2001 SUMMARY REPORT
of
ALBERT LAKE

Lake County, Illinois

Prepared by the

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

Christina L. Brant
Michael Adam
Mary Colwell
Joseph Marencik
Mark Pfister

June 2002

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Albert Lake is a very shallow, manmade impoundment located in Long Grove and Killdeer. The lake has a surface area of 18.7 acres and a maximum depth of 2.0 feet. Historically, the Southeast branch of the Lake Zurich sewage treatment plant discharged into Buffalo Creek upstream of Albert Lake. New homes are currently being built on and around the lake in the Tall Oaks subdivision. The lake's main use for homeowners along the shore appears to be aesthetics, since the shallow morphometry of the lake prevents recreational activities such as boating, fishing and swimming.

Each month from May-September 2001, water samples were collected from the inlet and outlet on Albert Lake and were analyzed for a variety of water quality parameters. During most of the summer, dissolved oxygen (DO) concentrations were less than 5.0, which causes aquatic organisms, especially fish, to become stressed.

Average total phosphorus (TP) concentrations at both the inflow and outflow were dramatically higher than average TP concentrations in the majority of the lakes in Lake County, and the August outlet TP concentration was the highest recorded to-date in Lake County. Outlet TP concentrations were four times higher than inlet concentrations each month, indicating that the water was picking up phosphorus as it passed through the lake. Resuspended sediment from huge numbers of common carp is believed to be the source of this in-lake phosphorus.

Average total suspended solids (TSS) concentrations in both the inlet and outlet were well above the majority of the County lakes and resulted in very low Secchi depths (water clarity) each month. These high TSS concentrations were also the result of high carp densities in the lake.

Due to poor water clarity, almost no aquatic plants were found in Albert Lake throughout the summer. Each of the plants found were observed in no more than 7% of the plant sampling sites and only occurred near the two small inlets, where water clarity was higher.

The majority of Albert Lake's shoreline (65%) was undeveloped and dominated by woodland and wetland, ideal habitat for wildlife. Due to this large amount of undeveloped shoreline, many waterfowl and songbirds were observed during the summer in and around the lake. Despite the large amount of desirable shoreline, 53.8% of Albert Lake's shoreline exhibited slight erosion.

The water quality problems documented on Albert Lake during this water quality study included (1) lack of aquatic vegetation, (2) poor water clarity, (3) presence of common carp, (4) low dissolved oxygen concentrations, and (5) invasive shoreline plant species.

Recommendations and options for lake management techniques to address these problems are described in the report.

LAKE IDENTIFICATION AND LOCATION

Albert Lake is located partially in Long Grove and partially in Killdeer, between Cuba Road and Long Grove Road (T 43N, R 10E, S 26). The lake is a very shallow, manmade impoundment with a surface area of 18.7 acres and mean and maximum depths of 1.0 feet and 2.0 feet, respectively. Albert Lake is on-line with Buffalo Creek and is part of the Buffalo Creek sub basin, which is within the Des Plaines River Watershed. Water exits the lake and flows southeast over a spillway into Buffalo Creek, which eventually empties into the Des Plaines River.

BRIEF HISTORY OF ALBERT LAKE

Albert Lake is a private lake owned by the Tall Oaks Homeowners Association and twelve individual homeowners on the lake. The lake was created in the 1950's by damming Buffalo Creek and allowing the surrounding land to flood. The original rock dam failed approximately 10 years ago, causing the lake to empty and all of the fish became heron food. The dam was replaced with the current dam by Hawthorn Developers. Historically, the southeast branch of the Lake Zurich sewage treatment plant discharged into Buffalo Creek, upstream of Albert Lake. The plant was located on Old Mill Grove Road, south of Rt. 22. This sewage treatment plant (STP) violated many permitted discharge limitations in the mid-eighties and was eventually closed. Several of these violations related to final effluent limitations and included: (1) biological oxygen demand violations during 11 out of 22 months between July 1986 and April 1988, with the maximum concentration being 250% over the permit limit, (2) total suspended solids violations during 12 months between September 1986 and April 1988 with the greatest excess concentrations being 1000% over the permit limit, and (3) fecal coliform violations during 17 out of 17 months between November 1986 and April 1988, with the greatest excess concentrations being 3430% over the permit limit. Additionally, the Village of Lake Zurich caused or allowed unpermitted bypasses of sand filters and subsequent separate unpermitted discharge to Buffalo Creek. Although there is no record of phosphorus discharge into the Creek from the southeast plant, phosphorus discharge from the northwest plant of the Lake Zurich STP into Flint Creek was permitted at a concentration of 1.0 mg/l. Assuming that the southeast plant had the same effluent concentration, and given that the average discharge from the plant was 1.25 million gallons per day, approximately 10.4 pounds of phosphorus/day or 3,807 pounds/year were being discharged into Buffalo Creek. However, the northwest plant violated its phosphorus limit on 17 out of 24 months between May 1987 and April 1988, with the greatest excess concentration being 890% over the permit limit. Based on other permit violations, it can be assumed that the southeast plant exceeded 1 mg/l TP on many occasions, and that a large amount of phosphorus was discharged into Buffalo Creek from the southeast STP and that our phosphorus load estimate is very conservative.

As a result of numerous complaints and subsequent legal proceedings, in July 1987, the northwest plant was placed on pending Restricted Status and the southeast plant was placed on pending Critical Review. In February 1989, the Village of Lake Zurich was ordered to pay a penalty of $45,000, to close the northwest plant and transfer the load to the southeast plant, and to take all necessary action to implement interim improvements to the southeast plant as soon as reasonably possible. Eventually, in 1993, the southeast plant was also closed and the water re-routed to a new Lake County STP facility outside Buffalo Grove.

SUMMARY OF CURRENT AND HISTORICAL LAKE USES

No public access is available to Albert Lake, and only homeowners who live on the lake (and their guests) can use the lake for recreation. The lake's main use appears to be aesthetics, since the shallow morphometry of the lake prevents recreational activities such as boating, fishing and swimming. Albert Lake's watershed is dominated by agricultural and light residential land uses. The shoreline of the lake is approximately one mile long and dominated by a mix of wetland and woodland.

LIMNOLOGICAL DATA – WATER QUALITY

Water samples collected from Albert Lake were analyzed for a variety of water quality parameters (See Appendix B for methodology). Because Albert Lake is very shallow and has a uniform depth throughout, surface water samples were collected at the inlet stream (inlet) and adjacent to the spillway (outlet) (Figure 1). In general, water temperature and dissolved oxygen (DO) concentrations were very similar at the inlet and outlet. During most of the summer, DO concentrations were less than 5.0 mg/l, which causes aquatic organisms, especially fish, to become stressed (Table 1, Appendix A). As a result, the observed fishery was made up almost entirely of common carp, a rough fish capable of surviving low DO concentrations that would typically kill most other fish species.

Phosphorus is a nutrient that can enter lakes through runoff or be released from lake sediment, and high levels of phosphorus typically trigger algal blooms or produce high plant density. Years of discharge violations by the Lake Zurich sewage treatment plant created sediment rich in phosphorus along the entire length of stream between the treatment plant and Albert Lake. It is likely that much of the phosphorus-rich sediment was deposited in the lake and that a large area of the lake near the inlet was filled in due to high sediment deposition in general. The inlet phosphorus concentrations ranged from 0.079-0.947 mg/l. Even at its lowest concentration, total phosphorus (TP) at the inflow (0.079 mg/l) was dramatically higher than average TP concentrations in the majority of the lakes in Lake County (0.047 mg/l) and increased each month from May-August. The phosphorus appeared to be entering the lake via sediment particles since phosphorus concentrations correlated with total suspended solids (TSS) in the inflow during the study (Figure 2). The increase in phosphorus concentrations each month at the inlet was the result of progressively lower water levels. Because very little rain fell in June, July and early August, water levels dropped in the inlet, and phosphorus that continued to flow through Buffalo Creek was concentrated into a smaller volume of water as it entered

Albert Lake. Due to heavy rainfall throughout August, water volume increased and phosphorus concentrations decreased from August to September. Approximately 23% of TP was made up of soluble reactive phosphorus (SRP), a form of phosphorus that is soluble in water and readily available for uptake by algae or plants. Approximately 75% of the lake samples collected in Lake County had non-detectable (<0.005 mg/l) SRP concentrations. The inlet SRP concentrations in Albert Lake ranged from 0.012-0.178 mg/l. Given this extremely large amount of available phosphorus, Albert Lake would likely have been dominated by algae blooms throughout the summer if high water turbidity had not reduced light levels.

Outlet TP concentrations (ranging from 0.160-3.880 mg/l) and SRP concentrations (ranging from 0.005-0.754 mg/l), were nearly four times greater than respective inlet concentrations, and the August outlet TP (3.880 mg/l) was the highest concentration recorded to-date in Lake County. Phosphorus concentrations of 0.1 mg/l indicate hypereutrophic conditions in a lake. Albert Lake's monthly outlet phosphorus concentrations exceeded this level throughout the summer (Figure 3). As in the inlet, the high amount of available phosphorus, in the form of SRP, would have resulted in dense algae blooms if water turbidity had been lower. The outlet phosphorus concentration increased each month from May to August, but decreased from August to September due to water level fluctuations and a lower concentration of phosphorus entering the lake. The large increase in phosphorus from the inlet to the outlet indicates that water was picking up phosphorus as it passed through the lake. The source of this in-lake phosphorus is believed to be re-suspended sediment. A huge number of common carp were observed in Albert Lake throughout the summer, and especially during spawning in June and July. Through their spawning and bottom-feeding activities, carp stir up phosphorus-rich lake sediment, releasing phosphorus bound to the sediment and creating very turbid conditions in the lake. Due to the shallow nature of Albert Lake, the conditions created by carp activities were exacerbated, leading to very high phosphorus and TSS levels (Figure 3).

Average TSS concentrations in both the inlet and outlet were well above the majority of County lakes, which had an average TSS concentration of 5.7 mg/l, and resulted in very low Secchi depths each month. The average outlet TSS value (75.1 mg/l) was 1.5 times the average inlet TSS value (50.8 mg/l). In addition, the July outlet TSS concentration (92 mg/l) was the highest ever measured in Lake County since 1995. As mentioned above, the source of the high inlet TSS value was the watershed of Buffalo Creek and the source of the higher outlet TSS value was in-lake carp activity. As a result, Secchi depths (water clarity) did not exceed 1.5 feet at the inlet or 1.0 foot at the outlet, and the Secchi depth of 0.49 feet recorded several times during the summer was the lowest ever in any County lake since 1995 (Figure 4). In general, the greater the Secchi depth, the better the water clarity, which can be reduced by either algae or sediment in the water column. High non-volatile suspended solids (NVSS) concentrations suggest that these low Secchi depths were caused almost entirely by sediment, not algae. NVSS represents the amount of suspended solids made up of inorganic materials, such as sediment or soil particles. Average inlet NVSS was 38.3 mg/l and average outlet NVSS was 56.3 mg/l. Both made

up approximately 75% of the respective average TSS concentrations for the inlet and outlet, indicating that very little of the TSS were made up of algae or plant material.

Total dissolved solids (TDS) and total volatile solids (TVS) in Albert Lake were also higher than the Lake County averages for each of these parameters. Average conductivity in Albert Lake, which represents the amount of dissolved ions in the lake and is related to TDS, was 1.5 to 2.0 times higher than the Lake County average of 0.7557 mS/cm on most sampling dates (Table 1, Appendix A). Often, conductivity is high in May as a result of a high concentration of road salt entering the lake via runoff. This was the case in Albert Lake; however, conductivity failed to decrease after runoff from salt-laden streets subsided.

Typically, lakes are either phosphorus (P) or nitrogen (N) limited. This means that one of these nutrients is in short supply relative to the other and that any addition of phosphorus or nitrogen to the lake might result in an increase of plant or algal growth. Other resources necessary for plant and algae growth include light or carbon. These are typically not limiting, but in Albert Lake low clarity may be limiting light. Most lakes in Lake County are phosphorus limited, but to compare the availability of nitrogen and phosphorus, a ratio of total nitrogen to total phosphorus (TN:TP) is used. Ratios less than or equal to 10:1 indicate nitrogen is limiting. Ratios greater than or equal to 15:1 indicate that phosphorus is limiting. Ratios greater than 10:1, but less than 15:1 indicate that there are enough of both nutrients to facilitate excess algal or plant growth. The inlet of Albert Lake had a TN:TP ratio of 5:1, while the outlet had a TN:TP ratio of 2:1. This indicates that the lake is highly nitrogen limited and that any increase in nitrogen entering the lake might cause noticeable impacts, such as the occurrence of algae blooms. In a highly nitrogen limited lake, such as this, algae may not reach nuisance densities because there is not enough N relative to P in the water column to sustain algal growth. If algae is not growing, it will not take up and utilize either N or P from the water, causing an increase in these nutrients. Although the average nitrogen concentrations in the inlet and outlet (1.28 mg/l and 2.24 mg/l, respectively) were higher than the County average (1.27 mg/l), and the August outlet concentration of 4.580 mg/l was the highest in the County, the phosphorus concentration was proportionally higher due to inflow from Buffalo Creek and constant sediment resuspension by carp. Without an adequate source of N all summer, the algae were not able to grow and no algae blooms were observed. Also as a result of the extreme N limitation, the algae were not able to use much P for growth. This unused P built up in the water column and contributed to the high phosphorus concentrations that were the main cause of the low TN:TP ratio.

Phosphorus levels can also be used to indicate the trophic state (productivity level) of a lake. The Trophic State Index (TSI) uses phosphorus levels, chlorophyll *a* levels and Secchi depth to classify and compare lake trophic states using just one value. The TSI is set up so that an increase in phosphorus concentration is related to an increase in algal biomass and a corresponding decrease in Secchi depth. A high TSI value indicates eutrophic (TSI=50-69) to hypereutrophic (TSI ≥70) lake conditions, typically characterized by high nutrient concentrations, high algal biomass, low DO levels, a rough fish population, and low water clarity. Albert Lake had an outflow phosphorus TSI

(TSIp) value of 106.3, indicating hypereutrophic conditions. This means that the lake is a highly enriched system with very poor water quality. Although the TSIp of Albert Lake is the highest in Lake County to date, it is not extremely unusual for Lake County, where most man-made lakes fall into the eutrophic and hypereutrophic categories (Table 2, Appendix A).

Most of the water quality parameters just discussed can be used to analyze the water quality of Albert Lake based on use impairment indices established by the Illinois Environmental Protection Agency (IEPA). According to this index, Albert Lake provides *Non-support* of aquatic life, swimming and recreation as a result of the high TSI values, high nonvolatile solids concentrations, and low percent plant coverage

LIMNOLOGICAL DATA – AQUATIC PLANT ASSESSMENT

Aquatic plant surveys were conducted every month for the duration of the study (See Appendix B for methodology). Shoreline plants of interest were also recorded. However, no quantitative surveys were made of these shoreline plant species and these data are purely observational. Due to poor water clarity, almost no aquatic plants were found in Albert Lake throughout the summer (Table 3). Each of the plants listed in Table 3 were observed in no more than 7% of the plant sampling sites during the summer of 2001 (Table 4, Appendix A), and only occurred near the two small inlets, where water clarity was higher. Of the seven emergent plant and trees species observed along the shoreline of Albert Lake, three (purple loosestrife, reed canary grass, and buckthorn) are invasive species that do not provide ideal wildlife habitat and have the potential to dominate the emergent plant community.

FQI (Floristic quality index) is a rapid assessment tool designed to evaluate the closeness that the flora of an area is to that of undisturbed conditions. It can be used to: 1) identify natural areas, 2) compare the quality of different sites or different locations within a single site, 3) monitor long-term floristic trends, and 4) monitor habitat restoration efforts (Nichols, 1999). Each floating or submerged aquatic plant is assigned a number between 1 and 10 (10 indicating the plant species most sensitive to disturbance). An FQI is calculated by multiplying the average of these numbers by the square root of the number of plant species found in the lake. A high FQI number indicates that there are a large number of sensitive, high quality plant species present in the lake. Non-native species were also included in the FQI calculations for Lake County lakes. The average FQI for 2000-2001 Lake County lakes is 15.5. Albert Lake has an FQI of 7.5, supporting the observation of very few high quality plants during the summer of 2001.

Table 3: Aquatic and shoreline plants on Albert Lake, May-September 2001.

<u>*Aquatic Plants*</u>	
Coontail	*Ceratophyllum demersum*
Small Duckweed	*Lemna minor*
Curlyleaf Pondweed	*Potamogeton crispus*
Sago Pondweed	*Stuckenia pectinatus*
<u>*Shoreline Plants*</u>	
Sweet Flag	*Acorus calamus*
Blue Flag Iris	*Iris hexagona*
Purple Loosestrife	*Lythrum salicaria*
Reed Canary Grass	*Phalaris arundinacea*
Common Buckthorn	*Rhamnus cathartica*
Common Cattail	*Typha latifolia*
Common Arrowhead	*Sagittaria cuneata*

LIMNOLOGICAL DATA – SHORELINE ASSESSMENT

A shoreline assessment was conducted at Albert Lake on August 8, 2001. The shoreline was assessed for a variety of criteria (See Appendix B for methods). Based on these assessments, several important generalizations could be made. The majority of Albert Lake's shoreline (65%) is undeveloped. This undeveloped shoreline is dominated by woodland (48.5%) and wetland (51.5%), ideal habitat for wildlife. The majority of the developed shoreline consists of woodland (45.5%), buffer (23.3%) and lawn (17.1%), while the remainder is wetland (12.6%) and rip rap (1.4%) (Figure 5). Despite the large amount of desirable shoreline, 53.8% of Albert Lake's shoreline exhibited slight erosion, 6.3% exhibited moderate erosion and 3.1% exhibited severe erosion. While wetland areas suffered the least amount of erosion (20.1%), woodland areas exhibited slight to moderate erosion along 87% of the shore. Developed areas with buffer or manicured lawn exhibited slight to severe erosion along 100% of the shore (Figure 6). Manicured lawns provide a poor shoreline-water interface due to the poor root structure of turf grasses. These grasses are incapable of stabilizing shorelines and typically lead to erosion. Buffered areas, if not properly planted or maintained, can suffer from undercutting, which leads to erosion. Despite this, Albert Lake has only minor erosion problems at this time and steps should be taken to ensure that erosion does not increase as the shoreline becomes more residentially developed.

LIMNOLOGICAL DATA – WILDLIFE ASSESSMENT

Wildlife observations were made on a monthly basis during water quality and plant sampling activities (See Appendix B for methodology). Good wildlife habitat was found around Albert Lake for the large number of birds observed during 2001 (Table 5). Only 35% of the shoreline is developed and almost half of this developed shoreline consists of woodland. The undeveloped shoreline along the lake is dominated by wetland and woodland, which serve as good habitat for birds and waterfowl. Care should be taken by new homeowners along the shoreline of Albert Lake to prevent the removal of this desirable shoreline vegetation on their properties. Despite the beneficial wildlife habitat found, invasive plant species (reed canary grass (*Phalaris arundinacea*), buckthorn (*Rhamnus cathartica*) and purple loosestrife (*Lythrum salicaria*)), were observed along 97% of Albert Lake's shoreline. These plants are seldom used by wildlife for food or shelter and can easily displace other native, more desirable plant species. Actions to control or eliminate these three invasive species around the lake and to maintain buffer strips of woodland or wetland along the shorelines currently being developed should be carried out.

Catfish and largemouth bass were present in the lake approximately 10 years ago, prior to the dam failure, indicating that the lake may have been much deeper as recently as the early 80's. Current DO levels would not support largemouth bass and the lake probably freezes through in the winter. Lake depth must have, originally, been great enough to prevent complete freeze and provide winter habitat for the bass and catfish present.

Table 5: Wildlife species observed at Albert Lake, May-September 2001.

Birds	
Double Crested Cormorant	*Phalacrocorax auritus*
Canada Goose	*Branta canadensis*
Mallards	*Anas platyrhnchos*
Great Egret	*Casmerodius albus*
Great Blue Heron	*Ardea herodias*
Cooper's Hawk	*Accipiter cooperii*
Red-tailed Hawk	*Buteo jamaicensis*
Belted Kingfisher	*Megaceryle alcyon*
Red-headed Woodpecker	*Melanerpes erythrocephalus*
Common Flicker	*Colaptes auratus*
Barn Swallow	*Hirundo rustica*
American Crow	*Corvus brachyrhynchos*
American Robin	*Turdus migratorius*
Red-winged Blackbird	*Agelaius phoeniceus*
House Sparrow	*Passer domesticus*
Mammals	
White-tailed Deer	*Odocoileus virginianus*

EXISTING LAKE QUALITY PROBLEMS

- *Lack of Aquatic Vegetation*

  One key to a healthy lake is a healthy aquatic plant community. Albert Lake is practically devoid of plants. Lack of quality aquatic plants and subsequent reduction of water quality is the result of low light penetration caused by high total suspended solids concentrations. The negative impacts associated with the absence of aquatic plants are wide spread and include those on water quality and fishery health.

- *Poor Water Clarity*

  Due to the absence of aquatic plants, which provide sediment stability and reduce sediment resuspension, and the presence of large numbers of common carp, the water column of Albert Lake is filled with suspended sediments. This keeps water clarity low and prevents any aquatic plants from growing. Poor water clarity also reduces the aesthetics of the lake and prevents recreational activities such as swimming.

- *Carp*

  Common carp are present in Albert Lake in very high densities, and are suspected to be one of the only fish species able to survive there. This carp species reproduces at a high rate and their spawning and feeding activities disturb bottom sediments. The presence of these fish in Albert Lake is contributing to and primarily causing very high TSS and TP levels, as well as very low Secchi depths.

- *Low Dissolved Oxygen Concentrations*

  Albert Lake experienced low dissolved oxygen levels virtually all summer. High water temperatures in this shallow lake were probably to blame for this problem. As water temperature rises, DO drops. Temperatures reached a maximum of 28^{o}C (83^{o}F) at the lake surface during the 2001 study, a level that can lead to very low DO concentrations. Low DO levels can cause fish stress and, if continual, can eventually lead to a fish kill. This is especially true during the winter when ice cover is present. Snow cover on frozen lakes prevents photosynthesis from occurring below the ice, eliminating a source of oxygen to the lake. Without a source of oxygen, respiration will quickly deplete the water of oxygen and a winter fish kill will occur. Only lakes with at least 25% of their volume below a depth of 10 feet are less susceptible to winter fish kills.

- *Invasive Shoreline Plant Species*

  Numerous exotic plant species have been introduced into our local ecosystems. Some of these plants are aggressive, quickly out-competing native vegetation and flourishing in an environment where few natural predators exist. The outcome is a loss of plant and animal diversity. Purple loosestrife is responsible for the “sea of purple” seen along roadsides and in wetlands during summer. It can quickly dominate a wetland or shoreline. Due in part to an extensive root system, large seed production (estimates range from 100,000 to 2.7 million per plant), and high seed germination rate, purple loosestrife spreads quickly. Buckthorn is an aggressive shrub species that grows along lake shorelines as well as most upland habitats. It shades out other plants and is quick to become established on disturbed soils. Purple loosestrife, buckthorn and reed canary grass (another exotic species) are present along 97% of the shoreline of Albert Lake and attempts should be made to control their spread.

POTENTIAL OBJECTIVES FOR THE ALBERT LAKE MANAGEMENT PLAN

I. Reduce or Eliminate Common Carp
II. Control Shoreline Erosion
III. Eliminate or Control Invasive Species
IV. Deepen the Lake

OPTIONS FOR ACHIEVING THE LAKE MANAGEMENT PLAN OBJECTIVES

Objective I: Reduce or Eliminate Common Carp

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

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

There are several techniques to remove carp. However, rarely does any technique eradicate carp from a lake. Commonly, once a lake has carp, it has carp forever. This is likely to be the case in Albert Lake, which receives new carp infestations each year through Buffalo Creek. However, it is up to the management entity to dictate how big the problem is allowed to become. Rotenone is the only reliable piscicide (fish poison) on the market at this time, but it kills all fish that is comes into contact with. Currently, there is a rotenone laced baiting system that can selectively remove carp. While the process is a step in the right direction, several factors still need to be worked out in order for it to be a viable alternative to the whole lake treatment. Until this baiting technique is further developed and produces consistent results, it is not recommended.

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

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

Pros

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

Cons

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

Costs

There is no cost associated with the no action option.

<u>Option 2: Rotenone</u>

Rotenone is a piscicide that is naturally derived from the stems and roots of several tropical plants. Rotenone is approved for use as a piscicide by the USEPA and has been used in the U.S. since the 1930's. It is biodegradable (breaks down into CO_2 and H_20) and there is no bioaccumulation. Because rotenone kills fish by chemically inhibiting the use of oxygen in biochemical pathways, adult fish are much more susceptible than fish eggs (carp eggs are 50 times more resistant). Other aquatic organisms are less sensitive to rotenone. However, some organisms are effected enough to reduce populations for several months. In the aquatic environment, fish come into contact with the rotenone by a different method than other organisms. With fish, the rotenone comes into direct contact with the exposed respiratory surfaces (gills), which is the route of entry. In other organisms this type of contact is minimal. More sensitive non-fish species include frogs and mollusks but these organisms typically recover to pretreatment levels within a few months. Rotenone has low mammalian and avian toxicity. For example, if a human consumed fish treated with normal concentrations of rotenone, approximately 8,816 lbs. of fish would need to be eaten at one sitting in order to produce toxic effects in humans. Furthermore, due to its unstable nature, it is unlikely that the rotenone would still be active at the time of consumption, and warm-blooded mammals have natural enzymes that would break down the toxin before it had any effects.

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

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

Pros

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

Cons

There are no negative impacts associated with removing excessive numbers of carp from a lake. However, in the process of removing carp with rotenone, other desirable fish species will also be removed. The fishery can be replenished with restocking and quality sport fishing normally returns within 2-3 years. Other aquatic organisms, such as mollusks, frogs, and invertebrates (insects, zooplankton, etc.), are also negatively impacted. However, this disruption is temporary and studies show that recovery occurs within a few months. Furthermore, the IDNR will not approve application of rotenone to waters known to contain threatened and endangered fish species. Another drawback to rotenone is the cost. Since the whole lake is treated and costs per gallon range from $50.00 - $75.00, total costs can quickly add up. This can be off-set with lake draw down to reduce treatment volume. Unfortunately, draw down is not an option on all lakes.

Costs

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

(18.7 acre-feet)(2.022 gallons) = 38 gallons needed to treat lake

(38 gallons)($50-75/gallon*) = $1,900-2,850 to treat entire lake

*Cost/gallon = $50-75 range

In waters with high turbidity and/or planktonic algae blooms, such as Albert Lake, the ppm may have to be higher. A IDNR fisheries biologist will be able to determine if higher concentrations will be needed. Due to the shallowness of Albert Lake and the low DO concentrations observed in 2001, restocking with other fish species may not be successful, as winterkill is almost certain to occur. However, the removal of carp would certainly increase lake clarity and possibly allow for the growth of aquatic plants (which will help to increase DO levels and reduce TP and TSS concentrations).

Objective II: Control Shoreline Erosion

Erosion is a potentially serious problem to lake shorelines and occurs as a result of wind, wave, or ice action or from overland rainwater runoff. While some erosion to shorelines is natural, human alteration of the environment can accelerate and exacerbate the problem. Erosion not only results in loss of shoreline, but negatively influences the lake's overall water quality by contributing nutrients, sediment, and pollutants into the water. This effect is felt throughout the food chain since poor water quality negatively affects everything from microbial life to sight feeding fish and birds to people who want to use the lake for recreational purposes. The resulting increased amount of sediment will, over time, begin to fill in the lake, decreasing overall lake depth and volume and potentially impairing various recreational uses. Although Albert Lake has only a minor erosion problem, (more severe along developed areas of the shoreline) action should be taken to repair this erosion and prevent future erosion from occurring.

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

Pros

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

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

Cons

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

Costs

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

Option 2: Install 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 under water 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 provides poor stabilization and is poor habitat for many fish and wildlife species, since it provides limited structure for fish and cover for wildlife. As noted earlier, some small fish and other animals will inhabit the rocks if boulders are used. Smaller rip-rap is more likely to wash away due to rising water levels or wave action. On the other hand, larger boulders are more expensive to haul in and install.

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. The steeper the slope and severity of erosion, the larger the boulders that will need to be used and thus, the higher the 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. Additional costs will be incurred if compensatory storage is needed. Contact the Army Corps of Engineers, local municipalities, and the Lake County Planning and Development Department.

Option 3: Create/Maintain a Buffer Strip

Another effective method of controlling shoreline erosion is to create or maintain 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. Since most of Albert Lake's shoreline is already buffered by woodland or wetland, this option would be very cost effective and is the most strongly recommended.

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

Buffer strips can be constructed in a variety of ways with various plant species. Generally, buffer strip vegetation consists of native terrestrial (land) species and emergent (at the land and water interface) species. Terrestrial vegetation such as native grasses and wildflowers can be used to create a buffer strip along lake shorelines. Table 6 (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 re-seeded 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, A-Jacks ®, or rip-rap.

Emergent vegetation, or those plants that grow in shallow water and wet areas, can be used to control erosion more naturally than seawalls or rip-rap. Native emergent vegetation can be either hand planted or allowed to become established on its own over time. Some plants, such as native cattails (*Typha* sp.), quickly spread and help stabilize shorelines; however, they can be aggressive and may pose a problem later. Other species, such as those listed in Table 6 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. 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.

Option 4: Install Biolog, Fiber Roll, or Straw Blanket with Plantings

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

Pros

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

Cons

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

Costs

Costs range from $25 to $35 per linear foot of shoreline, including plantings. This does not include the necessary permits and surveys, which may cost $1,000 – 2,000 depending on the type of earthmoving that is being done. Additional costs may be incurred if compensatory storage is needed.

Objective III: Eliminate or Control Invasive Species

Numerous exotic plant species have been introduced into our local ecosystems. Some of these plants are aggressive, quickly out-competing native vegetation and flourishing in an environment where few natural predators exist. Plants such as purple loosestrife (*Lythrum salicaria*), buckthorn (*Rhamnus 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*).

The presence of exotic species along a lakeshore is by no means a death sentence for the lake or other plant and animal life. If controlled, many exotic species can perform many of the original functions that they were brought here for. For example, reed canary grass was imported for its erosion control properties. It still contributes to this objective (offering better erosion control than commercial turfgrass), but needs to be isolated and kept in control. Many exotics are the result of garden or ornamental plants escaping into the wild. One isolated plant along a shoreline will probably not create a problem by itself. 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. Reed canary grass and buckthorn are the two dominant exotic species along the shoreline of Albert Lake.

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. Table 6 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.

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. In some areas where individual spot treatments are prohibitive or impractical (i.e., large expanses of a wetland or woodland), chemical treatments may not be an option due to the fact that in order to chemically treat the area, a broadcast application would be needed. Since many of the herbicides that are used are not selective, meaning they kill all plants they contact, this may be unacceptable if native plants are found in the proposed treatment area.

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

Pros

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

Cons

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

Costs

Two common herbicides, triclopyr (sold as Garlon™) and Glyphosate (sold as Eagre™, Rodeo®, Round-Up™) are commonly used to treat purple loosestrife and reed canary grass (Rodeo®) and buckthorn (Round-Up™). An application rate of 1 gallon Rodeo®/acre is required for for purple loosestrife and reed canary grass at a price of $200-$220/gallon. Wicking cut stumps is typically the most effective way of treating buckthorn, and Round-Up™ can be purchased at a cost of $65/gallon. Rodeo® is more expensive because it is the only form of this produce licensed for use in water. A Hydrohatchet®, a hatchet that injects herbicide through the bark, is about $300.00. Hand-held and backpack sprayers cost from $25-$45 and $80-150, respectively. Wicking devices are $30-40.

Objective IV. Deepen the Lake

Many of the problems occurring on Albert Lake are the result of the shallow morphometry of the lake. Low DO concentrations, high numbers of common carp, sediment resuspension, high phosphorus concentrations and turbid water conditions could be reduced or alleviated if the lake was deepened. Discharge from the Lake Zurich STP in the 1980's was very high in total suspended solids and, most likely, resulted in high sediment deposition in Albert Lake for many years. This probably decreased the lake depth over the years and increased the total phosphorus concentration in lake sediments by a substantial amount. With the current maximum depth of two feet, Albert Lake is susceptible to wind generated resuspension on a regular basis. The large number of carp in the lake also contribute to this resuspension through their feeding and spawning activities. Since the entire volume of the lake is exposed to the sediment, resuspension lead to high phosphorus concentrations and very low water clarity during the summer of 2001. If the lake was deepened, the surface water would be less influenced by sediment resuspension and water clarity would increase. This would allow for the establishment of several plant species, as was seen in the less turbid areas of the inlet. Additionally, in order for Albert Lake to sustain a healthy, diverse fish community, without the threat of winter fishkill, at least 25% of the lake volume must be below a depth of 10 feet. This would involve removing approximately 202,000 cubic yards of sediment at an absolute minimum cost of $338,400.00. A cost of $2 million would be more realistic for a project of this nature, given the conditions in and around the lake. More details regarding different types of dredging and the steps involved in carrying out a dredging project can be provided if desired by the private homeowners or the Tall Oaks Homeowners Association.