

**2002 SUMMARY REPORT  
of  
LAKE TRANQUILITY**

**Lake County, Illinois**

*Prepared by the*

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## EXECUTIVE SUMMARY

Lake Tranquility encompasses approximately 26.7 acres and has a shoreline length of 2.5 miles. The current maximum depth is 10.9 feet. The lake is used primarily for the recreational enjoyment of the public and residents around the lake. Public access is at Pedersen Park, located south of State Highway 173.

Water clarity, as measured by Secchi disk transparency readings, averaged 2.93 feet for the season at Site 1 and 1.35 feet at Site 2. The average total suspended solids (TSS) concentrations in Lake Tranquility (6.0 mg/L and 7.7 mg/L in the epilimnion and hypolimnion respectively) were considerably lower than the average TSS concentrations of Antioch Lake, which drains into Lake Tranquility.

The 2002 average total phosphorus concentration at Site 1 was 0.053 mg/L in the epilimnion and 0.067 mg/L in the hypolimnion. These concentrations are near the county medians. At Site 2, the average concentration was 0.104 mg/L, which was likely higher due to the sediment resuspension caused by the aeration system.

Lake Tranquility did stratify in June, July, and August. However, no dissolved oxygen problems were observed in 2002.

Due to the shallow nature of the lake, an aeration system to destratify the lake is not needed. The current aeration system is clearly causing poor water quality conditions in the south channel of the lake. Since the lake is heavily treated with algaecides, the use of the aerators to prevent algae may be redundant and may exacerbate the problem.

Nine aquatic plant species, one macro-algae, and several emergent shoreline plants were found in Lake Tranquility. The dominant plant was the exotic Eurasian water milfoil. The lake was treated with algaecides and herbicides in 2002.

The shoreline of Lake Tranquility was classified as 69% undeveloped. Wetland and shrub habitat comprised approximately 33% and 32% of the shoreline, respectively. Buffer habitat, which is a strip of unmowed vegetation preferably consisting of native herbs and shrubs located at the water's edge, made up 19% of the shoreline. The remaining habitat types were lawn (7%), riprap (5%), prairie (2%), woodland (1%), and seawall (1%).

Several areas (totaling approximately 903 feet or 7% of the shoreline) around Lake Tranquility were classified as moderately eroding. One 33-foot long section of the shoreline was classified as severely eroding. Both moderately and severely eroded areas should be addressed and rehabilitation implemented as soon as possible before more erosion takes place.

One bird species found around the lake, the sandhill crane, is listed as threatened by the State of Illinois. The bird was only heard in April, so it may not have nested in the area, but was likely passing through on migration or was nesting in another area of the county.

## **LAKE IDENTIFICATION AND LOCATION**

Lake Tranquility (T46N, R10E, Sections 7 and 18) is located west of State Highway 59 and south of State Highway 176 in the Village of Antioch (Antioch Township). It is part of the Sequoit Creek drainage of the Fox River watershed. This “Y” shaped lake is bordered on the west side by a large wetland complex that is connected to Lake Marie. Water enters Lake Tranquility from Lake Antioch on the northeastern end of the lake’s right channel and leaves through the wetland complex mentioned previously. In addition, two culverts, each draining a detention pond, are located in the southern channel of the lake.

Lake Tranquility encompasses approximately 26.7 acres and has a shoreline length of 2.5 miles. The current maximum depth was determined to be 10.9 feet, as measured in April 2002. Since no bathymetric (depth contour) map of Lake Tranquility is known to exist, the volume of the lake was estimated based on data from lakes with known depths and volumes. Mean depth was obtained by multiplying the maximum depth by 0.5. Volume was obtained by multiplying the mean depth by the lake surface area. Based on these calculations, Lake Tranquility has an estimated mean depth of 5.5 feet and an estimated volume of 145.5 acre-feet. Lake elevation is approximately 740 feet above sea level.

Lake Tranquility is listed as an ADID (advanced identification) wetland by the U.S. Environmental Protection Agency. This indicates that the lake and surrounding natural environments have potential to have high quality aquatic resources.

## **BRIEF HISTORY OF LAKE TRANQUILITY**

Lake Tranquility, previously known as Ackerman Channels, was constructed by dredging channels through a slough in 1940-41. An Illinois Department of Conservation (now Illinois Department of Natural Resources) document states that fishing was good for striped bass and crappie. It was privately owned by the individual who dredged the channels.

## **SUMMARY OF CURRENT AND HISTORICAL LAKE USES**

The lake is used primarily for the recreational enjoyment of the public and residents around the lake. Public access is at Pedersen Park, located south of State Highway 173. Since the park is located on the peninsula, the public has access to both northern channels of the lake. The park has a playground, picnic area, and a soccer field. Fishing is also a common activity. The park is open year-round from dawn until dusk. Use on the lake is restricted to non-motorized boats.

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

In the early 1990s, the builders of the subdivision located along the eastern side of the lake installed an aeration system in the southern channel. This system has one  $\frac{3}{4}$  horsepower compressor running at 10 cubic feet per minute at 10 psi. The unit runs four lines that run out to four diffusers that are set at approximately 6 feet deep. More information on this system will be discussed in the **Water Quality Assessment** section in this report.

## LIMNOLOGICAL DATA – WATER QUALITY

Water samples were taken monthly from April - September at the deep-hole location (Site 1) in the right channel of Lake Tranquility (Figure 1). A second set of samples (Site 2) was taken monthly in the southern channel of the lake. In May and June, samples were taken at the culvert located on the southern shoreline. In July, August and September samples were taken in the main body of the southern channel of the lake. This change in sampling location was in response to concerns about the impact to the lake of the detention pond effluent from a new development to the southwest of the lake. A culvert on the west side of the southern channel of the lake drains this detention pond. See Appendix B for water sampling methods.

Lake Tranquility's water quality is similar to many lakes in Lake County (Table 1 in Appendix A). Most of the water quality parameters measured were near the averages of other lakes that Lake County Health Department (LCHD) has monitored. Several important findings were noted.

Water clarity, as measured by Secchi disk transparency readings, averaged 2.93 feet for the season at Site 1 (excluding the June reading, since it was obscured by the bottom), which is below the county median (where 50% of the lakes are above and below this value) of 3.81 feet. Secchi disk readings were quite variable with the deepest reading being at the bottom (9.72 feet) in June and shallowest (1.94 feet) in September. Algae blooms, coupled with the herbicide treatments that occurred in the lake during the season are the likely reason for the drop in clarity.

Correlated with the clarity readings were the concentrations of total suspended solids (TSS) at Site 1. Solids suspended in the water reduce the depth at which the Secchi disk can be seen. In June, when the Secchi disk was seen on the lake bottom, TSS concentrations were 1.2 mg/L in the epilimnion and 2.4 mg/L in the hypolimnion. In contrast, the September TSS concentrations were 13.6 mg/L and 12.0 mg/L in the epilimnion and hypolimnion respectively. The average TSS concentrations in Lake Tranquility (7.5 mg/L and 7.7 mg/L in the epilimnion and hypolimnion, respectively) were considerably lower than the TSS concentrations of Antioch Lake, which drains into Lake Tranquility. In Antioch Lake in 2001, average TSS concentrations were 15.2 mg/L in the epilimnion and 14.4 mg/L in the hypolimnion. Field observations in 2001 suggest that there may be minimal flow leaving Antioch Lake and entering Lake Tranquility, since LCHD staff noted that the outflow of Antioch Lake was rarely flowing in 2001.

Figure 1.

Thus, it is possible that much of the nutrient-rich water from Antioch Lake remains there and has minimal impact on Lake Tranquility.

Secchi readings at Site 2 in the southern channel were considerably poorer than the deep-hole location. This site had an average Secchi reading of 1.35 feet in the three months (July, August, and September) it was taken. TSS concentrations at this site were also high, averaging 16.2 mg/L during the same months. Most of TSS is in the form of inorganic substances, such as sediment. At Site 2, the water is very turbid as a result of the nearby aeration system, which resuspended sediment into the water column causing the poor water quality in this channel. Carp activity may also be responsible for the poor water quality. Large numbers of carp were seen throughout the lake.

Correlated with the solids measured were high conductivity readings recorded throughout the season (averages: 0.8894 milliSiemens/cm in the epilimnion, 0.8889 milliSiemens/cm in the hypolimnion). The county medians are 0.7389 milliSiemens/cm for the epilimnion and 0.7492 milliSiemens/cm in the hypolimnion. Because of these high conductivity readings, one additional parameter, chlorides, was measured in all months except September. Since road salt washing in from State Highways 173 and 59 and adjacent residential roads were suspected to be the reason for the high conductivity readings, chloride concentrations help determine if this was the case since most road salt is sodium chloride, calcium chloride, potassium chloride, magnesium chloride or ferrocyanide salts. The four-month seasonal average for chlorides was 154 mg/L in the epilimnion and 153 mg/L in the hypolimnion at Site 1 and 181 mg/L at the surface at Site 2. The Illinois Environmental Protection Agency (IEPA) standard for chloride is 500 mg/L. Once values exceed this standard the water body is deemed to be impaired, thus impacting aquatic life. Chloride concentrations were likely diluted or flushed out of the lake since last winter. It is unknown if the input of road salt is compounding or if most of the salt used in the winter flushes out of the system by the following fall. However, some lakes in the county have seen a doubling of conductivity readings in the past 5-10 years. In a study by Environment Canada (equivalent to our USEPA), it was estimated that 5% of aquatic species such as fish, zooplankton and benthic invertebrates would be affected at chloride concentrations of about 210 mg/l. Additionally, shifts in algae populations in lakes were associated with chloride concentrations as low as 12 mg/l.

Total phosphorus (TP) concentrations at Site 1 in Lake Tranquility were near the county medians. The 2002 average TP concentration at Site 1 was 0.062 mg/L in the epilimnion and 0.067 mg/L in the hypolimnion. At Site 2, the average concentration was 0.104 mg/L, which was likely higher due to the sediment resuspension caused by the aeration system. This result may have also been due to the method of collection in June when the TP concentration was 0.257 mg/L. This sample was taken directly from the culvert and thus the phosphorus was not available for use by aquatic organisms in the lake. The county median for TP in oxic samples is 0.056 mg/L. Values above 0.03 mg/L in the epilimnion are considered sufficient enough to cause nuisance algae blooms. The phosphorus in the lake may be coming from internal (sediment, algae decay, etc.) or external sources (run-off). TP concentrations in Lake Tranquility were better than those



of Antioch Lake. In 2001, Antioch Lake had average TP concentrations of 0.145 mg/L in the epilimnion and 0.140 mg/L in the hypolimnion.

Average concentrations of all nitrogen parameters at Site 1 were either below detection limits or near county medians. Site 2 showed similar results with the exception of the April and June samples which had high concentrations of ammonia nitrogen (NH<sub>3</sub>-N) and nitrate nitrogen (NO<sub>3</sub>-N). These samples may have been high due to the fact that they were taken from the culvert at the southern end of the lake and, as in the case with TP at this site, the nitrogen was not available for use by aquatic organisms in the lake.

The average ratio between total nitrogen and total phosphorus for Lake Tranquility was 19:1, indicating a phosphorus-limited system. Nitrogen, as well as carbon, naturally occur in high concentrations and come from a variety of sources (soil, air, etc.) that are more difficult to control than sources of phosphorus. Lakes that are phosphorus-limited may be easier to manage, since controlling phosphorus is more feasible than controlling nitrogen or carbon.

Lake Tranquility stratified in June, July, and August. The thermocline was established at the 6-foot depth in June and at the 8-foot depth in July and August. By September, the thermocline had dissipated and the lake had completed its turnover.

Dissolved oxygen (DO) concentrations in Lake Tranquility did not indicate any significant problems. Generally concern arises when DO concentrations fall below 5 mg/L in the epilimnion. In 2002, all DO concentrations at the surface at both sites were above 5 mg/L. Anoxic conditions (where DO concentrations drop below 1 mg/L) did exist at Site 1 below 7 feet in July and August. Conditions in the lake (i.e., shallow morphology, water temperature, algae) may cause DO concentrations to fluctuate, which may cause low DO concentrations at various times. In order to determine if these DO conditions are a problem, the percent of volume at specific depths (preferably in one foot increments) is needed. Since no bathymetric map of Lake Tranquility exists, an accurate assessment of the DO conditions cannot be made.

The current aeration system is clearly causing poor water quality conditions in the south channel of the lake. Turbid water can be easily seen in the field and even on aerial photographs. Some of this turbidity may be caused by inflow from the detention ponds and stormsewers during heavy rains, but the action of the aeration system resuspends the sediment. Apparently the system was installed to prevent stagnant water and algae "scum". This section of the lake would likely be dominated with algae (possibly both filamentous and planktonic) if no chemicals or aeration were used. However, since the lake is heavily treated with algaecides the use of the aerators to prevent algae may be redundant. In addition, at least two of the diffusers were operating ineffectively. The continued maintenance and electrical costs of the system maybe more of a liability than the assets it provides.

Water levels on Lake Tranquility remained relatively stable throughout the season. The maximum change in water level occurred from July to August (3.1 inch decrease), with a

maximum seasonal change of 6.38 inches during the study. Lakes with fluctuating water levels potentially have poorer water quality and have more shoreline erosion problems. However this does not appear to be the case in Lake Tranquility. The wetland complex to the west of the lake likely buffers water fluctuation potential.

Rain events probably contribute additional sediment or nutrients (like phosphorus) to a lake, which may have influenced the water sample results. However, rain occurred within 48 hours only prior to water sampling in April (0.52 inches), June (0.72 inches), August (0.15 inches), and September (1.58 inches) as recorded at the Lake County Stormwater Management Commission rain gage in Antioch.

Based on data collected in 2002, standard classification indices compiled by the IEPA were used to determine the current condition of Lake Tranquility. A general overall index that is commonly used is called a trophic state index or TSI. The TSI index classifies the lake into one of four categories: oligotrophic (nutrient-poor, biologically unproductive), mesotrophic (intermediate nutrient availability and biological productivity), eutrophic (nutrient-rich, highly productive), or hypereutrophic (extremely nutrient-rich productive). This index can be calculated using total phosphorus values obtained at or near the surface. The TSIp for Lake Tranquility in 2002 classified it as a eutrophic lake (TSIp = 63.7). Eutrophic lakes are the most common types of lakes throughout the lower Midwest, and they are particularly common among manmade lakes. See Table 2 in Appendix A for a ranking of average TSIp values for Lake County lakes (Lake Tranquility is currently #51 of 103). This ranking is only a relative assessment of the lakes in the county. The current rank of a lake is dependent upon many factors including lake origin, water source, nutrient loads, and morphometric features (volume, depth, substrate, etc.). Thus, a small shallow manmade lake with high nutrient loads could not expect to achieve a high ranking even with intensive management.

In Lake Tranquility, the IEPA aquatic life impairment index was low, indicating a full degree of support for all aquatic organisms in the lake. However due to the poor water clarity, the swimming index indicated only a partial degree of support. Similarly, the recreation use index showed a partial impairment. LCHD did not test for bacteria or other harmful pathogens on Lake Tranquility in 2002.

## **LIMNOLOGICAL DATA – AQUATIC PLANT ASSESSMENT**

Aquatic plant species presence and distribution in Lake Tranquility were assessed monthly from April through September 2002 (see Appendix B for methods). Nine aquatic plant species, one macro-algae, and several emergent shoreline plants were found (see Table 3, below).

Sufficient light penetration for plant growth was found throughout most of the lake during the season. The 1% light levels (the point where plant photosynthesis ceases) reached the lake bottom in June and August. In July these levels reached a depth of approximately 7.5 feet. However, these levels only reached a depth of 6 feet in April and

5 feet in September. The maximum depth at which plants were found was 9.6 feet in June, which was near the deepest part of the lake, indicating that nearly 100% of the lake bottom could be covered with aquatic plants. In the southern channel the 1% light levels reached the bottom in all months sampled. However, no aquatic plants were seen in the area near the aerators, due to the turbid conditions that were created by the diffusers resuspending sediment. Due to these factors and the herbicide treatments that were made in the lake, the overall seasonal maximum aquatic plant coverage was estimated at 40% (note: this is plant coverage on the lake bottom and not an estimate of plants at the water's surface). The Illinois Department of Natural Resources recommends 25-40% aquatic plant coverage to maintain ideal fish habitat conditions.

Aquatic plants were common, but not overly abundant in Lake Tranquility. This is due mostly to the herbicide treatments that occur annually. In 2001, 481 lbs of copper sulfate was used for algae control, 7.5 gallons of endothall (Aquathol®), and 23.5 gallons of diquat (Reward®) for aquatic plant control. In 2002, 310 lbs of copper sulfate was used for algae control throughout the entire lake. For aquatic plant control, one gallon of fluridone (Sonar™) was used in the northeast channel of the lake and 11.5 gallons of diquat used in the southern channel, north of the aerators. The target of the herbicide treatments was the exotic Eurasian water milfoil (EWM). Based on the estimated volume of the lake, the fluridone treatment was applied to achieve a concentration of 10 ppb. However, since diquat was applied in the south channel as well, it is assumed that the fluridone treatment was targeting only the northern channels. Thus, the fluridone concentration in the northern channel was likely much higher than 10 ppb. More information on herbicide treatments can be found in **Objective IV. Aquatic Plant Management Options.**

EWM was the dominant plant in Lake Tranquility (Table 4 in Appendix A). It was found in 33% of all plant samples. It was most dominant in early summer, prior to herbicide treatments. Coontail, a native, was the next most common aquatic plant comprising 13% of the samples. It became most prevalent in July, when it represented 40% of the samples for that month. Another exotic, curlyleaf pondweed was also found, but its densities were much lower than EWM. Both exotics and coontail can be problematic if conditions are adequate for plant growth as they are in Lake Tranquility. Thus, an active aquatic plant management plan for the lake is needed.

Several native aquatic plants were found in the lake including white crowfoot and water stargrass, although each was found only once. Control of the nuisance exotics and promotion of these natives would be beneficial to the lake since aquatic plants will compete with algae for nutrients, help stabilize bottom sediments, and provide habitat for fish and wildlife.

Floristic quality index (FQI; Swink and Wilhelm 1994) is an assessment tool designed to evaluate the closeness that the flora of an area is to that of undisturbed conditions. It can be used to: 1) identify natural areas, 2) compare the quality of different sites or different locations within a single site, 3) monitor long-term floristic trends, and 4) monitor habitat restoration efforts. Each aquatic plant in a lake is assigned a number between 1 and 10

(10 indicating the plant species most sensitive to disturbance). This is done for every floating and submersed plant species found in the lake. These numbers are averaged and multiplied by the square root of the number of species present to calculate an FQI. A high FQI number indicates that there are a large number of sensitive, high quality plant species present in the lake. Non-native species were counted in the FQI calculations for Lake County lakes. In 2002, Lake Tranquility had a FQI of 15.0. The average FQI of lakes studied by LCHD from 2000-2002 is 14.2.

**Table 3. Aquatic and shoreline plants on Lake Tranquility, April - September 2002.**

Aquatic Plants

Coontail	<i>Ceratophyllum demersum</i>
Chara/Nitella	<i>Chara</i> sp./ <i>Nitella</i> sp.
Small Duckweed	<i>Lemna minor</i>
Eurasian Water Milfoil	<i>Myriophyllum spicatum</i>
Water Stargrass	<i>Heteranthera dubia</i>
Curlyleaf Pondweed	<i>Potamogeton crispus</i>
Small Pondweed	<i>Potamogeton pusillus</i>
White Water Crowsfoot	<i>Ranunculus longirostris</i>
Sago Pondweed	<i>Stuckenia pectinatus</i>
Watermeal	<i>Wolffia columbiana</i>

Shoreline Plants

Box Elder	<i>Acer negundo</i>
Prairie Dogbane	<i>Apocynum cannabinum</i>
Burdock	<i>Arctium minus</i>
Swamp Milkweed	<i>Asclepias incarnata</i>
Oxeye Daisy	<i>Chrysanthemum leucanthemum</i>
Chicory	<i>Cichorium intybus</i>
Canada Thistle	<i>Cirsium arvense</i>
Dogwood	<i>Cornus</i> sp.
Teasel	<i>Dipsacus sylvestris</i>
Spikerush	<i>Eleocharis</i> sp.
Horsetail	<i>Equisetum arvense</i>
Joe-Pye Weed	<i>Eupatorium maculatum</i>
Jewelweed	<i>Impatiens pallida</i>
Blue Flag Iris	<i>Iris hexagona</i>
Honeysuckle	<i>Lonicera</i> sp.
Purple Loosestrife	<i>Lythrum salicaria</i>
Sweet Clover	<i>Melilotus alba</i>
Red Mulberry	<i>Morus rubra</i>
Reed Canary Grass	<i>Phalaris arundinacea</i>
Common Reed	<i>Phragmites australis</i>
Cottonwood	<i>Populus deltoides</i>
Buckthorn	<i>Rhamnus cathartica</i>

**Table 3. Aquatic and shoreline plants on Lake Tranquility, April - September 2002 (cont'd).**

Staghorn Sumac	<i>Rhus typhina</i>
Multiflora Rose	<i>Rosa multiflora</i>
Blackberry	<i>Rubus sp.</i>
Black-eyed Susan	<i>Rudbeckia serotina</i>
Willow	<i>Salix sp.</i>
Chairmaker's Rush	<i>Scirpus pungens</i>
River Bulrush	<i>Scirpus fluviatilis</i>
Nightshade	<i>Solanum dulcamara</i>
Cattail	<i>Typha sp.</i>
Common Mullein	<i>Verbascum thapsus</i>
Blue Vervain	<i>Verbena hastata</i>
Wild Grape	<i>Vitis sp.</i>

### LIMNOLOGICAL DATA – SHORELINE ASSESSMENT

A shoreline assessment was conducted in August 2002 to determine the condition of the lake shoreline (see Appendix B for methods). Of particular interest was the condition of the shoreline at the water/land interface.

The shoreline of Lake Tranquility was classified as 69% undeveloped. Wetland and shrub habitat comprised approximately 33% and 32% of the shoreline, respectively (see Figure 2). Buffer habitat, which is a strip of unmowed vegetation preferably consisting of native herbs and shrubs located at the water's edge, made up 19% of the shoreline. The remaining habitat types were lawn (7%), riprap (5%), prairie (2%), woodland (1%), and seawall (1%). The buffer habitat around the lake was in some places of minimal effectiveness due to the narrow width of the vegetation. Buffers should be expanded where possible and native plants should replace exotics.

Several areas around Lake Tranquility were classified as moderately eroding (see Figure 3). These areas (totaling approximately 903 feet or 7% of the shoreline) were on shorelines of different types (woodland, buffer, shrub, and lawn habitats) and were found on both residential lots and undeveloped areas. One section of the shoreline was classified as severely eroding. This 33-foot long section is located on the east shoreline of the northwest channel of the lake. Both moderately and severely eroded areas should be addressed and rehabilitation implemented as soon as possible before more erosion takes place.

In addition to shoreline plants, emergent vegetation should be planted or encouraged to grow. These plants (arrowhead, bulrushes, spikerushes, etc.) help stabilize the shoreline by buffering wind and wave action. Similarly, buffer strips should be expanded or

Figure 2.

Figure 3.

installed between the water and manicured lawns to reduce nutrient-rich runoff entering the lake. Both emergent vegetation and buffer strips also provide habitat for fish and wildlife that use the lake. More information can be found in the section **Objective V: Shoreline Erosion Control**.

Several exotics were found growing along the shoreline, including reed canary grass, purple loosestrife, multiflora rose, honeysuckle, buckthorn and others. Purple loosestrife was not found in large numbers (mainly in the buffer area on the southeastern section of the shoreline), but has the potential to cause significant problems in the future as it spreads. Honeysuckle and buckthorn are currently a problem along the wooded areas. Similar to aquatic exotics, these terrestrial exotics are detrimental to the native plant ecosystems around the lake. Removal or control of exotic species is recommended.

## **LIMNOLOGICAL DATA – WILDLIFE ASSESSMENT**

Good numbers of wildlife, particularly birds, were noted on and around Lake Tranquility. See Appendix B for methods. Several of the species listed in Table 5 (below) were seen during spring or fall migration and were assumed not to be nesting around the lake. Good habitat exists along the shrubby area near Pederson Park as well as the wooded areas in the southern arm of the lake.

One bird species found around the lake, the sandhill crane, is listed as threatened by the state of Illinois. The bird was only heard in April, so it may not have nested in the area, but was likely passing through on migration or was nesting in another area of the county.

Several areas around the lake showed signs of past and recent beaver damage. Numerous trees around the eastern shoreline were damaged and residents have indicated the beavers have taken down many other trees. More information can be found in **Objective VII: Beaver Management**.

LCHD did not conduct any fish surveys in 2002. However, large numbers of common carp were noted during the season. Their presence greatly reduces habitat for other fish and wildlife and diminishes the lake's water quality.



**Table 5. Wildlife species observed on Lake Tranquility, April – September 2002.**

Birds

Canada Goose	<i>Branta canadensis</i>
Mallard	<i>Anas platyrhynchos</i>
American Coot	<i>Fulica americana</i>
Ring-billed Gull	<i>Larus delawarensis</i>
Great Egret	<i>Casmerodius albus</i>
Great Blue Heron	<i>Ardea herodias</i>
Green Heron	<i>Butorides striatus</i>
Sandhill Crane+	<i>Grus canadensis</i>
Sora Rail	<i>Porzana carolina</i>
Mourning Dove	<i>Zenaida macroura</i>
Common Flicker	<i>Colaptes auratus</i>
Downy Woodpecker	<i>Picoides pubescens</i>
Eastern Pewee	<i>Contopus virens</i>
Willow Flycatcher	<i>Empidonax traillii</i>
Tree Swallow	<i>Iridoprocne bicolor</i>
Rough-wing Swallow	<i>Stelgidopteryx ruficollis</i>
American Crow	<i>Corvus brachyrhynchos</i>
Blue Jay	<i>Cyanocitta cristata</i>
Black-capped Chickadee	<i>Poecile atricapillus</i>
Marsh Wren	<i>Cistothorus palustris</i>
Catbird	<i>Dumetella carolinensis</i>
American Robin	<i>Turdus migratorius</i>
Cedar Waxwing	<i>Bombycilla cedrorum</i>
Red-eyed Vireo	<i>Vireo olivaceus</i>
Warbling Vireo	<i>Vireo gilvus</i>
Yellow Warbler	<i>Dendroica petechia</i>
Common Yellowthroat	<i>Geothlypis trichas</i>
Red-winged Blackbird	<i>Agelaius phoeniceus</i>
Common Grackle	<i>Quiscalus quiscula</i>
Starling	<i>Sturnus vulgaris</i>
Northern Oriole	<i>Icterus galbula</i>
House Sparrow	<i>Passer domesticus</i>
Northern Cardinal	<i>Cardinalis cardinalis</i>
House Finch	<i>Carpodacus mexicanus</i>
American Goldfinch	<i>Carduelis tristis</i>
White-throated Sparrow	<i>Zonotrichia albicollis</i>
Swamp Sparrow	<i>Melospiza georgiana</i>
Song Sparrow	<i>Melospiza melodia</i>

Mammals

Muskrat	<i>Ondatra zibethicus</i>
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**Table 5. Wildlife species observed on Lake Tranquility, April – September 2002  
(cont'd).**

Amphibians

Bull Frog

Green Frog

*Rana catesbeiana*

*Rana clamitans melanota*

Reptiles

Painted Turtle

Snapping Turtle

*Chrysemys picta*

*Chelydra serpentina*

Insects

Cicadas

Dragonfly

Cicadidae

Anisoptera

**\*Endangered in Illinois**

**+Threatened in Illinois**

## EXISTING LAKE QUALITY PROBLEMS

- *Lack of a Bathymetric Map*

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

- *Poor Water Clarity and High Concentrations of Total Suspended Solids*

The water clarity readings in Lake Tranquility were below the county medians, while total suspended solid (TSS) concentrations were above the county medians. At Site 1, clarity readings declined and TSS concentrations increased after herbicide treatments. Clarity was particularly poor and TSS concentrations high at Site 2 in the south channel, due to the aeration system that was resuspending sediment. At both sites, algae blooms and carp activity also contributed to the poor clarity and TSS concentrations.

- *Aquatic Plant and Algae Management*

Residents around the lake are concerned about the amount of aquatic plants and algae present in the lake. As a result, the lake is treated with herbicides and algaecides annually. Due to the lake's nutrient concentrations and shallow depth, aquatic plants and algae will be an ongoing management issue. The challenge will be to balance chemical treatments while maintaining 20-40% coverage of beneficial aquatic plants.

- *Invasive Exotic Plant Species*

In the lake, Eurasian water milfoil (EWM) and curlyleaf pondweed were found. EWM is dominant and has been reported to be a problem in the lake for some time. Due to the relatively shallow depth of the lake, aquatic plants could cover much of the lake. An active aquatic plant management plan should be created to control these exotics.

Several other exotic species were found along Lake Tranquility's shoreline including reed canary grass, purple loosestrife, multiflora rose, honeysuckle, buckthorn and others. Buckthorn and honeysuckle were dense along the wooded areas. These exotics have the potential to become a significant problem and should be removed or kept in control to prevent their spread.

- *Shoreline Erosion*

Several areas around Lake Tranquility were classified as either moderately or severely eroding. The moderately eroding areas (totaling approximately 903 feet or 7% of the shoreline) were on shorelines of different types (woodland, buffer, shrub, and lawn habitats) and were found on both residential lots and undeveloped areas. One 33-foot section of the shoreline was classified as severely eroding. Both moderately and severely eroded areas should be addressed and rehabilitation implemented as soon as possible before more erosion takes place.

- *Aeration System*

The aeration system in the south channel is undersized and causing water quality problems by resuspending sediments. Turbid water can be seen on aerial photos. This section of the lake would likely be dominated with algae (possibly both filamentous and planktonic) if no chemicals or aeration were used. However, since the lake is heavily treated with algaecides the use of the aerators to prevent algae may be redundant. In addition, at least two of the diffusers were operating ineffectively. It is recommended that the aerators be turned off during 2003, and if needed, chemical treatments used to control algae. The turbidity that the aerators are causing may be more detrimental to the lake than the use of additional algaecides that may be required to reduce algae growth.

## **POTENTIAL OBJECTIVES FOR THE LAKE TRANQUILITY MANAGEMENT PLAN**

- I. Bathymetric Map
- II. Illinois Volunteer Lake Monitoring Program
- III. Nuisance Algae Management Options
- IV. Aquatic Plant Management Options
- V. Shoreline Erosion Control
- VI. Control Exotic Plant Species
- VII. Beaver Management
- VIII. Enhance Wildlife Habitat Conditions

## **OPTIONS FOR ACHIEVING THE LAKE MANAGEMENT PLAN OBJECTIVES**

### **Objective I: Bathymetric Map**

A bathymetric (depth contour) map is an essential tool for effective lake management since it provides critical information on the morphometric features of the lake (i.e., acreage, depth, volume, etc.). This information is particularly important when intensive management techniques (i.e., chemical treatments for plant or algae control, dredging, fish stocking, etc.) are part of the lake's overall management plan. Some bathymetric maps for lakes in Lake County do exist, but they are frequently old, outdated and do not accurately represent the current features of the lake. Currently no bathymetric map of Lake Tranquility exists.

Maps can be created by agencies like the Lake County Health Department - Lakes Management Unit or other companies. Costs vary, but can range from \$3,000-10,000 depending on lake size.

## **Objective II: Participate in the Volunteer Lake Monitoring Program**

In 1981, the Illinois Volunteer Lake Monitoring Program (VLMP) was established by the Illinois Environmental Protection Agency (Illinois EPA) to gather fundamental information on Illinois inland lakes, and to provide an educational program for citizens. Annually, 150-200 lakes (out of 3,041 lakes in Illinois) are sampled by approximately 250 citizen volunteers. The volunteers are primarily lake shore residents, lake owners/managers, members of environmental groups, public water supply personnel, and citizens with interest in a particular lake.

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

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

For more information about the VLMP contact the VLMP Regional Coordinator:

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

### **Objective III. Nuisance Algae Management Options**

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 hazards, such as swimmer's itch and other skin irritations have been linked to nuisance algae growth. Normally, excessive/nuisance algae growth is a sign of larger problems such excessive nutrients and/or lack of aquatic plants. Some treatment methods, such as copper sulfate, are only quick remedies to the problem. Solving the problem of nuisance algal growth involves treating the factors that cause the growth not the algae itself. Long-term solutions 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 are not very effective, unproven, unfounded, 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 growth. 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 not 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 wide spread and able to reach epidemic proportions, there will be many negative impacts on the lake. The fishery of the lake may become stunted due 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 produce 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<sub>4</sub>) 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 effective. 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 is 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°F) or when D.O. concentrations are low. 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 when temperature and D.O. concentrations are adequate. 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.

### ***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 is 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. Health risks associated with excessive algae growth (toxins, reduced visibility, etc.) 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. 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 sediment. This can cause problems for activities such as dredging. Due to a large amount of copper in the sediment, special permits and disposal methods would have to be utilized.

### ***Costs***

To calculate total cost it will be necessary to calculate surface acreage (SA) or acre-feet (AF) of the area(s) to be treated according to each lake's aquatic plant management plan. A chelated copper product such as Cutrine-Plus® is applied at 0.5 to 1.5 gallons per acre-foot at a cost of \$35 per gallon.

### **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. This floc layer 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 sometimes unreliable results deterred its

wide spread use. Currently, alum is commonly being used in ponds and small lakes, and its use in larger lakes is increasing. Alum treatment typically lasts 1 to 20 years depending on various parameters. Lakes with low mean depth to surface area ratio benefit more quickly from alum applications, while lakes with high mean depth to surface area ratio (thermally stratified lakes) will see more longevity from an alum application due to isolation of the flocculent layer. Lakes with small watersheds are also better candidates because external phosphorus sources can be limited. Alum treatments must be carefully planned and carried out by an experienced professional. If not properly done, there may be many 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 expand or reestablish. This in turn would improve fish habitat and provide improved food/habitat 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 may occur. Typically aluminum toxicity occurs if pH is below 6 or above 9. Most of Lake County's lakes are in 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.

### ***Costs***

Morphometric data is required to make proper calculations. To treat Lake Tranquility with alum (based on the estimated volume of 145.5 acre-feet) would cost approximately \$2,037 – 6,984.

#### **Option 4: Revegetation With Native Aquatic Plants**

A healthy native plant population can reduce algal growth. Many lakes with long-standing algal problems have a very sparse plant population or none at all. This is due to reduction in light penetration brought about by years of excessive algal blooms and/or mats. Revegetation should only be done when existing nuisance algal blooms 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. If aquatic herbicides are being used to control what vegetation does exist there use should be scaled back or abandoned all together. This will allow the vegetation to grow back, which will help in controlling the algae in addition to other positive impacts associated with a healthy plant population.

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 algae. 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 6 lists common, native plants that should be considered when developing a revegetation plan. Included in this list are emergent shoreline vegetation (rushes, cattails, etc) and submersed aquatic plants (pondweeds, *Vallisneria*, etc). Prices, planting depths, and planting densities are included and vary depending on plant species.

#### ***Pros***

By revegetating newly opened areas that were once infested with nuisance species, the lake will benefit in several ways. Once established, expanded native plant populations will help to control growth of nuisance algae by shading and competition for resources. 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 improve 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 were used costs would be substantially higher. Additional costs could be associated with constructing proper herbivory protection measures.

***Costs***

See Table 6 for pricing. These prices do not include time and labor for plant instillation.

## **Objective IV. Aquatic Plant Management Options**

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 are not very effective, unreliable, 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. However, if a no action aquatic plant management plan in a lake with non-native, invasive 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 alteration, 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. If the

lake contains native, non-invasive plant species, 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 algae may increase/remain stable 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 were uninhibited 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. The fishery of the lake may become stunted due to the 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. In addition, the decomposition of the massive amounts of vegetation will lead to a depletion of the lakes dissolved oxygen. 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 stands 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 the 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. However, if in the future a management plan was initiated, costs might be significantly higher since a no action plan was originally followed.

### **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, D.O. concentration, temperature).

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 above ground 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. Some granular products 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°F. 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. There may be more than one herbicide for a given plant. As with other management options, proper usage is the key to their effectiveness, benefits, and disadvantages.

In Lake Tranquility, if aquatic herbicides are used, the selection of the type of chemical used is important. Since the substrate of the lake consists of highly organic soft sediment, any chemicals in pellet form may lose their effectiveness due to absorption from the substrate. In addition, since the lake is not completely covered in aquatic plants, spot treatments with a liquid systemic herbicide, like 2,4-D would be the preferred option. 2,4-D will affect the dicots (i.e., Eurasian watermilfoil, coontail) but will not affect monocots like sago pondweed or water stargrass. However, if curlyleaf pondweed (which is a monocot) becomes problematic, spot treatments with an herbicide like endothall (Aquathol®) may be necessary since it is effective at controlling pondweeds. An herbicide like diquat (Reward®), which was used in the lake in 2002, will control many aquatic plants, however, due to the high turbidity in the southern channel, a diquat application may not control plants as well since the active ingredient in diquat can bind itself to particles of sediment, reducing its effectiveness.

One gallon of fluridone (Sonar™) was used in Lake Tranquility in 2002. Fluridone is a systemic herbicide frequently used as a whole-lake treatment for control of aquatic plants. However, in Lake Tranquility this type of treatment may be difficult to successfully implement due to the lake's unusual shape and because no accurate volume calculations exists. Prior to any future fluridone treatments, a bathymetric map for Lake Tranquility should be created.

### ***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 American pondweed (*Potamogeton nodosus*) 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 benefit greatly 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 stands of vegetation. The quality of fishing may improve 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 biodiversity and ecological. Total 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 to 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 food supply.

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 competes 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 biodiversity. 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.

Over-removal, 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***

To calculate total cost it will be necessary to calculate surface acreage (SA) or acre-feet (AF) of the area(s) to be treated according to each lake's aquatic plant management plan. Reward® is generally applied at 1-2 gallons per surface acre at a cost of about \$425 per surface acre. A 2,4-D granular product is normally applied at 100 pounds per surface acre at a cost of \$350-425 per surface acre. Endothall (Aquathol®) is applied at 1-3 gallons per acre-foot at \$150-175 per gallon.

### **Option 3: Mechanical Harvesting**

Mechanical harvesting involves the cutting and removal of nuisance aquatic vegetation by large specialized boats with underwater cutting bars. Plants are cut below the water at a level that will restore use of the lake. Typically, problematic areas are harvested and other areas are left alone. However, some management plans call for more widespread harvesting, especially when nuisance plants such as Eurasian watermilfoil become dominant. The total removal or over removal (neither of which should never be the plan of any management entity) of plants by mechanical harvesting should never be attempted. To avoid complete or over removal, the management entity should have a harvesting plan that determines where and how much vegetation is to be removed.

### ***Pros***

Mechanical harvesting can be a selective means to reduce stands of nuisance vegetation in a lake. Typically, plants cut low enough to restore recreational use and limit or prevent regrowth. This practice normally improves habitat for fish and other aquatic organisms. Some plant species such as curlyleaf pondweed, if harvested at the right time, do not grow back to nuisance proportions after harvesting. Plant clippings are high in nutrients and can be used as fertilizer or compost. Additionally, use of the lake is uninterrupted while harvesting is occurring.

By removing large quantities of plant biomass the overall quality of the lake may improve in many ways. The decrease in vegetative biomass will reduce the dissolved oxygen (D.O.) demand on the lake. This will cause increased dissolved oxygen levels. Some nuisance vegetation such as coontail have extremely high oxygen demands. Dense stands of these plants can quickly deplete a lake of D.O.

during certain periods of the day. This can cause fish stress. Additionally, a decrease in plant density will improve the lake's fishery by creating better opportunities for predation, which is essential in creating a balanced fish population. By removing nuisance vegetation, recreational uses of the lake will improve. The quality of activities such as boating, swimming, and fishing would greatly improve. By removing dense stands of vegetation the possibility of entanglement will decrease thereby increasing opportunities for boating and swimming. Paths cut by the harvester will open fishing areas especially if networks of fish "cruising lanes" are created.

### ***Cons***

Once widespread, mechanical harvesting is becoming a less attractive management technique for a variety of reasons. Many applicators that regularly employed mechanical harvesting no longer use or even offer this service due to low public demand. In addition, high initial investment, extensive maintenance, and high operational costs have also led to decreased use. Since many applicators no longer offer harvesting services, a lake association would have to purchase and maintain their own harvester. Many associations do not even have the financial resources to cover the maintenance and operational cost involved with owning a harvester. Harvester costs can range from \$50,000-\$150,000. Beside the financial limitations there are also physical limitations. Mechanical harvesters cannot be used in less than 2-4 feet of water (depending on draft of the harvester) and can not maneuver well in tight places. The harvested plant material must be disposed of properly to a place that can accommodate large quantities of plants and prevent any from washing back into the lake. Fish, mussels, turtles and other aquatic organisms are commonly caught in the harvester and injured or even removed from the lake in the harvesting process.

After the initial removal, there is a possibility for vegetation regrowth. 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 biodiversity. Additionally, these dense stands of nuisance vegetation may lead to an overpopulation of stunted fish due to a decrease in predation of forage species by predatory fish. This disruption in the fishery will have negative impacts throughout the ecosystem from zooplankton to higher organisms such as waterfowl.

If complete/over removal does occur several problems can result. One problem 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 also contribute to overall nutrient load of the lake, which can lead to increased frequency of algal blooms. Furthermore, the removal of aquatic vegetation, which competes with algae for resources with algae, can directly contribute to an increase in algal blooms. Removal of plants may lead to increased turbidity and decreased clarity. The fishery of the lake may decline

and/or become stunted due changes in predation related to decreased water clarity. Other organisms, such as waterfowl, which commonly forage on native aquatic plants, would also be negatively impacted by the removal of these plants.

Another problem with mechanical harvesting, even if properly done, is that it can be a nonselective process. In the areas where harvesting is being conducted, one plant can not be removed and another left. All the plants are removed from that area. After the initial removal, regrowth of desirable plants does not typically occur in these harvested areas. Due to their weedy nature, plants such as Eurasian water milfoil, are able to grow more quickly than native plants and become more established in harvested areas. This will create a monoculture of nuisance vegetation. This causes an overall decrease in plant biodiversity, which can have detrimental effects to the entire ecosystem. Depending on the plant species, frequent harvesting might be required (typically 2-4 times per season). Along with this increased harvesting frequency come increased operational costs (labor, gas, maintenance, etc.). Nuisance plants such as coontail and Eurasian watermilfoil can spread by vegetative fragments that may escape collection during the harvesting process and spread to uninfested parts of the lake. In addition to the release of plant fragments, as the plants are cut, there is a possibility of plant associated nutrients being released into the lake. This could cause an increase in algal blooms whenever harvesting is conducted. Short-term turbidity may also be created by the harvester paddle wheels stirring up sediment in harvested area.

#### ***Cost***

Depending on the type of the harvester (cutting width, payload capacity, hull material, HP of the motor, trailer options, etc) prices range from \$50,000 to \$150,000. Operational and maintenance cost typically range from \$161.00-\$445.00/acre.

#### **Option 4: Hand Removal**

Hand removal of excessive aquatic vegetation is a commonly used management technique. Hand removal is normally used in small ponds/lakes and 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 swaths through the weeds to create pathways to open water. Due to the limited amount of biomass removed, harvested plant material is often used as fertilizer and compost in gardens.

#### ***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. Many of the improved water quality benefits of a well-executed herbicide program or harvesting program are also shared by hand removal. Wildlife habitat, such as fish spawning beds, could be greatly improved. This in turn would benefit other portions of the lake's ecosystem.

### ***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. However, individual homeowners would be removing limited quantities of plant material so there would not be much to dispose of. 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). Over removal could also be a problem but is not normally a concern with hand removal.

### ***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 5: Water Milfoil Weevil**

*Euhrychiopsis lecontei* (*E. lecontei*) is a biological control organism used to control Eurasian water milfoil (EWM). *E. lecontei* is a native weevil, which feeds exclusively on milfoil species. It was originally discovered while investigating declines of EWM in a Vermont lake in the early 1990s. It was discovered in northeastern Illinois lakes by 1995. Another weevil, *Phytobius leucogaster*, also feeds on EWM but does not cause as much damage as *E. lecontei*. Therefore, *E. lecontei* is stocked as a biocontrol and is commonly referred to as the Eurasian water milfoil weevil. Currently, the LCHD-Lakes Management Unit has documented weevils (*E. lecontei* and/or *P. leucogaster*) in 24 Lake County lakes. Many of these lakes have seen declines in EWM densities in recent years. It is highly likely that *E. lecontei* and/or *P. leucogaster* occurs in all lakes in Lake County that have excessive EWM growth.

Weevils are stocked in known quantities to achieve a density of 1-4 weevils per stem. As weevil populations expand, EWM populations may decline. After EWM declines, weevil populations decline and do not feed on any other aquatic plants. When EWM starts to grow again in the spring, the weevil populations respond by keeping the increasing milfoil under control before it becomes a problem. Once the weevil is established, EWM should no longer reach nuisance proportions and begins to become more sparse. Best results are achieved in lakes that have shallow EWM infestations in areas where it is

undisturbed by recreational and management activities. Weevils need proper overwintering habitat such as leaf litter and mud, which are typically found on naturalized shorelines or shores with good buffer strips. Additionally, water temperatures need to be 68-70°F for maximum weevil activity. For this reason, weevils are typically stocked in late spring/early summer. Currently only one company, EnviroScience Inc., has a stocking program (called the MiddFoil® process). The program includes evaluation of EWM densities, of current weevil populations (if any), stocking, monitoring, and restocking as needed.

***Pros***

The milfoil weevil can provide long-term control of EWM. Typically, by the end of June EWM stands are starting to decline due to weevil damage. In many situations, EWM beds might not reach the surface before weevil damage causes declines. *E. lecontei* is also a selective means to control EWM. Studies have shown that *E. lecontei* has a strong preference for EWM and the only other plant it possibly will feed on is northern water milfoil. Since milfoil weevils are found to naturally occur in several lakes in Lake County, weevil stocking would be an augmentation rather than an introduction, making it a more natural control option.

If control with milfoil weevils were successful, the quality of the lake would be improved. Native plants could then start to recolonize. Fisheries of the lake would improve due to more balanced predation and higher quality habitat. Waterfowl would benefit due to increased food sources and availability of prey. Recreational activities such as fishing, swimming, and boating would be easier and more enjoyable with the removal of inhibiting stands of EWM.

***Cons***

Use of milfoil weevils does have some drawbacks. Control using the weevil has been inconsistent in many cases. EWM has been reduced one year, only to be unaffected the next. Reasons for these inconsistencies are under investigation. One possible explanation is lack of suitable overwintering habitat. The highly developed, manicured shorelines of many lakes in the County are not suitable habitat for weevil overwintering. Another possible explanation is cooler than normal summer water temperatures. Studies have shown that cooler water temperatures reduce weevil feeding and egg production.

Milfoil control using weevils may not work well on plants in deep water. Plants are able to compensate for weevil damage on upper portions of the plant by increasing growth on lower portions where weevil does not feed. Furthermore, weevils do not work well in areas where plants are continuously disturbed by activities such as powerboats and swimming, harvesting or herbicide use. In areas where weevils are to be stocked, activity should be reduced as much as possible. This may either limit the extent to which the weevils can be used or limit recreational use of the lake.



One of the most prohibitive aspects to weevil use is price. Typically weevils are stocked to achieve a density of 1-4 weevils per stem. This translates to 500-3000 weevils per acre. At a cost of \$1 per weevil plus labor, a EWM management program using weevils can be expensive. Additionally, there is no guarantee that weevils will provide long term control or even produce any results at all.

**Costs**

EnviroScience, Inc.  
3781 Darrow Road  
Stow, Ohio 44224  
1(800) 940-4025

Weevils are sold in units of 1000 bugs/unit and stocking rates must be at least 1 unit/stocked area. Normally there is a minimum purchase of 5-10 units. The cost of the weevils does not include the labor involved in initial surveys, stocking, and monitoring, which typically run an additionally \$3,500-\$4,500.

**Option 6: Reestablishing Native Aquatic Vegetation**

This option is identical to Option 4 in **Objective III. Nuisance Algae Management Options.**

## **Objective V: Shoreline Erosion Control**

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

### **Option 1: No Action**

#### ***Pros***

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

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

#### ***Cons***

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

#### ***Costs***

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

### **Option 2: Install a Steel or Vinyl Seawall**

Seawalls are designed to prevent shoreline erosion on lakes in a similar manner they are used along coastlines to prevent beach erosion or harbor siltation. Today, seawalls are generally constructed of steel, although in the past seawalls were made of concrete or wood (frequently old railroad ties). Concrete seawalls cracked or were undercut by wave

action requiring routine maintenance. Wooden seawalls made of old railroad ties are not used anymore since the chemicals that made the ties rot-resistant could be harmful to aquatic organisms. A new type of construction material being used is vinyl or PVC. Vinyl seawalls are constructed of a lighter, more flexible material as compared to steel. Also, vinyl seawalls will not rust over time as steel will.

Due to the gentle sloping shoreline of Lake Tranquility, seawalls would not be necessary or should be used when other options are deemed not feasible.

***Pros***

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

***Cons***

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

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

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

at catching prey. This may contribute to a lake's poor fishery (i.e., stunted fish populations).

### ***Costs***

Depending on factors such as slope and shoreline access, cost of seawall installation ranges from \$65-80 per linear foot for steel. The approximate costs to repair eroded shoreline on Lake Tranquility with steel seawall would be \$58,695 – 72,240 for the areas of moderate erosion (903 feet) and \$2,145 – 2,640 for the 33-foot severely eroded section. A licensed contractor installs both types of seawall. Additional costs may occur if the shoreline needs to be graded and backfilled, has a steep slope, or poor accessibility. Price does not include the necessary permits required. Additional costs will be incurred if compensatory storage is needed. Prior to the initiation of work, permits and/or surveys from the appropriate government agencies need to be obtained. For seawalls, a site development permit and a building permit are needed. Costs for permits and surveys can be \$1,000-2,000 for installation of a seawall. Contact the Army Corps of Engineers, local municipality, or the Lake County Planning and Development Department.

### **Option 3: Install Rock Rip-Rap or Gabions**

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

### ***Pros***

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

Fish and wildlife habitat can be provided if large boulders are used. Crevices and spaces between the rocks can be used by a variety of animals and their prey. Small mammals, like shrews can inhabit these spaces in the rock above water and prey upon many invertebrate species, including many harmful garden and lawn

pests. Also, small fish may utilize the structure underwater created by large boulders for foraging and hiding from predators.

### ***Cons***

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

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

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

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

### ***Costs***

Cost and type of rip-rap used depend on several factors, but average cost for installation (rocks and filter fabric) is approximately \$30-45 per linear foot. Costs for gabions are approximately \$20-30 per linear foot, and approximately \$60-100 per linear foot when filled with rocks. To repair the eroded shoreline on Lake Tranquility would cost \$27,090 – 40,635 for the areas of moderate erosion (903 feet) and \$990 – 1,485 for the 33-foot severely eroded section. 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 or gabions, depending on the circumstances. Additional costs will be incurred if compensatory storage is needed. Contact the Army Corps of Engineers, local municipalities, and the Lake County Planning and Development Department.

### **Option 4: Create a Buffer Strip**

Another effective method of controlling shoreline erosion is to create a buffer strip with existing or native vegetation. Native plants have deeper root systems than turfgrass and thus hold soil more effectively. Native plants also provide positive aesthetics and good

wildlife habitat. Cost of creating a buffer strip is quite variable, depending on the current state of the vegetation and shoreline and whether vegetation is allowed to become established naturally or if the area needs to be graded and replanted. Allowing vegetation to naturally propagate the shoreline would be the most cost effective, depending on the severity of erosion and the composition of the current vegetation. Non-native plants or noxious weedy species may be present and should be controlled or eliminated.

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

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

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

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

This option in conjunction with **Option 6: Install Biolog, Fiber Roll, or Straw Blanket with Plantings** is the preferred option for the shoreline erosion on Lake Tranquility.

### ***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 overwintering 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.

## **Option 5: Install A-Jacks®**

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

### ***Pros***

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



### ***Cons***

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

### ***Costs***

The cost of installation is approximately \$40-75 per linear foot, but does not include permits and surveys, which can cost \$1,000-2,000 and must be obtained prior to any work implementation. Additional costs will be incurred if compensatory storage is needed.

On Lake Tranquility the cost to repair the erosion with A-Jacks® would be approximately \$36,120 – 67,725 for the moderately eroded areas (903 feet) and \$1,320 – 2,475 for the 33-foot severely eroded section.

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

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

### ***Pros***

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

### ***Cons***

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

### ***Costs***

Costs range from \$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 VI: Eliminate or Control Exotic Species**

Numerous exotic plant species have been introduced into our local ecosystems. Some of these plants are aggressive, quickly out-competing native vegetation and flourishing in an environment where few natural predators exist. Plants such as purple loosestrife (*Lythrum salicaria*), buckthorn (*Rhamnus cathartica*), and reed canary grass (*Phalaris arundinacea*) are three examples. The outcome is a loss of plant and animal diversity. This section will address terrestrial shoreline exotic species.

Purple loosestrife is responsible for the “sea of purple” seen along roadsides and in wetlands during summer. It can quickly dominate a wetland or shoreline. Due in part to an extensive root system, large seed production (estimates range from 100,000 to 2.7 million seeds per plant), and high seed germination rate, purple loosestrife spreads quickly. Buckthorn is an aggressive shrub species that grows along lake shorelines as well as most upland habitats. It shades out other plants and is quick to become established on disturbed soils. Reed canary grass is an aggressive plant species that was introduced as a shoreline stabilizer. It is found on lakeshores, streambanks, marshes and exposed moist ground. Although it does serve to stabilize shorelines to some extent, it has low food value and does not provide winter habitat for wildlife. It is very successful in taking over disturbed areas and, if left unchecked, will dominate an area, particularly a wetland or shoreline, in a short period of time. Since it begins growing early in the spring, it quickly out-competes native vegetation that begins growth later in the year. Control of purple loosestrife, buckthorn, and reed canary grass are discussed below. However, these control measures can be similarly applied to other exotic species such as garlic mustard (*Alliaria 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. A table in Appendix A lists several native plants that can be planted along shorelines.

### ***Cons***

Native plant and wildlife diversity will be lost as stands of exotic species expand. Exotic species are not under the same stresses (particularly diseases and predators) as native plants and thus can out-compete the natives for nutrients, space, and light. Few wildlife species use areas where exotic plants dominate. This happens because many wildlife species either have not adapted with the plants and do not view them as a food resource, the plants are not digestible to the animal, or their primary food supply (i.e., insects) are not attracted to the plants. The result is a monoculture of exotic plants with limited biodiversity.

Recreational activities, especially wildlife viewing, may be hampered by such monocultures. Access to lake shorelines may be impaired due to dense stands of non-native plants. Other recreational activities, such as swimming and boating, may not be 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: Biological Control**

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

Recently two beetles (*Galerucella pusilla* and *G. californiensis*) and two weevils (*Hylobius transversovittatus* and *Nanophyes marmoratus*) have offered some hope to control purple loosestrife by natural means. These insects feed on either the leaves or juices of purple loosestrife, eventually weakening or killing the plant. In large stands of loosestrife, the beetles and weevils naturally reproduce and in many locations, significantly retard plant densities. The insects are host specific, meaning that they will attack no other plant but purple loosestrife. Currently, the beetles have proven to be most

effective and are available for purchase. There are no designated stocking rate recommendations, since using bio-control insects are seen as an inoculation and it may take 3-5 years for beetle populations to increase to levels that will cause significant damage. Depending on the size of the infested area, it may take 1,000 or more adult beetles per acre to cause significant damage.

### ***Pros***

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

### ***Cons***

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

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

### ***Costs***

The New York Department of Natural Resources at Cornell University (607-255-2821) sells overwintering adult beetles (which will lay eggs the year of release) for \$2 per beetle and new generation beetles (which will lay eggs beginning the following year) at \$0.25 per beetle. Some beetles may be available for free by contacting the Illinois Natural History Survey (217-333-6846).

## **Option 3: Control by Hand**

Controlling exotic plants by hand removal is most effective on small areas (< 1 acre) and if done prior to heavy infestation. Some exotics, such as purple loosestrife and reed canary grass, can be controlled to some degree by digging, cutting, or mowing if done early and often during the year. Digging may be required to ensure the entire root mass is removed. Spring or summer is the best time to cut or mow, since late summer and fall is when many of the plant seeds disperse. Proper disposal of excavated plants is important since seeds may persist and germinate even after several years. Once exotic plants are removed, the disturbed ground should be planted with native vegetation and closely monitored. 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 4: Herbicide Treatment**

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

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

***Pros***

Herbicides provide a fast and effective way to control or eliminate nuisance vegetation. Unlike other control methods, herbicides kill the root of the plant,

which prevents regrowth. If applied properly, herbicides can be selective. This allows for removal of selected plants within a mix of desirable and undesirable plants.

### ***Cons***

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

### ***Costs***

Two common herbicides, triclopyr (sold as Garlon™) and glyphosate (sold as Rodeo®, Round-up™, Eagle™, or AquaPro™), cost approximately \$100 and \$65 per gallon, respectively. Triclopyr is effective at preventing buckthorn from resprouting. Only Rodeo® is approved for water use. A Hydrohatchet®, a hatchet that injects herbicide through the bark, is about \$300.00. Another injecting device, E-Z Ject® is \$450.00. Hand-held and backpack sprayers costs from \$25-\$45 and \$80-150, respectively. Wicking devices are \$30-40.

## **Objective VII: Beaver Management**

The beaver (*Castor canadensis*) is the largest rodent in North America. Adults typically weigh 40-50 pounds, but may weigh over 90 pounds. Beavers make their homes in lodges or dens along a lake or streambank. They can live in a small group of two or in larger colonies of five or more. Beavers generally confine their activities to an area within 1/2 mile of their lodge or den.

Beavers were common in Illinois prior to the 1900's. Extensive hunting and trapping in the late 1800's and early 1900's nearly extirpated the beaver from the state. However, conservation efforts, including hunting and trapping laws and reintroduction programs, in the middle 1900's successfully brought the populations back. Currently, beavers are found throughout Illinois.

Beavers are frequently blamed for destroying valuable shrubs and trees and flooding yards and farm fields. In a lake, beavers may dam a culvert or a stream causing lake water levels to rise or fall depending of the directional flow of the culvert or stream. On many lakes, beavers do not build dams since the water level is deep enough. In these cases they build lodges along the shoreline.

Beavers provide many benefits as well. Their engineering skills benefit natural environments by creating wetlands, pools, and other habitats favored by many other wildlife species including waterfowl, other mammals, amphibians, and fish. Several endangered species also benefit from habitats created by beaver.

### **Option 1: No Action**

With this option, no attempts are made to curtail beaver activities. Beaver populations may increase or decrease, depending on the circumstances in and around the lake. Damage to nearby plants may occur if the beaver population continues to grow. If limited food sources are available, beaver may leave the area in search for more suitable conditions elsewhere.

#### ***Pros***

The quality habitats created by beaver will continue to provide havens for fish and wildlife species. Wildlife watching will likely be improved.

#### ***Cons***

Beaver populations may continue to increase, potentially causing more damage to valuable shrubs and trees. Significant alterations around the lake (reduction of plant life, particularly trees) may be viewed negatively by some lake residents. Also, higher water levels resulting from beaver dams may damage property or concern many landowners.

#### ***Costs***

Costs for this option is primarily from beaver damage or destruction (i.e., cut trees, flood damage, etc.).



## **Option 2: Exclusion**

One of the most successful options in beaver management is using exclusion techniques to prevent damage to valued resources, like shrubs and trees. Beavers have preferred foods (i.e., maple, aspen and willow trees) and will target these species before selecting other types of trees or shrubs.

Excluding the beavers from damaging these plants generally is accomplished by erecting a fence either around an area or individual plant that is to be protected. Any sturdy fencing material should work. In all cases, fences should be at least four feet in height, since beavers are not good climbers. The four foot height is necessary to prevent beaver from breaching the fence in winters with significant snow depths.

Individually, trees should be double wrapped with hardware cloth or welded wire. Wire should be to the base of the tree. Annual maintenance will be needed to prevent loose wire from slipping off the tree.

### ***Pros***

Excluding beaver from certain areas or individual plants will obviously prevent the damage or death of the plants selected for protection. Exclusion of beavers may also force them to move to another more suitable location since their main source of food and shelter has been made inaccessible.

### ***Cons***

Preventing beaver from damaging certain areas or plants may force them to select other areas or plants that are not protected. This may lead to having to exclude more areas or plants from damage than previously planned.

### ***Costs***

Hardware cloth or heavy duty welded wire are available for local hardware stores. Costs for fencing for larger areas are dependent on fence type, height, and length.

## **Option 3: Removal**

Removing beavers from an area is usually done by either live or kill trapping or shooting. Live traps may look like a box (Havahart traps) or an open clamshell (Hancock traps). These traps usually need to be set on dry land so the captured beaver does not drown. Kill traps (called conibear traps) are the most commonly used by trappers. These traps are usually set underwater, along a run, or at the surface of the water, generally near the lodge or den. Baits and scents are often used to lure beavers to traps. Seasonal trapping and hunting restrictions prohibit taking beaver when they are raising young. Licenses are required to trap or shoot beaver in Illinois. Many municipalities prohibit discharging a firearm within its boundaries.

***Pros***

Trapping beavers will remove the nuisance animals from the immediate area. If a commercial trapper is used, nothing else needs to be done by the landowner. Valuable shrubs and trees will be protected.

***Cons***

Physically removing beavers is a time consuming and sometimes expensive technique that often is short-lived. Hiring someone to trap beaver can be costly and seldom are all beavers trapped out of an area. The few that remain will reproduce and the problem may continue. Even if all members of a population are trapped, it is likely that other beavers will immigrate into the habitat vacated by the trapped individuals.

***Costs***

A trapping license in Illinois costs \$10.50 in 2001, hunting license cost \$7.50. A hunting license is not needed if only trapping is conducted. However, if either license is purchased a habitat stamp is also needed (\$5.50). Live traps can range from \$70 each (Havahart trap) to \$350 each (Hancock trap) or more. Kill traps like a #330 conibear cost \$18-20 each (cheaper if large numbers are purchased). A pair of setting tools needed to set conibear trap cost \$10. Additional cost may include bait or scent.

Commercial trappers usually charge a set-up fee (approximately \$200-250) and \$100/beaver. Costs increase if beavers are live-trapped.

**Option 4: Habitat Alteration**

Altering the habitat around the dam or lodge can also avert beaver damage. Removing the preferred foods (i.e., maple, aspen, and willow) and replacing or replanting with less preferred foods (i.e., pine or spruce) may reduce the amount of damage.

Physically removing the dam or lodge may encourage the beaver to move elsewhere. However, permits from the Illinois Department of Natural Resources are needed for this.

***Pros***

Altering habitat or physical removal of a dam may encourage beaver to leave the area.

***Cons***

Beaver may still gnaw on non-preferred food items. Damaged or removed dams may be rebuilt. Significant time and effort would be needed to alter the habitats around a lake.

***Costs***

Costs will depend on the degree of habitat alteration that is done. Most of the costs will be in the form of personal time by landowners or other interested parties.

## **Objective VIII: Enhance Wildlife Habitat Conditions**

The key to increasing wildlife species in and around a lake can be summed up in one word: habitat. Wildlife need the same four things all living creatures need: food, water, shelter, and a place to raise their young. Since each wildlife species has specific habitat requirements, which fulfill these four basic needs, providing a variety of habitats will increase the chance that wildlife species may use an area. Groups of wildlife are often associated with the types of habitats they use. For example, grassland habitats may attract wildlife such as northern harriers, bobolinks, meadowlarks, meadow voles, and leopard frogs. Marsh habitats may attract yellow-headed blackbirds and sora rails, while manicured residential lawns attract house sparrows and gray squirrels. Thus, in order to attract a variety of wildlife, a mix of habitats is 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).

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

### **Option 2: Increase Habitat Cover**

This option can be incorporated with Option 3 (see below). One of the best ways to increase habitat cover is to leave a minimum 25 foot buffer between the edge of the water and any mowed grass. Allow native plants to grow or plant native vegetation along shorelines, including emergent vegetation such as cattails, rushes, and bulrushes (see the table in Appendix A for costs and seeding rates). This will provide cover from predators and provide nesting structure for many wildlife species and their prey. It is important to control or eliminate non-native plants such as buckthorn, purple loosestrife, garlic mustard, and reed canary grass, since these species outcompete native plants and provide little value for wildlife.

Occasionally high mowing (with the mower set at its highest setting) may have to be done for specific plants, particularly if the area is newly established, since competition from weedy and exotic species is highest in the first couple years. If mowing, do not mow the buffer strip until after July 15 of each year. This will allow nesting birds to complete their breeding cycle.

Brush piles make excellent wildlife habitat. They provide cover as well as food resources for many species. Brush piles are easy to create and will last for several years. They should be placed at least 10 feet away from the shoreline to prevent any debris from washing into the lake.

Trees that have fallen on the ground or into the water are beneficial by harboring food and providing cover for many wildlife species. In a lake, fallen trees provide excellent cover for fish, basking sites for turtles, and perches for herons and egrets.

Increasing habitat cover should not be limited to the terrestrial environment. Native aquatic vegetation, particularly along the shoreline, can provide cover for fish and other wildlife.

### ***Pros***

Increased cover will lead to increased use by wildlife. Since cover is one of the most important elements required by most species, providing cover will increase the chances of wildlife using the shoreline. Once cover is established, wildlife usually have little problem finding food, since many of the same plants that provide cover also supply the food the wildlife eat, either directly (seeds, fruit, roots, or leaves) or indirectly (prey attracted to the plants).

Additional benefits of leaving a buffer include: stabilizing shorelines, reducing runoff which may lead to better water quality, and deterring nuisance Canada geese. Shorelines with erosion problems can benefit from a buffer zone because native plants have deeper root structures and hold the soil more effectively than conventional turfgrass. Buffers also absorb much of the wave energy that batters the shoreline. Water quality may be improved by the filtering of nutrients, sediment, and pollutants in run-off. This has a “domino effect” since less run-off flowing into a lake means less nutrient availability for nuisance algae, and less sediment means less turbidity, which leads to better water quality. All this is beneficial for fish and wildlife, such as sight-feeders like bass and herons, as well as people who use the lake for recreation. Finally, a buffer strip along the shoreline can serve as a deterrent to Canada geese from using a shoreline. Canada geese like flat, open areas with a wide field of vision. Ideal habitat for them are areas that have short grass up to the edge of the lake. If a buffer is allowed to grow tall, geese may choose to move elsewhere.

### ***Cons***

There are few disadvantages to this option. However, if vegetation is allowed to grow, lake access and visibility may be limited. If this occurs, a small path can be made to the shoreline. Composition and density of aquatic and shoreline vegetation are important. If vegetation consists of non-native species such as or Eurasian water milfoil or purple loosestrife, or in excess amounts, undesirable conditions may result. A shoreline with excess exotic plant growth may result in a poor fishery (exhibited by stunted fish) and poor recreation opportunities (i.e., boating, swimming, or wildlife viewing).

### ***Costs***

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

### **Option 3: Increase Natural Food Supply**

This can be accomplished in conjunction with Option 2. Habitats with a diversity of native plants will provide an ample food supply for wildlife. Food comes in a variety of forms, from seeds to leaves or roots to invertebrates that live on or are attracted to the plants. Plants found in the table in Appendix A should be planted or allowed to grow. In addition, encourage native aquatic vegetation, such as water lily (*Nuphar* spp. and *Nymphaea tuberosa*), sago pondweed (*Stuckenia pectinatus*), largeleaf pondweed (*Potamogeton amplifolius*), and wild celery (*Vallisneria americana*) to grow. Aquatic plants such as these are particularly important to waterfowl in the spring and fall, as they replenish energy reserves lost during migration.

Providing a natural food source in and around a lake starts with good water quality. Water quality is important to all life forms in a lake. If there is good water quality, the fishery benefits and subsequently so does the wildlife (and people) who prey on the fish. Insect populations in the area, including beneficial predatory insects, such as dragonflies, thrive in lakes with good water quality.

Dead or dying plant material can be a source of food for wildlife. A dead standing or fallen tree will harbor good populations of insects for woodpeckers, while a pile of brush may provide insects for several species of songbirds such as warblers and flycatchers.

Supplying natural foods artificially (i.e., birdfeeders, nectar feeders, corn cobs, etc.) will attract wildlife and in most cases does not harm the animals. However, “people food” such as bread should be avoided. Care should be given to maintain clean feeders and birdbaths to minimize disease outbreaks.

#### ***Pros***

Providing food for wildlife will increase the likelihood they will use the area. Providing wildlife with natural food sources has many benefits. Wildlife attracted to a lake can serve the lake and its residents well, since many wildlife species (i.e., many birds, bats, and other insects) are predators of nuisance insects such as mosquitoes, biting flies, and garden and yard pests (such as certain moths and beetles). Effective natural insect control eliminates the need for chemical treatments or use of electrical “bug zappers” that have limited effect on nuisance insects.

Migrating wildlife can be attracted with a natural food supply, primarily from seeds, but also from insects, aquatic plants or small fish. In fact, most migrating birds are dependent on food sources along their migration routes to replenish lost energy reserves. This may present an opportunity to view various species that would otherwise not be seen during the summer or winter.

#### ***Cons***

Feeding wildlife can have adverse consequences if populations become dependent on hand-outs or populations of wildlife exceed healthy numbers. This frequently happens when people feed waterfowl like Canada geese or mallard ducks.

Feeding these waterfowl can lead to a domestication of these animals. As a result, these birds do not migrate and can contribute to numerous problems, such as excess feces, which is both a nuisance to property owners and a significant contribution to the lake's nutrient load. Waterfowl feces are particularly high in phosphorus. Since phosphorus is generally the limiting factor for nuisance algae growth in many lakes in the Midwest, the addition of large amounts of this nutrient from waterfowl may exacerbate a lake's excessive algae problem. In addition, high populations of birds in an area can increase the risk of disease for not only the resident birds, but also wild bird populations that visit the area.

Finally, tall plants along the shoreline may limit lake access or visibility for property owners. If this occurs, a path leading to the lake could be created or shorter plants may be used in the viewing area.

#### ***Costs***

The costs of this option are minimal. The purchase of native plants and food and the time and labor required to plant and maintain would be the limit of the expense.

#### **Option 4: Increase Nest Availability**

Wildlife are attracted by habitats that serve as a place to raise their young. Habitats can vary from open grasslands to closed woodlands (similar to Options 2 and 3).

Standing dead or dying trees provide excellent habitat for a variety of wildlife species. Birds such as swallows, woodpeckers, and some waterfowl need dead trees to nest in. Generally, a cavity created and used by a woodpecker (e.g., red-headed or downy woodpecker, or common flicker) in one year, will in subsequent years be used by species like tree swallows or chickadees. Over time, older cavities may be large enough for waterfowl, like wood ducks, or mammals (e.g., flying squirrels) to use. Standing dead trees are also favored habitat for nesting wading birds, such as great blue herons, night herons, and double-crested cormorants, which build stick nests on limbs. For these birds, dead trees in groups or clumps are preferred as most herons and cormorants are colonial nesters.

In addition to allowing dead and dying trees to remain, erecting bird boxes will increase nesting sites for many bird species. Box sizes should vary to accommodate various species. Swallows, bluebirds, and other cavity nesting birds can be attracted to the area using small artificial nest boxes. Larger boxes will attract species such as wood ducks, flickers, and owls. A colony of purple martins can be attracted with a purple martin house, which has multiple cavity holes, placed in an open area near water.

Bat houses are also recommended for any area close to water. Bats are voracious predators of insects and are naturally attracted to bodies of water. They can be enticed into roosting in the area by the placement of bat boxes. Boxes should be constructed of rough non-treated lumber and placed >10 feet high in a sunny location.



### ***Pros***

Providing places where wildlife can rear their young has many benefits. Watching wildlife raise their young can be an excellent educational tool for both young and old.

The presence of certain wildlife species can help in controlling nuisance insects like mosquitoes, biting flies, and garden and yard pests. This eliminates the need for chemical treatments or electric “bug zappers” for pest control.

Various wildlife species populations have dramatically declined in recent years. Since, the overall health of ecosystems depend, in part, on the role of many of these species, providing sites for wildlife to raise their young will benefit not only the animals themselves, but the entire lake ecosystem.

### ***Cons***

Providing sites for wildlife to raise their young have few disadvantages. Safety precautions should be taken with leaving dead and dying trees due to the potential of falling limbs. Safety is also important when around wildlife with young, since many animals are protective of their young. Most actions by adult animals are simply threats and are rarely carried out as attacks.

Parental wildlife may chase off other animals of its own species or even other species. This may limit the number of animals in the area for the duration of the breeding season.

### ***Costs***

The costs of leaving dead and dying trees are minimal. The costs of installing the bird and bat boxes vary. Bird boxes can range in price from \$10-100.00. Purple martin houses can cost \$50-150. Bat boxes range in price from \$15-50.00. These prices do not include mounting poles or installation.

## **Option 5: Limit Disturbance**

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

### ***Pros***

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

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

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

***Cons***

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

***Costs***

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