2000 SUMMARY REPORT
of
LAKE LAKELAND ESTATES

Lake County, Illinois

Prepared by the

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LAKE IDENTIFICATION AND LOCATION

Lake Lakeland Estates is a natural slough pothole that was dug out in 1956 to create the present 14.3-acre lake. It is located within the village limits of Lake Barrington (T43N, R9E, S34, 35), and is within the Fox River watershed. There is only one main inlet that drains stormwater from the surrounding neighborhood that flows into the lake. Water flows out of the lake through a dropbox spillway in the west "arm" to a stormwater system. The lake has a maximum depth of 15 feet[1], and an average depth of 7.5 feet, which is estimated at half of the maximum depth. The estimated volume of the lake is 107 acre-feet[2], or 34.9 million gallons. At present, volume and average depth can only be estimated because data from an accurate recent bathymetric (depth contour) map is not available. The shoreline length around Lake Lakeland Estates is 0.9 miles.

SUMMARY OF CURRENT AND HISTORICAL LAKE USES

Lake Lakeland Estates receives runoff from a primarily residential watershed, with several homeowners owning portions of the lake bottom. The Lakeland Estates Property Owner's Association owns and manages a beach and park along the north shore. Members of the Association and their guests can use the picnic area, playground and swim raft at this park. Residents use the lake for fishing, non-motorized boating and aesthetics. The Association has been treating the lake with aquatic herbicides and algicides to control Eurasian water milfoil and algae.

LIMNOLOGICAL DATA - WATER QUALITY

Water samples were collected once a month, from May through September 2000, at the deep hole location (see Figure 1). Samples were collected at three and ten feet deep and analyzed for a variety of parameters. The document, "Interpreting Your Water Quality Data" explains these parameters in detail. See Appendix A for water quality sampling and laboratory methods.

The water clarity in Lake Lakeland Estates averaged 4.4 feet for the 2000 season, which is below the 5.0 foot seasonal average clarity reading for Lake County lakes. Clarity was best in June, at 8.1 feet. Typically, a lake dominated by plants has better clarity than a lake dominated by algae.

[1] Because this 15 foot depth was in a secluded area in the west "arm", water samples were collected from the 12.5 foot deep area in the main body of the lake to better represent of the lake's water quality.
[2] One acre-foot is one acre filled with one foot of water, or 325,900 gallons.

FIGURE 1. SAMPLING LOCATION MAP

During 2000, aquatic plants in Lake Lakeland Estates were treated with Reward®, an aquatic herbicide, on three occasions: May 13 (7.5 gallons), June 13 (3 gallons), and June 22 (3.5 gallons). After the June water quality sampling date, the plants began to

decompose, and released nutrients into the water column. The clarity decreased dramatically, as an algae bloom occurred in the water column. The clarity dropped from 8.1 feet deep in June to 0.95 feet in July. Only a slight increase in clarity was noted for the remainder of the season. Total suspended solids (TSS), such algae and sediment, clouded the water and decreased the clarity. The TSS concentrations, for example, were low in May and June (1.4 mg/L and 2.8 mg/L), but then were much higher for the remainder of the season, ranging from 10 mg/L to 14 mg/L. Figure 2 shows the relationship between the increasing TSS concentrations and decreasing water clarity. The median TSS concentration in Lake Lakeland Estates was approximately twice as high as the Lake County median[3]. Another form of solids, total volatile solids (TVS), is a measure of organic solids, such as algal bodies and decomposing plant or animal particles. The seasonal average concentration of TVS was also higher in this lake than the Lake County average.

The trophic condition of a lake indicates the overall level of nutrient enrichment. Most lakes in Lake County are eutrophic or nutrient rich, and are productive in terms of aquatic plants and/or algae and fish. Hypereutrophic lakes are those with excessive nutrients, and often have nuisance plant populations or algae growth reminiscent of "pea soup." Lake Lakeland Estates is classified as a eutrophic lake in terms of its phosphorus and seasonal water clarity. The median total phosphorus (TP) concentration was twice as high as the Lake County median in the water near the surface. After ranking 87 lakes in terms of their phosphorus content, Lake Lakeland Estates received a ranking of 52. Another form of phosphorus, soluble reactive phosphorus (SRP) is readily available for use by algae for growth. Because algae normally use this phosphorus form very quickly, it is often not detected in water samples near the surface, except in lakes with substantial amounts, such as Lake Lakeland Estates. SRP was found in every near surface and deep water sample from Lake Lakeland Estates.

The median total Kjeldahl nitrogen concentration was also higher near the surface of Lake Lakeland Estates than the Lake County median. The ratio of total nitrogen (TN) to total phosphorus in the lake will signify whether the lake is in shorter supply of either nitrogen or phosphorus. 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. Lake Lakeland Estates has a TN:TP ratio of 12.7:1 indicating a lake with enough of both nutrients to support algal growth. This is why soluble reactive phosphorus was readily available throughout the season.

Two reasons why Lake Lakeland Estates had nutrient concentrations higher than the Lake County medians may be due to internal nutrient loading and inputs from the surrounding watershed, such as lawn fertilizers. Not only do decomposing plants and algae release nitrogen and phosphorus back into the water column, but these nutrients were also

[3] Medians and averages were calculated with LCHD water quality data collected from 72 lakes from 1995 – 2000.

FIGURE 2. TSS/SECCHI GRAPH

released from the sediment under oxygen poor conditions (anoxia) into the water column. Because of the difference in temperature between the upper and lower water layers from May through August, the water layers had different densities and did not mix. Beneficial

bacteria used oxygen to decompose plant, algae and animal materials near the bottom, and eventually caused this bottom water layer to become anoxic. Dissolved oxygen (D.O.) was measured from the surface down to the bottom at one-foot increments. The months that the lake held the least amount of D.O. were July and August, when concentrations were sufficient for a bluegill/bass fishery (3.0 mg/L) from the surface down to only four feet deep. During the other months, D.O. was sufficient from the surface down to six feet deep (May, June) or to the bottom (September). However, without a recent, accurate bathymetric map of this lake, the volume of water with sufficient D.O. for aquatic life cannot be accurately calculated.

The Illinois Environmental Protection Agency has guidelines to classify Illinois lakes for their ability to support aquatic life or recreational uses. The guidelines consider several aspects, such as water clarity, phosphorus concentrations and aquatic plant coverage. Lake Lakeland Estates fully supports aquatic life according to these criteria. Because of its high phosphorus content and relatively low water clarity, the lake only partially supports swimming and recreational uses. This does not mean that Lake Lakeland Estates has health risks due to bacteria, but rather is impaired from a perspective of swimmer safety, due to poor visibility. The LCHD did not collect samples for fecal coliform bacteria, which is only one of the parameters that can be used to determine how well a lake supports swimming uses.

LIMNOLOGICAL DATA - AQUATIC PLANT ASSESSMENT

Nine species of plants were recorded in Lake Lakeland Estates during 2000, and are listed in Table 1 (See Appendix A for sampling methodology). The variety of plant species is low, which is common for manmade lakes. The three most commonly found were nitella, Eurasian water milfoil and small pondweed. Nitella, which is actually a macroalgae[4], was found in 41% of the plant sample locations. Eurasian water milfoil, which was found in 39% of the plant sample locations, is an exotic (non-native) species, and is frequently found in nuisance plant populations in Lake County lakes. Small pondweed, a beneficial, native plant species, was found in 16% of the plant sample locations. Plant coverage prior to the aquatic herbicide use in June was approximately 79% of the lake bottom. However, the plants were not in nuisance populations at that time. Only small areas had dense plant beds. Plant beds were thick in a small bay directly adjacent to the Association beach, in another bay about 450 feet east of the beach and at the very end of the east "arm" of the lake. The small area adjacent to the beach had small pondweed and nitella, which are both beneficial. Interestingly, after the small pondweed had died from the aquatic herbicide treatment, Eurasian water milfoil grew in this area. Eurasian water milfoil was noted in the other two areas of dense plant beds. These areas comprised about 0.87 acres, or approximately 6% of the lake bottom. After the aquatic herbicide treatment, a few plants were scattered close to the shoreline, but were still dense in a small area at the far east end. No plants were found in the center of

[4] This is a large alga with a plant-like appearance.

the lake for the remainder of the season. Because the area of dense plant beds is small, if the Association wishes to continue using aquatic herbicides, they may want to avoid using herbicides in the area directly adjacent to the beach and spare the small pondweed. This would help prevent Eurasian water milfoil from dominating the area and eventually eliminating the beneficial small pondweed. The plants that should be targeted for control should *not* include beneficial native plants, but the non-native species such as Eurasian water milfoil and curlyleaf pondweed.

Table 1. Aquatic Plant Species in Lake Lakeland Estates

Aquatic Plants	
Coontail	*Ceratophyllum demersum*
Duckweed	*Lemna minor*
Eurasian Water Milfoil	*Myriophyllum spicatum*
Northern Water Milfoil	*Myriophyllum sibiricum*
Curlyleaf Pondweed	*Potamogeton crispus*
Flatstem Pondweed	*Potamogeton zosteriformis*
Leafy Pondweed	*Potamogeton foliosus*
Small Pondweed	*Potamogeton pusillus*
Macroalgae	
Nitella	*Nitella*

Aquatic plants will not photosynthesize in water depths with less than 1% of the available sunlight. Water clarity and depth are the major limiting factors in determining the maximum depth at which aquatic plants will grow. In the case of Lake Lakeland Estates, light was less than 1% below a depth of 6.2 feet in May, and below 9.2 feet in June. After the aquatic plants died from the aquatic herbicide treatment, the water clarity decreased as a result of the subsequent algae bloom. The light level was less than 1% below an average of 4.6 feet deep between July and September. Most often, plants were found in depths less than five feet deep. Because of the use of aquatic herbicides, the potential coverage of dense plant beds can only be estimated. If aquatic plants were not treated with herbicides, they could cover the lake bottom up to 9 feet deep. This was the 1% light level depth in June, which corresponds with an estimated coverage of 79% of the lake bottom. A timetable of aquatic herbicide treatments is listed in Table 2.

Table 2. Herbicide/Algicide Treatment Schedule for Lake Lakeland Estates.

Year	Product Used

1995	110 gallons of Copper sulfate, 35 gallons AV-70 (chelated copper)
1995	5.5 gallons of Diquat, 350 pounds of 2,4-D
1996	87 gallons of copper sulfate
1996	1.2 gallons of Reward® (diquat) , 450 pounds of 2,4-D
1997	90.5 gallons of copper sulfate, 90 pounds of Cutrine (chelated copper)
1997	8 gallons of Reward®, 100 pounds of 2,4-D
1998	95 gallons copper sulfate, 5 gallons Clearigate (chelated copper)
1998	8.5 gallons Reward®
1999	Information not available
2000	14 gallons Reward®, copper sulfate for algae (no amounts available)

A recent, accurate bathymetric map complete with volume calculations is an important lake management tool, especially for the application of aquatic herbicides and algicides. Lake Lakeland Estates does have an old bathymetric map from 1975, but it is outdated, most likely inaccurate and does not have an accompanying data table with volume calculations of depth contours and whole lake volume. The creation of a new bathymetric map is recommended.

LIMNOLOGICAL DATA - SHORELINE ASSESSMENT

In early May 2000, Lake County Health Department staff assessed the shoreline of Lake Lakeland Estates. See Appendix A for a discussion of the methods used. Of the 4649 feet of shoreline that rings Lake Lakeland Estates, 4040 feet, or 87 % of the shoreline, is classified as being developed. This includes 1586 feet of mowed turfgrass (34%), 2109 feet of unmowed buffer areas (45%). The 608 feet (13%) of undeveloped shoreline offers good wildlife habitat such as woodland and shrubby areas. Other types of shoreline that each comprises about 5% or less of the total shoreline include riprap, woodland, wetland and beach. Although the main body of the lake does not have severely eroding shorelines, 1511 feet (24%), of the total shoreline are slightly eroding, and 335 feet (7%) are moderately eroding (See Figure 3). Of the total 1846 feet of eroding shoreline, 1335 feet or 72%, is classified as unmowed buffer areas, and 680 feet of eroding shoreline is turfgrass mowed to the water's edge. Approximately 906 feet of mowed turfgrass is not eroding at this time. Frequently, shorelines with mowed turfgrass to the water's edge are in some stage of erosion. Some of the buffer areas are less than 5 feet wide, which could be one reason these buffer areas are eroding. In any case, eroding shorelines may continue to worsen as a result of wind induced wave action if protective measures are not taken. This can add sediment to the water and result in a loss of shoreline property, lower clarity and increased nutrients.

Some erosion mitigation was conducted at a small section (approximately 10' x 30') of shoreline at the end of the far eastern "arm" of the lake during 2000. It appears that a groundwater seep may have been causing erosion of the shoreline in this location. A

consultant set a drainage pipe at the lake level so groundwater could percolate through the pipe and flow out to the lake instead of flowing over bare soil. However, about 15' – 20' of rill erosion is still occurring down the slope to one side of the pipe. A few stones were placed at the very beginning of the rill erosion, but water still was running down through it. The stones will not prevent further rill erosion. Eight willow tree saplings were planted on the slope. It is unknown if the consultant planted other herbacious plants, but if this was done, they did not survive. Large patches of the ground on this "mitigated" slope were still bare. The area is infested with two exotic species, buckthorn trees and garlic mustard plants. The areas with scattered herbacious understory plants were garlic mustard or weedy seedlings. The buckthorn trees were very dense and allowed very little light to reach the willow saplings. Both buckthorn and garlic mustard, an herbacious woodland plant, exude chemicals from their roots that discourage other plants from growing nearby, which is probably why the soil is bare in some areas. In order for the willow saplings to survive and anchor the soil to prevent further erosion, both the buckthorn and garlic mustard need to be removed. This should have been done as part of the shoreline mitigation. Other plants can then be planted in the bare areas. Other erosion control alternatives can be found on page in Objective IV, "Mitigate Shoreline Erosion."

Staff also noted reed canary grass and purple loosestrife in a buffer along one lot in the middle of the south shore. These plants are invasive, aggressive plants and can easily dominate the shoreline. Removal of these plants is recommended, along with replanting the area with native plants soon after.

FIGURE 3. SHORELINE EROSION MAP

LIMNOLOGICAL DATA – WILDLIFE ASSESSMENT

LCHD staff observed the species of wildlife during sampling visits to Lake Lakeland Estates. Methodology is discussed in Appendix A. A listing of the wildlife can be found in Table 3. The undeveloped wooded shore provided good habitat for songbirds. Although residential areas usually do not offer good wildlife habitat, the mature trees in the lots surrounding the lake offer some songbird habitat. Downed trees (deadfall) in the water offer good habitat for fish, turtles and wading birds. Deadfall should be left in the water. Options for improving or increasing habitat for wildlife can be found in Objective V, "Maintain or Enhance Areas for Wildlife." During 1998, a private consulting firm conducted a fisheries assessment. Because the company only visited the lake once, not all management issues could be accurately assessed. Their findings indicated good bluegill and largemouth bass populations, although the bluegill may have started to become stunted. Northern pike were successfully reproducing in the lake. Based on their findings, the consultant recommended the following:

1. Age about 100 bluegill to determine if stunting was occurring
2. Stock channel catfish
3. Enhance habitat via placement of fish structures
4. Reduce nutrient loading to the lake
5. Keep weed removal to a minimum

Information from the Association states that grass carp were stocked in the lake approximately 10-12 years ago. The number stocked is not available, but since plants still exist in the lake, they were probably stocked in low numbers or they have since died.

Table 3. Wildlife Species Present

Birds

Canada Goose	*Branta canadensis*
Great Egret	*Casmerodius albus*
Great Blue Heron	*Ardea herodias*
Green Heron	*Butorides striatus*
*Sandhill Crane	*Grus canadensis*
Red-tailed Hawk	*Buteo jamaicensis*
American Kestrel	*Falco sparverius*
Belted Kingfisher	*Megaceryle alcyon*
Red-headed Woodpecker	*Melanerpes erythrocephalus*
Common Flicker	*Colaptes auratus*
Downy Woodpecker	*Picoides pubescens*
Barn Swallow	*Hirundo rustica*
American Crow	*Corvus brachyrhynchos*
Blue Jay	*Cyanocitta cristata*
Black-capped Chickadee	*Poecile atricapillus*
House Wren	*Troglodytes aedon*
American Robin	*Turdus migratorius*
Cedar Waxwing	*Bombycilla cedrorum*
Red-eyed Vireo	*Vireo olivaceus*
Nashville Warbler	*Vermivora ruficapilla*
Red-winged Blackbird	*Agelaius phoeniceus*
Brown-headed Cowbird	*Molothrus ater*
Common Grackle	*Quiscalus quiscula*
Starling	*Sturnus vulgaris*
House Sparrow	*Passer domesticus*
Northern Cardinal	*Cardinalis cardinalis*
House Finch	*Carpodacus mexicanus*
American Goldfinch	*Carduelis tristis*
Chipping Sparrow	*Spizella passerina*
Song Sparrow	*Melospiza melodia*

Mammals

Gray Squirrel	*Sciurus carolinensis*

Amphibians

Bull Frog	*Rana catesbeiana*
Green Frog	*Rana clamitans melanota*

*Threatened in Illinois

EXISTING LAKE QUALITY PROBLEMS

- *The lake does not have a recent accurate bathymetric map with data for volume calculations.*

  A recent, accurate bathymetric map complete with volume calculations is an important lake management tool, especially for the applications of alum (a phosphorus binding agent), aquatic herbicides and algicides.

- *Nutrient concentrations are elevated. Algae blooms are occurring after aquatic plant herbicide treatments that dramatically reduced the water clarity.*

  Lake Lakeland Estates is a nutrient rich lake system. The lake has concentrations of phosphorus that were higher than Lake County medians.

- *Slight or moderate shoreline erosion is present on 31% of the shoreline.*

  Although the lakeshore does not have areas with severe erosion, 1511 feet (24%), of the total shoreline is slightly eroding, and 335 feet (7%) are moderately eroding. The majority of the eroding shorelines are classified as buffer strip or turfgrass. Some of the buffer areas are less than 5 feet wide, which could be one reason these buffer areas are eroding. Eroding shorelines could worsen, resulting in a loss of shoreline property, loss of clarity and increased nutrient concentrations.

POTENTIAL OBJECTIVES FOR LAKE LAKELAND ESTATES MANAGEMENT PLAN

I. Create a Bathymetric Map.
II. Create a Comprehensive Aquatic Plant Management Plan.
III. Nuisance Algae Management
IV. Mitigate Shoreline Erosion.
V. Enhance Areas for Wildlife.
VI. Remove Exotic Shoreline Plant Species

ALTERNATIVES FOR ACHIEVING THE LAKE MANAGEMENT PLAN OBJECTIVES FOR LAKE LAKELAND ESTATES

Objective I: Create 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 aquatic herbicide use, fish stocking, dredging, or an alum treatment were part of the overall lake management plan. Lake Lakeland Estates does not have a recent accurate bathymetric map with volume calculations. The old map created in 1975 by the IDNR is outdated and most likely inaccurate. 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.

Objective II: Create a Comprehensive Aquatic Plant Management Plan.

The amount of dense plant coverage in Lake Lakeland Estates covered approximately 6% of the lake bottom during 2000. Dense plant beds could cover 79% of the lake bottom according to light limitation and the scattered plants already present before the herbicide treatment. From a fisheries perspective, the Illinois Department of Natural Resources recommends that plants in a lake cover between 20% and 40% of the lake bottom. Items to include in a comprehensive aquatic plant management plan are:

1. If the Association continues to use aquatic herbicides, the amounts of aquatic herbicides used and the areas of the lake to be treated should not be increased, since most of the lake did not have plant beds in nuisance proportions.
2. The native plants should not be treated with herbicides. Only the exotic nuisance plants such as Eurasian water milfoil should be targeted for herbicide treatment. The area with Eurasian water milfoil covered approximately 0.87 acres. Reward®, a liquid contact herbicide, can target native pondweeds, so the Association may want to consider using granular 2,4-D again, a systemic herbicide. 2,4-D targets milfoil better than Reward®, and in granular form, would be better for spot treatments. Liquid herbicides can easily drift into areas with native, beneficial plants, whereas granular herbicides can be applied to specific areas with less tendency to drift into other areas.
3. Introducing beneficial native plants could offer important habitat and once established, would help improve the water clarity by stabilizing the sediment and competing with algae for sunlight and nutrients. Unlike Eurasian water milfoil, native plants do not normally grow to nuisance proportions.
4. Part of the plan should include monitoring the size of both nuisance and beneficial plant beds to see if changes are needed in controlling the nuisance plants or encouraging the growth of healthy native plants.

5. Algae control may be necessary, especially when beginning to reintroduce native beneficial plants.

All aquatic plant management techniques have both positive and negative characteristics. If used properly, they can all be beneficial to a lake's well being. If misused or abused, they all share similar outcomes - negative impacts to the lake. Putting together a good aquatic plant management plan should not be rushed. Plans should consist of a realistic set of goals well thought out before implementation. The plan should be based on the management goals of the lake and involve usage issues, habitat maintenance/restoration, and limitations of the lake. For an aquatic plant management plan to achieve long term success, follow up is critical. A good aquatic plant management plan considers both the short and long-term needs of the lake. The management of the lake's vegetation does not end once the nuisance vegetation has been reduced/eliminated. It is critical to continually monitor problematic areas for regrowth and remove as necessary. An association or property owner should not always expect immediate results. A quick fix of the vegetation problems may not always be in the best interest of the lake. Sometimes the best solutions take several seasons to properly solve the problem. The management options covered below are commonly used techniques that are coming into wider acceptance and have been used in Lake County. There are other plant management options that are not covered below as they not are very effective, or are too experimental to be widely used.

Option 1: No Action

If the lake is dominated by native, non-invasive species, the no action option could be ideal. Under these circumstances native plant populations could flourish and keep nuisance plants from becoming problematic. With a no action aquatic plant management plan in a lake with non-native nuisance species, nothing would be done to control the aquatic plant population of the lake regardless of the type and extent of the vegetation. Nuisance vegetation could continue to grow until epidemic proportions are reached. Growth limitations of the plant and the characteristics of the lake itself (light penetration, lake morphology, substrate type, etc.) will dictate the extent of infestation. Rooted plants, such as curly leaf pondweed (*Potamogeton crispus*) and elodea (*Elodea canadensis*), will be bound by physical factors such as substrate type and light availability. Plants such as Eurasian watermilfoil and coontail, which can grow unrooted at the surface regardless of water depth, could grow to cover 100% of the water's surface. This could cause major inhibition of the lakes recreational uses and impact fish and other aquatic organisms adversely.

Pros

There are positive aspects associated with the no action option for plant management. The first, and most obvious, is that there is no cost. However, if an active management plan for vegetation control were eventually needed, the cost would be substantially higher than if the no action plan had not been followed in the first place. Another benefit of this option would be the lack of environmental manipulation. Under the no action option, no chemicals, mechanical altercation,

or introduction of any organisms would take place. This is important since studies have shown that nuisance plants are more likely to invade disrupted areas. Expansion of the native plant population would increase the overall biodiversity and health of the lake. Habitat, breeding areas, and food source availability would greatly improve. Use of the lake would continue as normal and in some cases might improve (fishing) if native plants keep "weedy" plants under control.

An additional benefit of the no action option is the possible improvement in water quality. Turbidity could decrease and clarity should increase due to sediment stabilization by the plant's roots. Algal blooms could be reduced due to decreased resource availability and sediment stabilization. However, the occurrence of filamentous may increase due to their surface growth habitat. The lake's fishery could improve due to habitat availability, which in turn would have numerous positive effects on the rest of the lake's ecosystem.

Cons

Under the no action option, if nuisance vegetation is dominant in the lake and able to reach epidemic proportions, there will be many negative impacts on the lake. By their weedy nature, the nuisance plants would out-compete the more desirable native plants. This could eventually, drastically reduce or even eliminate the native plant population of the lake and reduce the lake's biodiversity. This will also impact fish populations. The fishery of the lake may become stunted due the to lack of quality forage fish habitat and reduced predation. Predation will decrease due to the difficulty of finding prey in the dense stands of vegetation. This will cause an explosion in the small fish population and with food resources not increasing, growth of fish will be reduced. Decreased dissolved oxygen levels, due to high biological oxygen demand from the excessive vegetation, will also have negative impacts on the aquatic life. Wildlife populations will also be negatively impacted by these dense stands of vegetation. Birds and waterfowl will have difficulty finding quality plants for food or in locating prey within the dense plant stands.

Water quality could also be negatively impacted with the implementation of the no action option. Deposition of large amounts of organic matter and release of nutrients upon the death of the massive stands of vegetation is a probable outcome of the no action option. These dead plants will contribute to the sediment load of the lake and could accelerate its filling in. The large nutrient release when the plants die back in the fall could lead to lake-wide algae blooms and an overall increase of the internal nutrient load to the lake. In addition, the decomposition of the massive amounts of vegetation uses dissolved oxygen. If too much oxygen is stripped from the water column for use in plant decomposition, this can cause fish stress, and eventually, if the stress is frequent or severe enough, fish kills. All of the impacts above could in turn have negative impacts on numerous aspects of the lake's ecosystem.

In addition to the ecological impacts, many physical uses of the lake will be negatively impacted. Boating could be nearly impossible without becoming entangled in thick mats of plants. Swimming could also become increasingly difficult due to thick vegetation that would develop at beaches. Fishing could become more and more exasperating due in part to the thick vegetation and also because of stunted fish population. In addition, the aesthetics of the lake will also decline due to large areas of the lake covered by tangled mats of vegetation and the odors that will develop when they decay. The combination of the above events could cause property values on the lake to suffer. Property values on lakes with weedy plant/algae problems have been shown to decrease by as much as 15-20%.

Costs

No cost will be incurred by implementing the no action management option.

Option 2: Aquatic Herbicides

Aquatic herbicides are the most common method to control nuisance vegetation/algae. When used properly, they can provide selective and reliable control. Products can not be licensed for use in aquatic situations unless there is less than a 1 in 1,000,000 chance of any negative effects on human health, wildlife, and the environment. Aquatic herbicides are not allowed to be environmentally persistent, bioaccumulate, or have any bioavailability. Prior to herbicide application, licensed applicators should evaluate the lake's vegetation and, along with the lake's management plan, choose the appropriate herbicide and treatment areas, and apply the herbicides during appropriate conditions (i.e. low wind speed).

There are two groups of herbicides: contact and systemic. Contact herbicides, like their name indicates, kill on contact. These herbicides affect only the above ground portion of the plant that they come into contact with and therefore do not kill the root system. An example of a contact herbicide is diquat. Systemic herbicides are taken up by the plant and disrupt cellular processes, which in turn cause plant death. These herbicides kill both the upper portions of the plant as well as the root system. An example of a systemic herbicide is fluridone. Both types of herbicides are available in liquid or granular forms. Liquid forms are concentrated and need to be mixed into water to obtain the desired concentration. The solution is then sprayed on the water's surface or injected into the water in the treatment areas. Granular herbicides are broadcast in a known rate over the treatment area where they sink to the bottom and slowly release the herbicide which is then taken up by the plant. These are referred to as SRP formulations (Slow Release Pellet). Other granular herbicides come in crystal form and dissolve as they come in contact with water. This is typical of herbicides such as copper sulfate. Many herbicides come in both liquid and granular forms to fit the management needs of the lake. Herbicide applications can either be done as whole lake treatments or as more selective spot treatments. Multiple herbicides are often mixed and applied together. This is called a tank mix. This is done to save time, energy, and cost.

Aquatic herbicides are best used on actively growing plants to ensure optimal herbicide uptake. For this reason, herbicides are normally applied mid to late spring when water temperatures are above 60^0F. This is the time of year when the plants are most actively growing and before seed/vegetative propagule formation. Follow up applications should be done as needed. When choosing an aquatic herbicide it is important to know what plants are present, which ones are problematic, which plants are beneficial, and how a particular herbicide will act upon these plants. The herbicide label is very important and should always be read before use.

Because the amount of dense plant growth is small in Lake Lakeland Estates, (less than 1 acre) the Association may want to treat just small areas of the non-native plant beds, or those that contain Eurasian water milfoil. The far east "arm" of the lake could be left alone since the area is small and shallow and apparently not used for access to the main body of the lake. The native plant species should not be treated with herbicides unless they become problematic. The Association could lessen the amount of aquatic herbicides to see the actual extent of the plant beds. If necessary, spot treatments could then be used in the appropriate locations. As part of a plant management plan, the locations and extent of the plant beds could be used to gauge the success of future plant treatments and modify the plan as needed to reach a goal of 20%-40% plant coverage. If the Association wishes to continue using herbicides, they may want to consider doing small spot treatments as opposed to whole lake treatments. The use of 2,4-D is commonly used for spot treatments, and in pellet form, lessens the chance of herbicide drift. 2,4-D is also a systemic herbicide that can offer longer control than Diquat. Diquat, or Reward®, is a contact herbicide. The use of the herbicide fluridone (Sonar™, Avast) in liquid form requires the knowledge of the lake volume, which can only be estimated. However, the granular form of fluridone (SRP) can be used for spot treatments with the knowledge of the amount of surface acres to be treated, which would be 0.87 acres in this case.

Pros

When used properly, aquatic herbicides can be a powerful tool in management of excessive vegetation. Often, aquatic herbicide treatments can be more cost effective in the long run compared to other management techniques. A properly implemented plan can often provide season long control with minimal applications. Ecologically, herbicides can be a better management option than using mechanical harvesting or grass carp. When properly applied aquatic herbicides may be selective for nuisance plants such as Eurasian watermilfoil but allow desirable plants such as the pondweeds to remain. This removes the problematic vegetation and allows native and more desirable plants to remain and flourish with minimal manipulation.

The fisheries and waterfowl populations of the lake would greatly benefit due to an increase in quality habitat and food supply. Dense stands of plants would be thinned out and improve spawning habitat and food source availability for fish. Waterfowl population would greatly benefit from increases in quality food sources, such as large-leaf pondweed (*Potamogeton amplifolius*). Another

environmental benefit of using aquatic herbicides over other management options is that they are organism specific. The metabolic pathways by which herbicides kill plants are plant specific which humans and other organisms do not carry out. Organisms such as fish, birds, mussels, and zooplankton are generally unaffected.

By implementing a good management plan with aquatic herbicides, usage opportunities of the lake would increase. Activities such as boating and swimming would improve due to the removal of dense stand of vegetation. The quality of fishing may recover because of improved habitat. In addition to increased usage opportunities, the overall aesthetics of the lake would improve, potentially increasing property values on the lake.

Cons

The most obvious drawback of using aquatic herbicides is the input of chemicals into the lake. Even though the United States Environmental Protection Agency (USEPA) approved these chemicals for use, human error can make them unsafe and bring about undesired outcomes. If not properly used, aquatic herbicides can remove too much vegetation from the lake. This could drastically alter the biodiversity and ecological balance of the lake. Total removal or over-removal of plants can cause a variety of problems lake-wide. The fishery of the lake may decline and/or become stunted due predation issues related to decreased water clarity. Other wildlife, such as waterfowl, which commonly forage on aquatic plants, would also be negatively impacted by the decrease in vegetation.

Another problem associated with removing too much vegetation is the loss of sediment stabilization by plants, which can lead to increased turbidity and resuspension of nutrients. The increase in turbidity can cause a decrease in light penetration, which can further aggravate the aquatic plant community. The resuspension of nutrients will contribute to the overall nutrient load of the lake, which can lead to an increased frequency of noxious algal blooms. Furthermore, the removal of aquatic vegetation, which compete with algae for resources, can directly contribute to an increase in blooms.

After the initial removal, there is a possibility for regrowth of vegetation. Upon regrowth, weedy plants such as Eurasian watermilfoil and coontail quickly reestablish, form dense stands, and prevent the growth of desirable species. This causes a decrease in plant biodiveristy. Additionally, these dense stands of nuisance vegetation can lead to an overpopulation of stunted fish due to a decrease in predation of forage species by predatory fish. This disruption in the fisheries can have negative impacts throughout the ecosystem from zooplankton to higher organisms such as waterfowl and other wildlife. Additionally, some herbicides have use restrictions regarding their use in relation to fish, swimming, irrigation, etc.
Overremoval, and possible regrowth of nuisance vegetation that may follow will drastically impair recreational use of the lake. Swimming could be adversely

affected due to the likelihood of increased algal blooms. Swimmers may become entangled in large mats of filamentous algae. Blooms of planktonic species, such as blue-green algae, can produce harmful toxins as well produce noxious odors. If regrowth of nuisance vegetation were to occur, motors could become entangled making boating difficult. Fishing would also be negatively impacted due to the decreased health of the lake's fishery. The overall appearance of the lake would also suffer due to an increase in unsightly algal blooms and massive stands of vegetation. This in turn could have an unwanted effect on property values. Studies have shown that problematic algal blooms can decrease property values by 15-20%.

Costs[5]

The following costs are for the 0.87 acres of Eurasian water milfoil. 2,4-D costs $350-$425 per surface acre. The use of this product on the 0.87 acres of dense Eurasian water milfoil would cost approximately $305 - $370. For the liquid form of fluridone (Sonar ™, Avast), a systemic herbicide, the cost is approximately $11.75 per acre-foot for a dosage of 10 parts per billion (ppb). Price estimates were not available for the granular form of fluridone at the time this report was written. The use of the contact herbicide, Reward would cost about $370 - $740 to treat 0.87 acres.

Option 3: Hand Removal

Hand removal of excessive aquatic vegetation is a commonly used management technique. Hand removal is normally used in limited areas for selective vegetation removal. Areas surrounding piers and beaches are commonly targeted areas. Typically tools such as rakes and cutting bars are used to remove vegetation. These are easily obtainable through many outdoor supply catalogs or over the internet. Some rakes are equipped with tines as well as cutting edges. Tools can also be hand made by drilling a hole in the handle of a heavy-duty garden rake and tying it to a length of rope. Weights may be needed in order to provide forceful contact with the plants. In many instances, homeowners on lakes with near shore vegetation problems simply cut paths through the weeds to create pathways to open water.

Pros

Hand removal is a quick, inexpensive, and selective way to remove nuisance vegetation. Hand removal is an activity in which all lake residents could participate. The work involved in removing plants can provide a rewarding sense of accomplishment. By removing excess vegetation, use of beaches and piers would be improved. Wildlife habitat, such as fish spawning beds, could be greatly improved. This in turn would benefit other portions of the lake's ecosystem. Harvested plant material is often used as fertilizer and compost in gardens.

[5] Costs of these products were quoted during 2000.

Cons

There are few negative attributes to hand removal. One negative implication is labor. Depending on the extent of infestation, removal of large amount, of vegetation can be quite tiresome. Another drawback can be disposal. Finding a site for numerous residents to dispose of large quantities of harvested vegetation can sometimes be problematic. Another drawback is possible nonselective removal by hand harvesting. By throwing a rake blindly into the depths, it is impossible to determine what plants are removed and which ones are not until the rake is pulled up. Even in shallow depths, untrained persons might mistakenly remove desirable vegetation and/or disrupt valuable habitat (fish spawning beds).

Costs

Plant removal rakes can range in price from $50-150 and cutting tools commonly range in price from $50-200. Both are available from numerous catalogs and from the internet.. A homemade rake would cost about $20-40.

Option 4: Reestablishing Native Aquatic Vegetation

Revegetation should only be done when existing nuisance vegetation, such as Eurasian water milfoil, are under control using one of the above management options. If the lake has poor clarity due to excessive algal growth or turbidity, these problems must be addressed before a revegetation plan is undertaken. Without adequate light penetration, revegetation 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.

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 4 lists common, native plants that should be considered when developing a revegetation plan. Included in this list are aquatic shoreline vegetation (rushes, cattails, etc) and deeper water 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 is less expensive 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 4 for pricing.

Table 4. Costs for Native Plants

1"-1.5' Deep	Seeding Rate	Seed Price	Planting Rate	Price/Plant
Arrow Arum (*Peltandra virginica*)	NA	$4-5/oz	1000/acre	$0.40-1.00
Bottle Brush Sedge (*Carex comosa*)	0.12-0.19 lbs./acre	$6-8/oz	NA	NA
Chairmakers Rush (Scirpus americanus)	0.06-0.25 lbs/acre	$8-15/oz	1000/acre	$0.25-0.85
Common Arrowhead (Sagittaria latifolia)	0.06-0.125 lbs/acre	$15-16/oz	1000/acre	$0.60-1.25
Common Burreed (Sparganium euycapum)	0.06-0.25 lbs/acre	$10-15/oz	1000/acre	$0.22-0.50
Common Cattail (Typha latifolia)	0.06-0.5 lbs/acre	$3-15/oz	1000/acre	$0.40-1.00
Hardstem Bulrush (Scirpus acutus)	0.06-0.25 lbs/acre	$8-15/oz	1000/acre	$0.25-0.50
Pensylvania Smartweed (Polygonum pensylvanicum)	0.06-0.25 lbs/acre	$5/oz	NA	NA
River Bulrush (Scirpus fluviatilis)	0.06-0.25 lbs/acre	$5/oz	NA	NA
Soft Rush (Juncus effusus)	0.06-0.125 lbs/acre	$15-16/oz	$4-5	$0.25-0.90
Softstem Bulrush (Scirpus validus)	NA	$20/oz	1000/acre	$0.25-0.90
Water Plantain (Alisma subcordatum)	0.06-0.25 lbs/acre	$10-15/oz	1000/acre	$0.25-0.85
Water Smartweed (Polygonum fluitans)	0.06-0.5 lbs/acre	$3-25/oz	1000/acre	$0.35-0.50
White Water Buttercup (Ranunculus longirostris)	NA	NA	500/acre	$0.40-0.50
Yellow Water Buttercup (Ranunculus flabellaris)	NA	NA	500/acre	$0.70-1.51
1.5'-3' Deep	**Seeding Rate**	**Seed Price**	**Planting Rate**	**Price/Plant**
Watersheild (Brasenia schreberi)	NA	NA	1000/acre	$0.65-1.49
White Water Lily (Nymphaea tuberosa)	NA	NA	200/acre	$0.30-0.40
Yellow Water Lily (Nuphar advena)	NA	NA	200/acre	$3.75
3'-8' Deep	**Seeding Rate**	**Seed Price**	**Planting Rate**	**Price/Plant**
Elodea (Elodea canadensis)	NA	NA	1000/acre	$0.25-0.51
Large-leaved Pondweed (Potamogeton amplifolius)	NA	NA	1000/acre	$0.25-0.51
Richardson's Pondweed (Potamogeton richardsonii)	NA	NA	250lbs/acre	$2/lb
Sago Pondweed (Potamogeton pectinatus)	NA	NA	1000/acre	$0.35-0.50
Vallisineria, Eel Grass (Vallisineria americana)	NA	NA	1000/acre	$0.40-0.75
Water Stargrass (Zosterella dubia)	NA	$4.00/lb	1000/acre	$0.25-0.50

Objective III: Nuisance Algae Management

The growth of nuisance or excessive algae can cause a number of problems. Excessive algal growth can cause decreases in water clarity and light penetration. This can lead to several major problems such as loss of aquatic plants, decline in fishery health, and interference with recreational activities. Health nuisances, such as swimmer's itch and other skin irritations have been linked to excessive algal growth. Normally, excessive algae growth is a sign of larger problems such excessive nutrients and/or lack of aquatic plants. This is the case in Lake Lakeland Estates. Some treatment methods, such as copper sulfate, are only quick remedies to the problem. Solving the problem of excessive algal growth involves treating the factors that cause the excessive growth not the algae it

self. Long term solutions to excessive algae typically include an integrated approach such as alum treatments, revegetation with aquatic plants, and limiting external sources of nutrients. Interestingly enough, these long-term management strategies are seldom used, typically because of their high initial costs. Instead, the cheap, quick fix of using copper sulfate, though temporary, is much more widely used. However, the costs of continually applying copper sulfate over years, even decades, can eventually far exceed the costs of a slower acting, eventually more effective, integrated approach.

As with aquatic plant management techniques, algae management practices have both positive and negative characteristics. If used properly, they can be beneficial to a lake's well being. If misused or abused, they all share similar outcomes - negative impacts to the lake. Putting together a good management plan should not be rushed. Plans should consist of a realistic set of goals well thought out before implementation. The plan should be based on the management goals of the lake and involve usage issues (beaches, boat ramps, etc.), habitat maintenance/restoration issues, and nutrient levels. For an algal management plan to achieve long term success, follow up is critical. The management of the lake's algae problem does not end once the blooms and/or mats have been reduced/eliminated. It is critical to continually monitor problematic areas for regrowth and treat as necessary. An association or property owner should not always expect immediate results. A quick fix of the algal problem may not always be in the best interest of the lake. Sometimes the best solutions take several seasons to properly address the problem. The management options covered below are commonly used techniques and those that are coming into wider acceptance, and have been used in Lake County. There are other algae management options that are not covered below as they not are very effective, or are too experimental to be widely used.

Option 1: No Action

With a no action management plan nothing would be done to control the nuisance algae regardless of type and extent. Nuisance algae, planktonic and/or filamentous, could continue to grow until epidemic proportions are reached. Growth limitations of the algae and the characteristics of the lake itself (light penetration, nutrient levels.) will dictate the extent of infestation. Unlike aquatic plants, algae are not normally bound by physical factors such as substrate type. The areas in which filamentous and thick surface planktonic blooms (scum) occur can be affected by wind and wave action if strong enough. However, under normal conditions, with no action, both filamentous and planktonic algal blooms can spread to cover 100% of the surface. This could cause major inhibition of the lakes recreational uses and impact fish and other aquatic organisms adversely.

Pros

There are positive aspects associated with the no action option for nuisance algae management. The first, and most obvious, is that there is no cost. However, if an active management plan for algae control were eventually needed, the cost would be substantially higher than if the no action plan had been followed in the first

place. Another benefit of this option would be the lack of environmental manipulation. Under the no action option, chemicals or introduction of any organisms would take place. Use of the lake would continue as normal unless blooms worsened. In this case, activities such as swimming might have to be suspended due to an increase in health risks. Other problems such as strong odors (blue-green algae) might also increase in frequency.

Cons

Under the no action option, if nuisance algae becomes widespread and able to reach epidemic proportions, there will be many negative impacts on the lake. The fishery of the lake may become stunted due the to lack of quality forage fish habitat and reduced predation. This will cause an explosion in the small fish population and with food resources not increasing, growth of fish will be reduced. Fish kills can result from toxins released by some species such as some blue-green algae. Blue-green algae can also produced toxins that are harmful to other algae. This allows blue-green algae to quickly dominate a body of water. Decreased dissolved oxygen levels, due to high biological oxygen demand from the excessive algae growth, will also have negative impacts on the aquatic life. Wildlife populations will also be negatively impacted by dense growths of algae. Birds and waterfowl will have difficulty finding quality plants for food or in locating prey within the turbid green waters. Additionally, some species, such as blue-green algae, are poor sources of food for zooplankton and fish.

Water quality could also be negatively impacted with the implementation of a no action option. Decomposition of organic matter and release of nutrients upon algal death is a probable outcome. Large nutrient release with algae die back could lead to lake-wide increases of internal nutrient load. This could in turn, could increase the frequency or severity of other blooms. In addition, decomposition of massive amounts of algae, filamentous and planktonic, will lead to a depletion of dissolved oxygen in the lake. This can cause fish stress, and eventually, if stress is frequent or severe enough, fish kills. All of the impacts above could in turn have negative impacts on numerous aspects of the lake's ecosystem.

In addition to ecological impacts, many physical lake uses will be negatively impacted. Boating could be nearly impossible without becoming entangled in thick mats of filamentous algae. Swimming could also become increasingly difficult and unsafe due to thick mats and reduction in visibility by planktonic blooms. Fishing could become more and more exasperating due in part to the thick mats and stunted fish populations. In addition, the aesthetics of the lake will also decline due to large areas of the lake covered by large green mats and/or blooms of algae and the odors that may develop, such as with large blue-green blooms. The combination of above events could cause property values on the lake to suffer. Property values on lakes with algae problems have been shown to decrease by as much as 15-20%.

Costs

No cost will be incurred by implementing the no action management option.

Option 2: Algicides

Algicides are a quick and inexpensive way to temporarily treat nuisance algae. Copper sulfate ($CuSO_4$) and chelated copper products are the two main algicides in use. These two compounds are sold by a variety of brand names by a number of different companies. They all work the same and act as contact killers. This means that the product has to come into contact with the algae to be affective. Algicides come in two forms, granular and liquid. Granular herbicides are spread by hand or machine over an effected area. They can also be placed in a porous bag (such as a burlap sack) and dragged though the water in order to dissolve and disperse the product. Granular algicides are mainly used on filamentous algae where they are spread over the mats. As the granules dissolve, they kill the algae. Liquid algicides, which are much more widely used, are mixed with a known amount of water to achieve a known concentration. The mixture is then sprayed onto/into the water. Liquid algicides are used on both filamentous and planktonic algae. Liquid algaecides are often mixed with herbicides and applied together to save on time and money. The effectiveness of some herbicides are enhanced when mixed with an algicide. When applying an algicide it is imperative that the label is completely read and followed. If too much of the lake is treated at any one time an oxygen crash may occur. This may cause fish kills due to decomposition of treated algae. Additionally, treatments should never be made when blooms/mats are at their fullest extent. It is best to divide the lake into at least two sections depending on the size of the lake. Larger lakes will need to be divided into more sections. Then treat the lake one section at a time allowing at least two weeks between treatments. Furthermore, application of algicides should never be done in extremely hot weather (>90^{o}F). This will help lessen the likelihood of an oxygen crash and resulting fish kills. When possible, treatments should be made as early in the season as possible. It is best to treat in spring or when the blooms/mats starts to appear there by killing the algae before they become a problem. If the Lake Lakeland Estates Property Owner's Association follows through with the objective of reintroducing native plants species, algae control may be needed to improve water clarity for the plants to receive sunlight. This would be important at least until the new plants have become established.

Pros

When used properly, algicides can be a powerful tool in management of nuisance algae growth. A properly implemented plan can often provide season long control with minimal applications. Another benefit of using algicides are their low costs. The fisheries and waterfowl populations of the lake would greatly benefit due to a decrease in nuisance algal blooms. By reducing the algae, clarity would increase. This in turn would allow the native aquatic plants to return to the lake. Newly established stands of plants would improve spawning habitat and

food source availability for fish. Waterfowl population would greatly benefit from increases in quality food sources, such as large-leaf pondweed (*Potamogeton amplifolius*) and sago pondweed (*Potamogeton pectinatus*). Additionally, copper products, at proper dosages, are selective in the sense that they do not affect aquatic vascular plants and wildlife.

By implementing a good management plan, usage opportunities for the lake would increase. Activities such as boating and swimming would improve due to the removal of thick blooms and/or mats of algae. The quality of fishing may recover due to improved habitat and feeding opportunities. In addition to increased usage opportunities, overall aesthetics of the lake would improve, potentially increasing property values.

Cons

The most obvious drawback of using algicides is the input of chemicals into the lake. Even though the United States Environmental Protection Agency (USEPA) approved these chemicals for use, human error and overuse can make them unsafe and bring about undesired outcomes. By continually killing particular algal species, lake managers may unknowingly be creating a larger problem. In many instances, over use of copper is leading to selection of species tolerant to copper. As the algae are continuously exposed to copper, some species are becoming more and more tolerant. This results in the use of higher concentrations in order to achieve adequate control, which can be unhealthy for the lake. In other instances, by eliminating one type of algae, lake managers are finding that other species that are even more problematic are filling the empty gap. These species that fill the gap can often be more difficult to control due to an inherent resistance to copper products. Additionally, excessive use of copper products can lead to a build up of copper in lake sediments. This can cause problems for activities such as dredging. Due to a large amount of copper in the sediments, special permits and disposal methods would have to be utilized.

Costs

To calculate total cost it is be necessary to calculate acre-feet (AF) of the area(s) to be treated according to the lake's aquatic plant management plan. Copper sulfate costs about $20 per acre-foot. Lake Lakeland Estates would benefit from the creation of an accurate bathymetric map to determine water volume. This is important for calculations to determine the correct amounts of algicide.

Option 3: Alum Treatment

A possible remedy to excessive algal growth is to eliminate or greatly reduce the amount of phosphorus. This can be accomplished by using aluminum sulfate (alum). Alum does not directly kill algae as copper sulfate does. Instead, alum binds phosphorus making it unavailable, thus reducing algal growth. Alum binds water-borne phosphorus and forms

a flocculent layer that settles on the bottom, which can then prevent sediment bound phosphorus from entering the water column. Phosphorus inactivation using alum has been in use for 25 years. However, cost and unreliable results deterred its wide spread use. Currently, alum is commonly being used in ponds, and its use in larger lakes is increasing. Alum treatment typically lasts 1 to 20 years depending on various parameters. Lakes with low average depth to surface area are good candidates. This encompasses many lakes within Lake County. Lakes that are thermally stratified experience longer inactivation than non-stratified lakes due to isolation of the flocculent layer. Lakes with small watersheds are also better candidates because external phosphorus sources can be limited. At this time, the amount of phosphorus entering Lake Lakeland Estates from the watershed is unknown. Alum treatments must be carefully planned and carried out by an experienced professional. If not properly done, there may be detrimental side effects.

Pros

Phosphorus inactivation is a possible long-term solution for controlling nuisance algae and increasing water clarity. Alum treatments can last as long as 20 years. This makes alum more cost effective in the long-term compared to continual treatment with algaecides. Studies have shown reductions in phosphorus concentrations by 66% in spring and 68% in summer. Chlorophyll *a*, a measure of algal biomass, was reduced by 61%. Reduction in algal biomass caused an increase in dissolved oxygen and a 79% increase in secchi disk readings. Effects of alum treatments can be seen in as little as a few days. The increase in clarity can have many positive effects on the lake's ecosystem. With increased clarity, plant populations could reestablish. This in turn would improve fish habitat and provide improved food sources for other organisms. Recreational activities such as swimming and fishing would be improved due to increased water clarity and healthy plant populations. Typically, there is a slight invertebrate decline immediately following treatment but populations recover fully by the following year.

Cons

There are several drawbacks to alum. External nutrient inputs must also be reduced or eliminated for alum to provide long-term effectiveness. With larger watersheds this could prove to be physically and financially impossible. Phosphorus inactivation may be shortened by excessive plant growth or motorboat traffic, which can disturb the flocculent layer and allow phosphorus to be released. Also, lakes that are shallow, non-stratified, and wind blown typically do not achieve long term control due to disruption of the flocculent layer. If alum is not properly applied toxicity problems to aquatic life may occur. Typically aluminum toxicity occurs if pH is below 6 or above 9. Lake Lakeland Estates is within this safe range. However, at these pHs, special precautions must be taken when applying alum. By adding the incorrect amounts of alum, pH of the lake could drastically change. Due to these dangers, it is highly recommended that a

lake management professional plans and administers the alum treatment. Without a recent, accurate bathymetric map with accompanying volume calculations, an alum treatment should not be considered. Accurate volume calculations are critical in determining the correct amount of alum to apply.

Costs

Costs are variable and amounts needed are strictly dependent on volume calculations. Aluminum sulfate is applied at a rate of 40-80lbs/acre-foot at 35-60 cents/lb. A very rough estimate for Lake Lakeland Estates using the estimated volume of 107 acre-feet results in an estimated cost range of $1500-$6850. A better cost estimate can be obtained with the use of a recent, accurate bathymetric map.

Objective IV: Mitigate Shoreline Erosion

Although there are no areas with severe erosion at this time along the shore of Lake Lakeland Estates, 1511 feet (24%), of the total shoreline are slightly eroding, and 335 feet (7%) are moderately eroding. No severely eroding shorelines were noted. These shorelines may continue to erode as a result of wind induced wave action if protective measures are not taken. The Association should share the information in this section with all lakeshore homeowners.

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 exasperate the problem. Erosion not only results in loss of shoreline, but negatively influences the lake's overall water quality by contributing nutrients, sediment, and pollutants into the water. This effect is felt throughout the food chain since poor water quality negatively affects everything from microbial life to sight feeding fish and birds to people who want to use the lake for recreational purposes. The resulting increased amount of sediment will over time begin to fill in the lake, decreasing overall lake depth and volume and potentially impairing various recreational uses. The slope at the far east "arm" of the lake had some erosion mitigation done, but the buckthorn and garlic mustard that are infesting this area may prevent the newly planted willow saplings from thriving. The bare soil in this area will continue to erode if the buckthorn and garlic mustard are not controlled and the bare areas remain. Options for their control are outlined in Objective VI: "Remove Exotic Shoreline Plant Species."

Option 1: No Action

Pros

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

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

Cons

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

Costs:

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

Option 2: Create a Buffer Strip

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

Stabilizing the shoreline with vegetation is most effective on slopes no less than 2:1 to 3:1, horizontal to vertical, or flatter. Usually a buffer strip of at least 25 feet is recommended, however, wider strips (50 or even 100 feet) are recommended on steeper

slopes or areas with severe erosion problems. Areas where erosion is severe or where slopes are greater than 3:1, additional erosion control techniques may have to be incorporated such as biologs, A-Jacks®, or rip-rap.

Buffer strips can be constructed in a variety of ways with various plant species. Generally, buffer strip vegetation consists of native terrestrial (land) species and emergent (at the land and water interface) species. Terrestrial vegetation such as native grasses and wildflowers can be used to create a buffer strip along lake shorelines. 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., 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, or rip-rap.

Emergent vegetation, or those plants that grow in shallow water and wet areas, can be used to control erosion more naturally than seawalls or rip-rap. Native emergent vegetation can be either hand planted or allowed to become established on its own over time. Some plants, such as native cattails (*Typha* sp.), quickly spread and help stabilize shorelines, however they can be aggressive and may pose a problem later. Other species, such as those listed in Table 5 in should be considered for native plantings.

Pros

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

The buffer strip will stabilize the soil with its deep root structure and help filter run-off from lawns and agricultural fields by trapping nutrients, pollutants, and

sediment that would otherwise drain into the lake. This may have a positive impact on the lake's water quality since there will be less "food" for nuisance algae. Buffer strips can filter as much as 70-95% of sediment and 25-60% of nutrients and other pollutants from runoff.

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

Many fish and wildlife species prefer the native shoreline vegetation habitat. This habitat is an asset to the lake's fishery since the emergent vegetation cover may be used for spawning, foraging, and hiding. Various wildlife species are even dependent upon shoreline vegetation for their existence. Certain birds, such as marsh wrens (*Cistothorus palustris*) and endangered yellow-headed blackbirds (*Xanthocephalus xanthocephalus*) nest exclusively in emergent vegetation like cattails and bulrushes. Hosts of other wildlife like waterfowl, rails, herons, mink, and frogs to mention just a few, benefit from healthy stands of shoreline vegetation. Dragonflies, damselflies, and other beneficial invertebrates can be found thriving in vegetation along the shoreline as well. Two invertebrates of particular importance for lake management, the water-milfoil weevils (*Euhrychiopsis lecontei* and *Phytobius leucogaster*), which have been shown to naturally reduce stands of exotic Eurasian water-milfoil (*Myriophyllum spicatum*). Weevils need proper over wintering habitat such as leaf litter and mud which are typically found on naturalized shorelines or shores with good buffer strips. Many species of amphibians, birds, fish, mammals, reptiles, and invertebrates have suffered precipitous declines in recent years primarily due to habitat loss. Buffer strips may help many of these species and preserve the important diversity of life in and around lakes.

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

Cons

There are few disadvantages to native shoreline vegetation. Certain species (i.e. cattails) can be aggressive and may need to be controlled occasionally. If stands

of shoreline vegetation become dense enough, access and visibility to the lake may be compromised to some degree. However, small paths could be cleared to provide lake access or smaller plants could be planted in these areas.

Costs:

If minimal amount of site preparation is needed, costs can be approximately $10 per linear foot, plus labor. Cost of installing willow posts is approximately $15-20 per linear foot. The labor that is needed can be completed by the property owner in most cases, although consultants can be used to provide technical advice where needed. This cost will be higher if the area needs to be graded. If grading is necessary, appropriate permits and surveys are needed. If filling is required, additional costs will be incurred if compensatory storage is needed. The permitting process is costly, running as high as $1,000-2,000 depending on the types of permits needed. Plants and prices can be found in Table 5.

Table 5. Prices for Buffer Strip Plants

Terrestrial-Dry soil	**Seeding Rate**	**Seed Price**	**Planting Rate**	**Price/Plant**
Big Bluestem Grass (*Andropogon gerardii*)	10-25b lbs/acre	$20/lb	NA	$4-5
Bluejoint Grass (*Calamagrostis canadensis*)	2 lbs/acre	$2-4/oz	NA	$4-5
Little Bluestem Grass (*Andropogon scoparius*)	10-25 lbs/acre	$20/lb	NA	$4-5
Prairie Cord Grass (*Spartina pectinata*)	0.25-1.0 lbs/acre	$2-3/oz	250-500/acre	$2-4
Switch Grass (*Panicum virgatum*)	0.5-2.0 lbs./acre	$6-7/oz	NA	$1-5
Terrestrial-Wet Soil	**Seeding Rate**	**Seed Price**	**Planting Rate**	**Price/Plant**
Blue Flag (*Iris versicolor*)	NA	$10/oz	1000/acre	$0.60-1.50
Blue Vervain (*Verbena hastata*)	NA	$6/oz	500-1000/acre	$0.80-1.00
Blunt Spike Rush (*Eleocharis obtusa*)	NA	$30/oz	500-1000/acre	$0.50-1.00
Boneset (*Eupatorium perfoliatum*)	0.006-0.25 lbs./acre	$6-7/oz	500-700/acre	$1.00
Water Horsetail (*Equisetum fluviatile*)	NA	NA	1000/acre	$0.50
Joe-Pye-Weed (*Eupatorium maculatum*)	NA	$8/oz	500-700/acre	$0.50-1.00
Sweet Flag (*Acorus calamus*)	NA	$10/oz	250/acre	$0.50-1.00
Wild Rice (*Zizania aquatica*)	NA	$5.00/lb	1000/acre	$0.50-0.20
Trees and Shrubs	**Seeding Rate**	**Seed Price**	**Planting Rate**	**Price/Plant**
Bur Oak (*Quercus macrocarpa*)	NA	NA	NA	$5-6
Buttonbush (*Cephalanthus occidentalis*)	NA	NA	NA	$6-7
Red Osier Dogwood (*Cornus stolonifera*)	NA	$9/oz	NA	$2-5
White Oak (*Quercus alb*a)	NA	$5-8/oz	NA	$6-7
Seed Mixes	**Seeding Rate**	**Seed Price**	**Planting Rate**	**Price/Plant**
Forb and Grass Seed Mix	500 square ft	$20-60	NA	NA
Forb and Grass Seed Mix	1000 square ft	$66-108	NA	NA

Option 3: 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. The moderately eroding shorelines along Lake Lakeland Estates could benefit from this option.

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 $25 to $35 per linear foot of shoreline, including plantings. The costs for mitigating the 517 feet of the Association's shoreline adjacent to the beach would range from $12,925 to $18,095. The eroding private lots have slightly different shoreline lengths, but one that is 150 long would have a cost range of $3,750- $5,250. This option could cost a little less than the use of riprap, and also has the benefit of maintaining and/or enhancing the shoreline for wildlife. This does not include the necessary permits and surveys, which may cost $1,000 – 2,000 depending on the type of earthmoving. Additional costs may be incurred if compensatory storage is needed.

Option 4: Install Rock Rip-Rap

Rip-rap is the term for using rocks to stabilize shorelines. Size of the rock depends on the severity of the erosion, distance to rock source, and aesthetic preferences. Generally, four

to eight inch diameter rocks are used. Rip-rap can be incorporated with other erosion control techniques such as plant buffer strips. If any plants will be growing on top of the rip-rap, fill will probably be needed to cover the rocks and provide an acceptable medium for plants to grow on. Prior to the initiation of work, permits and/or surveys from the appropriate government agencies need to be obtained (see costs below).

Pros

Rip-rap can provide good shoreline erosion control. Rocks can absorb some of the wave energy while providing a more aesthetically pleasing appearance than seawalls. If installed properly, rip-rap will last for many years. Maintenance is relatively low, however, undercutting of the bank can cause sloughing of the rip-rap and subsequent shoreline. Areas with severe erosion problems may benefit from using rip-rap. 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 and prey upon many invertebrate species, including many harmful garden and lawn pests. Also, small fish may utilize the structure created by large boulders for foraging and hiding from predators.

Cons

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

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

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

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

Costs:

Cost and type of rip-rap used depend on several factors, but average cost for installation (rocks and filter fabric) is approximately $30-45 per linear foot. Costs for a 150 foot length of shoreline would range $4,500-$6,750. 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 $1,000-2,000 for installation of rip-rap, depending on the circumstances. Contact the Army Corps of Engineers, local municipalities, and the Lake County Planning and Development Department.

Objective V: Enhance Areas for Wildlife.

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 variety 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). More information about non-native (exotic) plants can be found in Objective VI: "Remove Exotic Shoreline Plant Species."

Option 1: No Action

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

Option 2: Increase Habitat Cover

This option can be incorporated with Option 3 (see below). One of the best ways to increase habitat cover is to leave a minimum 25 foot buffer between the edge of the water and any mowed grass. Allow native plants to grow or plant native vegetation along shorelines, including emergent vegetation such as cattails, rushes, and bulrushes (see 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 Appendix A should be planted or allowed to grow. In addition, encourage native aquatic vegetation, such as water lily, sago pondweed, largeleaf pondweed, and wild celery 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 exasperate 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. Purple martin houses can cost $50-150. Bat boxes range in price from $15-50. These prices do not include mounting poles or installation.

Objective VI: Remove Exotic Shoreline Plant Species

The lot with exotic shoreline plant species is located in approximately the middle of the south shore of the Lake Lakeland Estates, and is about 160 feet long. Reed canary grass and purple loosestrife are both growing on this property. It would be best to remove these plants now before they begin to spread. The removal of these plants could be done either manually or with herbicides. Herbicide use would be more expensive. The buckthorn trees and garlic mustard need to be removed in the property at the east end of the lake. This is critical if the willow saplings planted for erosion control are to survive and provide shoreline protection.

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 athartica*), 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 per plant), and high seed germination rate, purple loosestrife spreads quickly. Buckthorn is an aggressive shrub species that grows along lake shorelines as well as most upland habitats. It shades out other plants and is quick to become established on disturbed soils. Reed canary grass is an aggressive plant that if left unchecked will dominate an area, particularly a wetland or shoreline, in a short period of time. Since it begins growing

early in the spring, it quickly out-competes native vegetation that begins growth later in the year. Control of purple loosestrife, buckthorn, and reed canary grass are discussed below. However, these control measures can be similarly applied to other exotic species such as garlic mustard (*Allilaria officianalis*) or honeysuckle (*Lonicera* spp.) as well as some aggressive native species, such as box elder (*Acer negundo*).

Presence of exotic species along a lakeshore is by no means a death sentence for the lake or other plant and animal life. If controlled, many exotic species can perform many of the original functions that they were brought here for. For example, reed canary grass was imported for its erosion control properties. It still contributes to this objective (offering better erosion control than commercial turfgrass), but needs to be isolated and kept in control. Many exotics are the result of garden or ornamental plants escaping into the wild. One isolated plant along a shoreline will probably not create a problem by itself. However, problems arise when plants are left to spread, many times to the point where treatment is difficult or cost prohibitive. A monitoring program should be established, problem areas identified, and control measures taken when appropriate. This is particularly important in remote areas of lake shorelines where the spread of exotic species may go unnoticed for some time.

Option 1: No Action

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

Pros

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

Costs:

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

Option 2: Control by Hand

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

Pros

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

Cons

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

Costs:

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

Option 3: Herbicide Treatment

Chemical treatments can be effective at controlling exotic plant species. However, chemical treatment works best on individual plants or small areas already infested with the plant. This is the case with Lake Lakeland Estates. Since many of the herbicides that are used are not selective, meaning they kill all plants they contact; this may be unacceptable if native plants are found in the proposed treatment area.

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

Because the purple loosetrife and reed canary grass are near water along Lake Lakeland Estates, only the herbicide Rodeo® (active ingredient, glyphosphate) can be used, as it is approved for use near water.

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:

One gallon of Rodeo® costs about $200, and can treat one acre of plants. Hand-held and backpack sprayers cost from $25-$45 and $80-150, respectively. Wicking devices are $30-40.

Table 6. 2000 Lake Lakeland Estates Water Quality Data

Epilimnion

DATE	DEPTH	ALK	TKN	NH3	NO3	TP	SRP	TDS	TSS	TS	TVS	SECCHI	COND	pH	DO
5/18/00	3	159	1.21	<0.1	<0.05	0.05	0.01	433	1.4	438	164	6.89	0.677	8.1	6.18
6/22/00	3	179	1.16	<0.1	0.058	0.07	0.03	382	2.8	444	157	8.1	0.6967	7.8	5.94
7/20/00	3	192	<0.5	<0.1	0.069	0.15	0.01	410	10	442	140	0.95	0.6800	7.6	3.41
8/24/00	3	204	1.4	<0.1	<0.05	0.11	0.01	466	13	489	148	2.89	0.7226	8.4	7.69
9/21/00	3	213	2.06	0.192	<0.05	0.09	0.02	412	14	456	156	3.12	0.7300	8.2	5.13
Epilimnion Avg.		189	1.46[k]	0.192[k]	0.064[k]	0.09	0.016	421	8.2	454	153	4.39	0.7013	7.99	5.67
Epilimnion Median		192	1.31	0.19	0.06	0.09	0.01	412	10	444	156	3.12	0.6967	8.10	5.94

Hypolimnion

DATE	DEPTH	ALK	TKN	NH3	NO3	TP	SRP	TDS	TSS	TS	TVS	SECCHI	COND	pH	DO
5/18/00	9	176	1.2	<0.1	0.052	0.07	0.03	456	2.9	471	159	NA	0.7084	7.6	0.02
6/22/00	10	189	1.24	<0.1	0.061	0.15	0.06	440	6.9	493	167	NA	0.7173	7.2	0.06
7/20/00	10	208	<0.5	0.752	0.07	0.38	0.32	398	9.1	451	144	NA	0.7299	7	0.20
8/24/00	10	227	3.1	1.69	<0.05	0.62	0.46	464	14	497	157	NA	0.7808	7	0.09
9/21/00	9	212	1.97	0.139	<0.05	0.08	0.01	410	19	456	155	NA	0.7289	8.2	5.78
Hypolimnion Avg.		202	1.88[k]	0.860[k]	0.061[k]	0.26	0.175	434	10.4	474	156	NA	0.7331	7.39	1.23

Glossary

ALK = Alkalinity, mg/L CaCO3
TKN = Total Kjeldahl nitrogen, milligrams per liter (mg/L)
NH3-N = Ammonia nitrogen, mg/L
NO3-N = Nitrate nitrogen, mg/L
TP = Total phosphorus, mg/L
SRP = Soluble reactive phosphorus, mg/L
TDS = Total dissolved solids, mg/L
TSS = Total suspended solids, mg/L
TS = Total solids, mg/L
TVS = Total volatile solids, mg/L
SECCHI = Secchi Disk Depth, Ft.
COND = Conductivity, milliSiemens/cm
DO = Dissolved oxygen, mg/L
pH units are equal o the -Log of (H) ion activity.

Note: "k" denotes that the actual value is known to be less than the value presented.
NA = Not Applicable

Appendix A. Methods for Field Data Collection and Laboratory Analyses

Water Sampling and Laboratory Analyses

Two water samples were collected once a month from May through September. Sample locations were generally at the deepest point in the lake (see sample site map), three feet below the surface, and approximately two feet off the bottom. Samples were collected with a horizontal or vertical Van Dorn water sampler. Approximately three liters of water were collected for each sample for all lab analyses. After collection, all samples were placed in a cooler with ice until delivered to the Lake County Health Department lab, where they were refrigerated. TestAmerica Incorporated, an environmental services lab, analyzed samples collected for total Kjeldahl nitrogen (TKN). The Health Department lab analyzed all other samples. Analytical methods for the parameters are listed in Table A1. Except nitrate nitrogen, all methods are from the Eighteenth Edition of Standard Methods, (eds. American Public Health Association, American Water Works Association, and Water Pollution Control Federation, 1992). Methodology for nitrate nitrogen was taken from the 14th edition of Standard Methods. Total Kjeldahl nitrogen was analyzed by method 351.2 from the Methods for Chemical Analyses of Water and Wastes (EPA 600 Series). Dissolved oxygen, temperature, conductivity and pH were measured at the deep hole with a Hydrolab DataSonde® 4a. Photosynthetic Active Radiation (PAR) was recorded using a LI-COR® 192 Spherical Sensor attached to the Hydrolab DataSonde® 4a. Readings were taken at the surface and then every foot until reaching the bottom in lakes $\leq$ 15 feet deep, and every two feet in lakes >15 feet.

Plant Sampling

Plants were sampled using a garden rake fitted with hardware cloth. The hardware cloth surrounded the rake tines and is tapered two feet up the handle. A rope was tied to the end of the handle for retrieval. At random locations in the littoral zone, the rake was tossed into the water, and using the attached rope, was dragged across the bottom, toward the boat. After pulling the rake into the boat, any plants on the rake were identified and recorded. Plants that were not found on the rake but were seen in the immediate vicinity of the boat at the time of sampling, were also recorded. Plants difficult to identify in the field were placed in plastic bags and identified with plant keys after returning to the office. The depth of each sampling location was measured either by a hand-held depth meter, or by pushing the rake straight down and measuring the depth along the rope or rake handle. One-foot increments were marked along the rope and rake handle to aid in depth estimation. Approximate locations of each point were drawn on an aerial photo of the lake. Locations of the plant edge were also identified and marked on the aerial

photo. The plant edge was defined as the area where aquatic plants presence dissipated, typically toward the deeper portions of the lake. The number of sample locations was contingent upon lake surface area, area of littoral zone, and presence and distribution of plants.

Shoreline Assessment

To assess the current condition of each lake's shoreline, a shoreline assessment was completed in 2000. This survey was conducted with the use of a boat, aerial photos, and county parcel maps. The shoreline along the land/water interface on each parcel was observed from a boat and various parameters were assessed (Table A2). Shorelines were first identified as developed or undeveloped. The type of shoreline was then determined and length of each type was recorded based on the parcel map or was estimated. In addition, several other parameters were measured including: the extent of shoreline vegetation, the degree of slope and erosion, the presence of inlets, recreational structures (including piers, boat lifts, swimming platforms, etc.), aerators, irrigation pumps, water control structures, invasive vegetation, beaver activity, and deadfall (trees or shrubs lying in the water).

Frequently a parcel consisted of several shoreline types. For example, a parcel may have a beach, a steel seawall, and rip-rap along the its shore. In this case, the parcel was subdivided into three separate sections.

Data was entered and analyzed in ArcView 3.2 © Geographic Information System (GIS) software. Total shoreline lengths and percentages for each category were determined using Excel software.

Wildlife Assessment

Species of wildlife were noted during visits to each lake. When possible, wildlife was identified to species by sight or sound. However, due to time constraints, collection of quantitative information was not possible. Thus, all data should be considered anecdotal. Some of the species on the list may have only been seen once, or were spotted during their migration through the area.

Table A1. Analytical Methods Used for Water Quality Parameters.

Parameter	***Method***
Temperature	Hydrolab DataSonde® 4a
Dissolved oxygen	Hydrolab DataSonde ®4a
Nitrate nitrogen	Brucine method
Ammonia nitrogen	Electrode method, #4500F
Total Kjeldahl nitrogen	EPA 600 Series, Method 351.2
pH	Hydrolab DataSonde® 4a, Electrometric method
Total solids	Method #2540B
Total suspended solids	Method #2540D
Total dissolved solids	Method #2540C
Total volatile solids	Method #2540E, from total solids
Alkalinity	Method #2320B, titration method
Conductivity	Hydrolab DataSonde® 4a
Total phosphorus	Methods #4500-P B 5 and #4500-P E
Soluble reactive phosphorus	Methods #4500- P E and #4500-P B1
Clarity	Secchi disk
Color	Illinois EPA Volunteer Lake Monitoring Color Chart
Photosynthetic Active Radiation (PAR)	Hydrolab DataSonde® 4a, LI-COR® 192 Spherical Sensor

Table A2. Shoreline Type Categories and Assessment.

Category	*Assessment*
Developed	Yes, No
Inlets	None, Culvert, Creek, Farm Tiles, Storm Water Outlet, Swale, Sump
Shoreline Vegetation	None, Light, Moderate, Heavy
Type	Prairie, Shrub, Wetland, Woodland, Beach, Buffer, Canopy, Lawn, Rip-rap, Seawall, Vacant
Slope	Flat, Gentle, Steep
Erosion	None, Slight, Moderate, Severe
Water Control Structures	None, Culvert, Dam, Spillway
Recreational Structures	Yes, No
Irrigation Present	Yes, No
Aerator Present	Yes, No
Invasive Vegetation	Yes, No
Beaver Activity	Yes, No
Deadfall	Yes, No

APPENDIX B. Multiparameter DATA

APPENDIX C. PLANT SPECIES AND OCCURRENCES

5/19/00 - 9/19/00	Nitella	Northern Watermilfoil	Small Pondweed	Unknown
Num. of Sites	26	5	10	1
% Occurrence	41%	8%	16%	2%

5/19/00	Nitella	Northern Watermilfoil	Small Pondweed	Unknown
Num. of Sites	5	1	0	0
% Occurrence	36%	7%	0%	0%

6/22/00	Nitella	Northern Watermilfoil	Small Pondweed	Unknown
Num. of Sites	8	4	6	0
% Occurrence	57%	29%	43%	0%

7/18/00	Nitella	Northern Watermilfoil	Small Pondweed	Unknown
Num. of Sites	7	0	2	0
% Occurrence	54%	0%	15%	0%

8/22/00	Nitella	Northern Watermilfoil	Small Pondweed	Unknown
Num. of Sites	5	0	2	1
% Occurrence	42%	0%	17%	8%

9/19/00	Nitella	Northern Watermilfoil	Small Pondweed	Unknown
Num. of Sites	1	0	0	0
% Occurrence	10%	0%	0%	0%

Objective VIII: Watershed Care

Lakes naturally become nutrient enriched and shallow over time. Without human interference, this process can take hundreds, even thousands of years. However, this process may take only decades if people are negatively impacting a lake's watershed. A watershed is the surrounding land that directs runoff to a lake. Many people do not realize the significance of the connection between a lake and its watershed. The watershed and its land uses (i.e.; urban, suburban, industrial, agricultural) directly influence the quality of a lake. As stormwater runoff flows over land, it picks up pollutants such as fertilizer, soil, pesticides, bacteria, salt, debris, motor oil and antifreeze. The quality and quantity of runoff directly affects the lake's water quality. Because pollution in runoff originates from a multitude of sources instead of one specific location, it is termed non-point source pollution. By contrast, point source pollution originates at a specific location and is from a single source. In the Midwest, agricultural land was previously targeted as the worst offender in non-point source pollution. However, with continued growth and development in Lake County, urban areas are now the largest contributor of pollutants in stormwater runoff. Good watershed controls can lessen concentrations of these pollutants in runoff. However, with watershed controls alone, improvement of the lake or pond may not occur for a number of years. For example, in cases of severe algal blooms, the lake's internal nutrient load may be so large that in-lake procedures may also be necessary to achieve any results. On the other hand, if the lake continues to receive large nutrient loads from the watershed, improvement from the in-lake procedures can be short-lived. Below are some watershed protection options that individuals, lake management organizations and municipalities can do to help care for their lakes. Several watershed protection options working in conjunction with each other give the best results.

Options for Watershed Nutrient Reduction

The two key ingredients (nutrients) for plant and algae growth are nitrogen and phosphorus. Fertilizers used for lawn and garden care have significant amounts of both. The three numbers on the fertilizer bag identify the percent of nitrogen, phosphorus and potash in the fertilizer mixture. For example, a fertilizer with the numbers 5-10-5 has 5% nitrogen, 10% phosphorus and 5% potash. Fertilizers considered low in phosphorus (the second number) have a number of 5 or lower. Low phosphorus fertilizers can be purchased at several local home improvement centers. A lower concentration of phosphorus applied to a lawn will result in a smaller concentration of phosphorus in stormwater runoff from that area. An established lawn will not be negatively affected by a lower phosphorus rate. However, for areas with new seeding or new sod, the homeowner would still want to use a fertilizer formulated for encouraging growth until the lawn is established.

Soil types can have different amounts of nitrogen and phosphorus. A simple soil test can determine the correct type and amount of fertilizer needed for the soil. Knowing this, homeowners can avoid applying the wrong type or amount of fertilizer. A lawn will not grow better if more fertilizer than necessary is applied. Excess fertilizer can enter nearby

lakes and ponds via stormwater runoff. In some instances, areas with rich soils (like those in Lake County) do not need the amounts of nitrogen and phosphorus that homeowners regularly apply. An over-fertilized lawn can contribute more phosphorus than a maintained septic system. A soil test costs about $15. Information about soil testing labs and the test can be obtained by calling the University of Illinois Cooperative Extension Office at (847) 223-8627.

During a rain event, fertilizer and other pollutants can enter a lake through runoff. An unfertilized, unmowed buffer strip of dense native vegetation about 25 feet will slow down the runoff and prevent some fertilizer from entering the lake. Growing a buffer strip along the shoreline can help to filter pollutants, stabilize the shore edge and provide important wildlife habitat. (See Objective IV: "Mitigate Shoreline Erosion," and Objective V: "Enhance Areas for Wildlife."

Option 1. Test the soil first, before fertilizing.

Pros

Results of the soil test may indicate that the homeowner was previously over-applying fertilizer. If the correct amount and type of fertilizer is less than what was previously applied, the homeowner can save money. Using less fertilizer also means less can run off to a lake or pond.

Cons

The homeowner would need to wait for test results before purchasing and applying fertilizers.

Costs

The soil test costs about $15.00. The cost can be offset by potential savings in the use of fertilizer. Prices of fertilizers depend on the grade (i.e., "premium" varieties) and additives such as herbicides (i.e., "weed and feed"). Prices range from $11 -$13 for 5,000 square foot coverage, to $34 for 15,000 square foot coverage.

Option 2. Buffer Strips

Buffer strips of unmowed native vegetation at least 25 feet wide along the shoreline can slow nutrient laden runoff from entering a lake. For example, if a homeowner fertilizes their lawn, this would be an option to consider. (See Objective IV: "Mitigate Shoreline Erosion" and ObjectiveV: "Enhance Areas for Wildlife".

Pros

Not only will a buffer strip of native vegetation slow nutrient runoff, it can help prevent shoreline erosion.

A buffer strip can provide habitat for beneficial wildlife.

Different plant mixes for the buffer strip can be chosen to be more aesthetically pleasing and colorful than mowed grass.

A buffer strip with tall plant species can deter waterfowl from congregating along the shore at that location.

A buffer strip would save the homeowner yard work time since no mowing is necessary.

Cons
The initial cost of new plants for the buffer strip can be expensive depending on what types of plants the homeowner desires.

Some people feel a buffer strip may block their view of the lake. A path of shorter plants or a mowed pathway would rectify this.

Installing the buffer strip takes time if done by the homeowner. If a landscaping crew is hired, the costs will increase.

Costs
See "Option 2, Create a Buffer Strip" in Objective IV: "Mitigate Shoreline Erosion."

Option 3. Lake Friendly Lawn and Garden Care Practices – Phosphorus Reduction.

3a. Several burn piles were noted around the shoreline at Lake Lakeland Estates. Compost yard waste instead of burning yard waste. Ashes from yard waste contain nutrients, and are easily washed into a lake. Avoid burn piles of any sort, especially near the lake shoreline. People may feel that this is a good location since it's easy to extinguish the fire with the lake water. However, ashes close to the water's edge can easily enter the lake and contribute to the internal nutrient load. It's best not to have a burn pile at all. Never burn yard waste (or anything else) in ditches. The ditches flow to a body of water somewhere, even if a lake is not close by.

3b. Avoid dumping yard waste along or into a ditch, pond, lake or stream. As yard waste decomposes, the nutrients within are released directly into the water, or are flushed to a lake via the ditch.

3c. Avoid applying fertilizer up to the water's edge. Leave a buffer strip of at least 25 feet of unfertilized yard before the shoreline.

3d. Avoid applying fertilizers when heavy rains are expected, or over-watering the ground after applying fertilizer.

3e. When landscaping, keep site disturbance to a minimum, especially the removal of vegetation and exposure of bare soil. Exposed soil can easily erode.

3f. When landscaping, seed or plant exposed soil and cover it with mulch as soon as possible to minimize erosion and runoff.

3g. Use lawn and garden chemicals sparingly, or do not use them at all.

Pros
Following these tips helps prevent excess fertilizer from entering the lake and contributing to the internal nutrient load.

Less fertilizer used means more money saved by the homeowner.

Burning yard waste not only increases the risk of more nutrients entering the water, but the smoke aggravates some health conditions and adds to air pollution.

Cons
If a homeowner does not want to compost or burn yard waste, they need to dispose of it through a yard waste disposal service. This is not expensive, but is an added cost.

Some people enjoy burning yard waste and may not want to stop burning.

Costs
People who have yard waste picked up by their garbage service can incur costs of $60 per year or $1.50 - $2.00 per bag.

Option 4. Disseminate Information About Watershed Care

The Lake Lakeland Estates Property Owner's Association can be instrumental in circulating educational information about watersheds and how to care for them. Watershed residents are the first to notice problems in the area, such as a lack of erosion control at construction sites. The Association would be an advocate for the watershed, and members could voice their concerns about future development impacts to local officials. This Association could disseminate information to educate the community about the watershed and how it affects the lakes. Topics can be presented in a way that gets people's attention, such as how they affect property values or individual expenses. ("Want to save money on your lawn fertilizer?") Several types of educational outreach can be used together for best results.

4a. Community newsletter.

4b. Newspaper articles.

4c. Fact sheets or flyers

Pros

A galvanized organization can be a stronger working unit and a stronger voice than a few individuals. These types of organizations can help preserve the lake system.

Getting people to change their habits can be difficult. Educating people about watershed protection can encourage people to do so. When people support these ideas, watershed protection is easier to accomplish. Fundraising for more expensive projects may be possible if more people are educated and understand the reasons why these plans are important.

Cons
Forming an organization takes time and effort. Keeping an organization active can be difficult and also requires time and effort.

Education on a volunteer basis takes time. Some people may find it difficult to help with an education drive.

Costs
Costs for a newsletter would include paper, printing and postage. Postage is less expensive if done by bulk rate mailing. If possible, money can be saved by bringing packets of information door-to-door.

Options for Watershed Sediment Reduction

Continued sediment inflow can fill areas of the lake and cause the water to become turbid. Incoming sediment can smother fish eggs or cover young aquatic plants. Increased turbidity reduces sunlight penetration, limiting aquatic plant growth. Damage to native aquatic plants from multiple sediment inputs can lead to the loss of these plant species and the animals that depend on them. Sight-feeding fish have a difficult time finding food in turbid water. Often, nutrients such as phosphorus are attached to sediment particles that reach the lake through stormwater runoff, which can contribute to plant and algae growth.

Option 3. Lake Friendly Lawn, Garden and Home Building Practices – Sediment

3a. Seed and mulch bare soil as soon as possible to minimize erosion and runoff. The Watershed Development Ordinance requires that disturbed areas shall be stabilized by seeding, mulching, sodding and/or non-vegetative measures within 14 days after the completion of the project.

3b. During home building projects, disturb as little vegetation as possible to minimize erosion and runoff. The Watershed Development Ordinance requires that soil disturbance shall be conducted in such a manner as to minimize erosion.

3c. Incorporate a buffer strip of native vegetation next to the shoreline. See Option 2, "Create a Buffer Strip" in Objective IV: "Mitigate Shoreline Erosion."

3d. Minimize impervious surfaces when considering installing pathways or even driveways. Gravel can be a suitable and less expensive option than asphalt or concrete. This will allow water to infiltrate into the ground rather than flow across impervious surfaces and contribute to runoff.

Pros

All practices have the goal of keeping sediment onsite. In addition to preventing sediment from entering a lake through runoff, the property owner or managing entity would not need to periodically replace soil in areas where erosion is problematic.

Areas prone to eroding such as steep grades can be protected before severe erosion begins. This could prevent the need to use erosion control practices later, which would add costs to the project.

The addition of a buffer strip of native vegetation can improve the area for wildlife, enhance the aesthetics, and possibly increase the property value.

Cons

In some home construction projects, it may be difficult not to disturb vegetation if heavy equipment is used.

Some people may not prefer the aesthetics that a buffer strip or naturalized areas provide.

Installation of a buffer strip of native plants can add to the cost of the project.

Other Options for Watershed Care

Option 3: Pet Waste

Pick up pet waste and dispose of it properly. To encourage people to pick up pet waste in public areas, the managing entity could provide waste disposal bags (such as "Mutt Mitts") onsite, and post signs about cleaning up after pets.

Pros
Picking up after a pet can help prevent bacteria and nutrients from entering the lake via runoff. Cleaning up pet waste helps keep neighborhood lawns and common areas cleaner.

Cons
Some people may find picking up pet waste offensive, but people also feel that stepping in it is offensive.

Costs

If someone uses a plastic grocery bag, it's free. A denser bag, such as Mutt Mitts, costs about $22.00 for a pack of 100 bags.