To begin a revegetation program, emergent species should be considered first, since submersed aquatic plants would not thrive in the turbid waters in these lakes. Without adequate light penetration, revegetation of submersed species will not work. At maximum, planting depth light levels must be greater than 1-5% of the surface light levels for plant growth and photosynthesis. The 1% light level in the Churchill Lakes only reached down to a maximum of 2 feet deep during 2003.

There are two methods by which reestablishment can be accomplished. The first is use of existing plant populations to revegetate other areas within the lake. Plants from one part of the lake are allowed to naturally expand into adjacent areas thereby filling the niche left by the nuisance plants. Another technique utilizing existing plants is to transplant vegetation from one area to another. The second method of reestablishment is to import native plants from an outside source. A variety of plants can be ordered from nurseries that specialize in native aquatic plants. These plants are available in several forms such as seeds, roots, and small plants. These two methods can be used in conjunction with one another in order to increase both quantity and biodiversity of plant populations. Additionally, plantings must be protected from herbivory by waterfowl and other wildlife. Simple cages made out of wooden or metal stakes and chicken wire are erected around planted areas for at least one season. The cages are removed once the plants are established and less vulnerable. If large-scale revegetation is needed it would be best to use a consultant to plan and conduct the restoration. Table 9 lists common, native plants that should be considered when developing a revegetation plan. Included in this list are emergent shoreline vegetation (rushes, cattails, etc) and submersed aquatic plants (pondweeds, *Vallisneria*, etc). Prices, planting depths, and planting densities are included and vary depending on plant species.

Pros

By revegetating newly opened areas that were once infested with nuisance species, the lake will benefit in several ways. Once established, expanded native plant populations will help to control growth of nuisance vegetation. This provides a more natural approach as compared to other management options. In addition, using established native plants to control excessive invasive plant growth can be less expensive in the long run than other options. Expanded native plant populations will also help with sediment stabilization. This in turn will have a positive effect on water clarity by reducing suspended solids and nutrients that decrease clarity and cause excessive algal growth. Properly revegetating shallow water areas with plants such as cattails, bulrushes, and water lilies can help reduce wave action that can lead to shoreline erosion. Increases in desirable vegetation will increase the plant biodiversity and also provide better quality habitat and food sources for fish and other wildlife. Recreational uses of the lake such as fishing and boating will also increase due to the improvement in water quality and the suppression of weedy species.

Cons

There are few negative impacts to revegetating a lake. One possible drawback is the possibility of new vegetation expanding to nuisance levels and needing control.

However, this is an unlikely outcome. Another drawback could be high costs if extensive revegetation is needed using imported plants. If a consultant is used costs would be substantially higher. Additional costs could be associated with constructing proper herbivory protection measures.

Costs

See Table 9 in Appendix A for plant pricing. Costs will be higher if a consultant/nursery is contracted for design and labor. Additional costs will include herbivory protection materials such as metal posts and protective wire mesh (chicken wire).

Objective V: Conduct a Fisheries Assessment

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

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

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

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

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

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

Objective VI: Control Excessive Numbers of Carp

A frequent problem that plagues many of the lakes in the County is the presence of common carp (*Cyprinus carpio*). Common carp were first introduced into the United States from Europe in the early 1870's, and were first introduced into Illinois river systems in 1885 to improve commercial fishing. The carp eventually made their way into many inland lakes and are now so widespread that many people do not realize that they are not native to the U.S.

Carp prefer warm waters in lakes, streams, ponds, and sloughs that contain high levels of organic matter. This is indicative of many lakes in Lake County. Carp feed on insect larvae, crustaceans, mollusks, and even small fish by rooting through the sediment. Immature carp feed mainly on small crustaceans. Because their feeding habits cause a variety of water quality problems, carp are very undesirable in lakes. Rooting around for food causes resuspension of sediment and nutrients, which can both lead to increased turbidity. Additionally, spawning, which occurs near shore in shallow water, can occur from late April until June. The spawning activities of carp can be violent, further contributing to turbidity problems. Adult carp can lay between 100,000 –500,000 eggs, which hatch in 5-8 days. Initial growth is rapid with young growing 4 ¾" to 5" in the first year. Adults normally range in size from 1-10 lbs., with some as large as 60 lbs. Average carp lifespan is 7-10 years, but they may live up to 15 years.

There are several techniques to remove carp from a lake. However, rarely does any technique completely eradicate carp from a lake. However, it is up to the management entity to dictate how big the problem is allowed to become. Rotenone is the only reliable piscicide (fish poison) on the market at this time, but it kills all fish that is comes into contact with. Currently, there is a rotenone laced baiting system that can selectively remove carp. While the process is a step in the right direction, several factors still need to be worked out in order for it to be a viable alternative to the whole lake treatment. Until this baiting technique is further developed and produces consistent results, we do not recommend it at this time.

Option 1: No Action

By following a no action management approach, nothing would be done to control the carp population of the lake. Populations will continue to expand and reach epidemic proportions if they do not already exist.

Pros

There are very few positive aspects to following a no action plan for excessive carp populations. The only real advantage would be the money saved by taking no action.

Cons

There are many negative aspects to a no action management plan for carp management. The feeding habits of carp cause most of the associated problems. As carp feed they root around in the lake sediment. This causes resuspension of sediment and nutrients. Increased nutrient levels can lead to increased algal blooms, which, combined with resuspended sediment, lead to increased turbidity (reduced clarity). As a result there is a decrease in light penetration, negatively impacting aquatic plants. Additionally, the rooting action of the carp causes the direct disruption of aquatic plants. Loss of aquatic plants can further aggravate sediment and nutrient loads in the water column due to loss of sediment stabilization provided by the plants. Additionally, the fishery of the lake may decline and/or become stunted due to predation issues related to decreased water clarity and loss of habitat. Other wildlife, such as waterfowl, which commonly forage on aquatic plants and fish, would also be negatively impacted by the decrease in vegetation.

The loss of aquatic plants and an increase in algae will drastically impair recreational use of the lake. Swimming could be adversely affected due to the increased likelihood of algal blooms. Swimmers may become entangled in large mats of filamentous algae, and blooms of planktonic species, such as blue-green algae, can produce harmful toxins and noxious odors. Fishing would also be negatively affected due to the decreased health of the lake's fishery. The overall appearance of the lake would also suffer from an increase in unsightly algal blooms, having an unwanted effect on property values.

Costs
There are no costs associated with the no action option.

Option 2: Rotenone

Rotenone is a piscicide that is naturally derived from the stems and roots of several tropical plants. Rotenone is approved for use as a piscicide by the USEPA and has been used in the U.S. since the 1930's. It is biodegradable (breaks down into CO_2 and H_2O) and there is no bioaccumulation. Because rotenone kills fish by chemically inhibiting the use of oxygen in biochemical pathways, adult fish are much more susceptible than fish eggs (carp eggs are 50 times more resistant). Other aquatic organisms are less sensitive to rotenone. However, some organisms are effected enough to reduce populations for several months. In the aquatic environment, fish come into contact with the rotenone by a different method than other organisms. With fish, the rotenone comes into direct contact with the exposed respiratory surfaces (gills), which is the route of entry. In other organisms this type of contact is minimal. Other species include frogs and mollusks but these organisms typically recover to pretreatment levels within a few months. Rotenone has low mammalian and avian toxicity. For example, if a human consumed fish treated with normal concentrations of rotenone, approximately 8,816 lbs. of fish would need to be eaten at one sitting in order to produce toxic effects. Furthermore, due to its unstable nature, it is unlikely that the rotenone would still be active at the time of consumption. Additionally, warm-blooded mammals have natural enzymes that would break down the toxin before it had any effects.

Rotenone is available in 5% and 2.5% concentrations. Both concentrations are available as synergized formulations. The synergist (piperonal butoxide) is an additive that inhibits fish detoxification of rotenone, making the rotenone more effective. Rotenone has varying levels of toxicity on different fish species. Some species of fish can detoxify rotenone quicker than it can build up in their systems. Unfortunately, concentrations to remove undesirable fish, such as carp, bullhead and green sunfish, are high enough to kill more desirable species such as bass, bluegill, crappie, walleye, and northern pike. Therefore, it is difficult to selectively remove undesirable fish while leaving desirable ones. Typically, rotenone is used at concentrations from 2 ppm (parts per million) – 12 ppm. For removal of undesirable fish (carp, bullhead and green sunfish) in lakes with alkalinities in the range found in Lake County, the target concentration should be 6 ppm. Sometimes concentrations will need to be increased based on high alkalinity and/or high turbidity. Rotenone is most effectively used when waters are cooling down (fall) not warming up (spring) and is most effective when water temperatures are <50^{o}F. Under these conditions, rotenone is not as toxic as in warmer waters but it breaks down slower and provides a longer exposure time. If treatments are done in warmer weather they should be done before spawn or after hatch as fish eggs are highly tolerant to rotenone. If this were considered in NCL/SCL, is would also need to be done when the water level does not overtop the spillway. The rotenone would affect fish in Squaw Creek.

Rotenone rarely kills every fish (normally 99-100% effective). Some fish can escape removal, resulting in the need to use another rotenone treatment about every 10 years. At this point in time, carp populations will have become reestablished due to reintroduction and reproduction by fish that were not removed during previous treatment. To ensure the best results, precautions can be taken to assure a higher longevity. These precautions include banning live bait fishing (minnows bought from bait stores can contain carp) and making sure every part of the lake is treated (i.e., cattails, inlets, and harbored shallow areas). Restocking of desirable fish species may occur about 30-50 days after treatment when the rotenone concentrations have dropped to sub-lethal levels. Since it is best to treat in the fall, restocking may not be possible until the following spring.   To use rotenone in a body of water over 6 acres a *Permit to Remove Undesirable Fish* must be obtained from the Illinois Department of Natural Resources (IDNR), Natural Heritage Division, Endangered and Threatened Species Program. Furthermore, only an IDNR fisheries biologist licensed to apply aquatic pesticides can apply rotenone in the state of Illinois, as it is a restricted use pesticide.

Pros

Rotenone is one of the only ways to effectively remove undesirable fish species. This allows for rehabilitation of the lake's fishery, which will allow for improvement of the aquatic plant community, and overall water quality. By removing carp, sediment will be left largely undisturbed. This will allow aquatic plants to grow and help further stabilize the sediment. As a result of decreased carp activity and increased aquatic plant coverage, fewer nutrients will be resuspended, greatly reducing the likelihood of nuisance algae blooms and associated dissolved oxygen problems. Additionally, reestablishment of aquatic plants will have other positive effects on lake health and water quality, increases in fish habitat and food source availability for wildlife such as waterfowl.

Cons

There are no negative impacts associated with removing excessive numbers of carp from a lake. However, in the process of removing carp with rotenone, other desirable fish species will also be removed. The fishery can be replenished with restocking and quality sport fishing normally returns within 2-3 years. Other aquatic organisms, such as mollusks, frogs, and invertebrates (insects, zooplankton, etc.), are also negatively impacted. However, this disruption is temporary and studies show that recovery occurs within a few months. Furthermore, the IDNR will not approve application of rotenone to waters known to contain threatened and endangered fish species. Another drawback to rotenone is the cost. Since the whole lake is treated and costs per gallon range from

$50.00 - $75.00, total costs can quickly add up. This can be off-set with lake draw down to reduce treatment volume. Unfortunately, draw down is not an option on all lakes.

Costs
As with most intensive lake management techniques, a good bathymetric map is needed so that an accurate lake volume can be determined. To achieve a concentration of 6 ppm, which is the rate needed for most total rehabilitation projects (remove carp, bullhead and green sunfish), 2.022 gal/AF is required.

(Lake volume in Acre Feet)(2.022 gallons) = Gallons needed to treat lake

(Gallons needed)(Cost/gallon*) = Total cost

*Cost/gallon = $50-75 range

In waters with high turbidity (such as NCL and SCL) and/or planktonic algae blooms, the ppm may have to be higher. An IDNR fisheries biologist will be able to determine if higher concentrations will be needed.

A minimum estimation of costs for both NCL and SCL would be:

452 ac/ft x 2.022 = 913 gallons
913 gallons x $50 = $45,650
913 gallons x $75 = $68,475

Objective VII: 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.

Objective VIII: 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.

Invasive shoreline plants around NCL and SCL are not in large populations at this time. However, they can cause problems if they expand. Their removal now would curtail their expansion.

<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: Biological Control</u>

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

Recently two leaf beetles (*Galerucella pusilla* and *G. calmariensis*) and two weevils, one a root-feeder (*Hylobius transversovittatus*) and one a flower-feeder (*Nanophyes marmoratus*) have offered some hope to control purple loosestrife by natural means. These insects feed on the leaves, roots, or flowers of purple loosestrife, eventually weakening and killing the plant or, in the case of the flower-feeder, prevent seeding. In large stands of loosestrife, the beetles and weevils naturally reproduce and in many locations, significantly reduce plant densities. The insects are host specific, meaning that they will attack no other plant but purple loosestrife. Currently, the beetles have proven to be most effective and are available for purchase. There are no designated stocking rate recommendations, since using bio-control insects are seen as an inoculation and it may take 3-5 years for beetle populations to increase to levels that will cause significant damage. Depending on the size of the infested area, it may take 1,000 or more adult beetles per acre to cause significant damage. Since the purple loosestrife population is not terribly large along the shoreline of NCL/SCL, this method may not be cost-effective.

Pros

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

Cons

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

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

Costs

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

Option 3: Control by Hand

Controlling exotic plants by hand removal is most effective on small areas (< 1 acre) and if done prior to heavy infestation. Some exotics, such as purple loosestrife and reed canary grass, can be controlled to some degree by digging, cutting, or mowing if done early and often during the year. Digging may be required to ensure the entire root mass is removed. Spring or summer is the best time to cut or mow, since late summer and fall is when many of the plant seeds disperse. Proper disposal of excavated plants is important since seeds may persist and germinate even after several years. Once exotic plants are removed, the disturbed ground should be planted with native vegetation and closely monitored since regrowth is common. Many exotic species, such as purple loosestrife, buckthorn, and garlic mustard are proficient at colonizing disturbed sites. Since the purple loosestrife population is not terribly large along the shorelines of NCL and SCL, this method would be 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.

<u>Option 4: Herbicide Treatment</u>
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. Since the purple loosestrife population is not terribly large along the shoreline of NCL/SCL, this method would be cost-effective.

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 IX: Canada Goose Management

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

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

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

Residents of NSL and SCL have expressed concern over the number of Canada geese that frequent the area. Although we did not see excessive numbers on our field visits, residents still may want to take measures to discourage them from congregating since their abundant feces add more phosphorus to the lake.

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

Pros

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

Cons

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

Costs

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

Option 2: Removal

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

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

Egg addling, or destroying the egg by shaking, piercing, or freezing, can be used to reduce or eliminate a successful clutch. Eggs should be returned to the nest so the hen goose does not re-lay another clutch. However, if no eggs hatch, she may still lay another clutch. Leaving one or two eggs unaltered and allowing them to hatch may prevent another clutch from being laid and reduces the total year's reproduction. Egg addling requires a state and federal permit.

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

Pros

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

Cons

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

Costs

A Illinois residential waterfowl hunting license (including state and federal waterfowl stamps) is $39.00 for the 2002-2003 hunting season. For depredation permits, there is a $25 fee for the federal permit. Once the federal permit is issued the state permit can be obtained at no charge.

<u>Option 3: Dispersal/Repellent Techniques</u>

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

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

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

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

Pros

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

Cons

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

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

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

Costs

Costs for the propane cannons are approximately $660 ($360 for the cannon, $300 for a timer), not including the propane tank. The cost of ReJeX-iT® is $80/gallon, GooseChase™ is $95/gallon, and Flight Control™ costs $200/gallon. One gallon covers one acre of turf using ReJeX-iT® and, GooseChase™, and two acres using Flight Control™. Rental costs for a pair of wing-clipped swans is approximately $2,500 per pair for a season (March-October). Rental costs for using dogs varies greatly depending on the size of the water body, but can range from $500-$6,000 per month.

Option 4: Exclusion

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

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

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

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

Option 5: Habitat Alteration
One of the best methods to deter geese from using an area is through habitat alteration. Habitats that consist of mowed turfgrass to the edge of the shoreline are ideal for geese. Low vegetation near the water allows geese to feed and provides a wide view with which to see potential predators. In general, geese do not favor habitats with tall vegetation. To achieve this, create a buffer strip (approximately 10-20 feet wide) between the shoreline and any mowed lawn. Planting natural shoreline vegetation (i.e., bulrushes, cattails, rushes, grasses, shrubs, and trees, etc.) or allowing the vegetation to establish naturally can create buffer strips. A table in Appendix A has a list of native plants, seeding rates, and approximate costs that can be used when creating buffer strips.

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

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

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

is in natural vegetation, the less turfgrass that needs to be constantly manicured and maintained.

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

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

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

Option 6: Do Not Feed Waterfowl!
There are few “good things”, if any, that come from feeding waterfowl. Birds become dependent on handouts, become semi-domesticated, and do not migrate. This causes populations to increase and concentrate, which may create additional problems such as diseases within waterfowl populations. The nutritional value in many of the “foods” (i.e., white bread) given to geese and other waterfowl are quite low. Since geese are physiologically adapted to eat a variety of foods, they can actually be harmed by filling-up on human food. Geese that are accustom to hand feeding may become aggressive toward other geese or even the people feeding the geese.

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

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