2002 SUMMARY REPORT
of
LAKE NAPA SUWE

Lake County, Illinois

Prepared by the

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EXECUTIVE SUMMARY

Lake Napa Suwe is a 60.6-acre shallow slough located northwest of the intersection of Bonner and Peterson Roads in unincorporated Fremont and Wauconda Townships. Access to Lake Napa Suwe is private with bottom ownership belonging to fifteen private individuals and two developers. Additionally, there is the Lake Napa Suwe Homeowners Association. However, the Association does not take an active role in managing the lake. The main uses of the lake are fishing and boating (canoe, rowboat, paddleboat).

Overall, Lake Napa Suwe has very poor water quality as compared to other County lakes. Dissolved oxygen concentrations are low and are near unhealthy levels for much of the summer (June, July, August). Secchi disk readings, a measurement of water clarity, were also troublesome. Average Secchi depth for Lake Napa Suwe in 2002 was 0.81 feet and July's Secchi reading (0.56 feet) was the tenth worst reading taken by the LMU in the last 5 years. The two main factors contributing to the poor clarity are high nutrient concentrations and suspended sediment. In 2002, the average total phosphorus concentration in Lake Napa Suwe was 0.230 mg/L, which is four times higher than the Lake County median value of 0.056 mg/L. These high phosphorus concentrations, which are causing summer long algae blooms, are directly related to internal phosphorus loading from sources such as sediment resuspension and decaying algae. The average total suspended solid concentration in Lake Napa Suwe was 60.4 mg/L and was as high as 122.0 mg/L, which is twenty times higher than the Lake County median concentration of 6.0 mg/L. These high concentrations of suspended sediment are greatly reducing clarity and contributing to the internal loading of nutrients in Lake Napa Suwe.

Aquatic plant assessments revealed that there is very little aquatic plant growth in Lake Napa Suwe for the entire study. The absence of a aquatic plants has negatively impacted many aspects of lake health, as a healthy aquatic plant population is critical to good lake health. Aquatic plants provide many water quality benefits such as sediment stabilization and competition with algae for available resources. Additionally, aquatic vegetation is an important source of habitat and food for wildlife such as fish and waterfowl.

Shoreline assessment revealed that a majority of Lake Napa Suwe's shoreline is undeveloped (81%). The undeveloped shoreline consisted mostly of wetland (40%) and shrub (38%). The majority of developed shoreline is made up of buffered areas (75%) and manicured lawn (24%). The high percentage of lawn is discouraging as this is considered an undesirable shoreline type for several reasons including poor root structure and habitat. Erosion on Lake Napa Suwe is also somewhat problematic with 14% of the shoreline eroding. A majority of the eroded shoreline was *Slightly* eroded (12%) with some experiencing *Moderate* erosion (2%). The most affected shoreline types regardless of development were lawn and shrub. This can be attributed to poor soil stabilization provided by turf grass on the lawns and the dominance of low quality, shallow rooted, invasive species in the shrub areas.

LAKE IDENTIFICATION AND LOCATION

Lake Napa Suwe is located northwest of the intersection of Bonner and Peterson Roads in unincorporated Fremont and Wauconda Townships near the Village of Wauconda (T44N, R9&10E, Sections 13,19,24). Lake Napa Suwe is a 60.6-acre shallow slough with a current maximum depth of 5 feet, estimated average depth of 2.5 feet with a lake volume of approximately 152 acre-feet (Lake County Health Department – Lakes Management Unit [LMU] data). Lake Napa Suwe is part of the Mutton Creek sub basin of the Fox River watershed. The main inflow into Lake Napa Suwe is from Drummond Lake to the east. Lake Napa Suwe has an outlet structure on the west end of the far northern bay, that until fairly recently (1998) had been in disrepair. With the installation of a new control structure, lake levels are currently 1-2 feet above what they had been in the past. During most of the summer, water levels were high enough to crest this spillway and continue the flow of Mutton Creek, eventually into Island Lake, and then into the Fox River. The lakes immediate watershed is becoming increasingly residential. Currently there is a new development on the northeast side of the lake (previously Wauconda Orchards) and future development is planned for the northwest side of the lake.

SUMMARY OF CURRENT AND HISTORICAL LAKE USES

Historically, Lake Napa Suwe was named Breeden Lake or Breeden Slough after the adjacent Breeden's Wauconda Orchard, which was in operation from 1959-2002 and was located on the northeastern shore. The owner of the orchard eventually changed the name to Lake Napa Suwe to reflect the names of his daughters (Nancy, Pat, Sue, and Wendy). Now the site is being developed into a residential community.

Access to Lake Napa Suwe is private with bottom ownership belonging to fifteen private individuals and two developers. Additionally, there is the Lake Napa Suwe Homeowners Association, which is made up of residents of the west shore, but does not take an active role in managing the lake. The shallow nature of the lake limits its uses, which include recreational boating (paddle, canoe), fishing (even though it probably has a very poor fishery), and aesthetic enjoyment. Historical reports (Illinois Department of Conservation) describe the lake as 38 acres and 9 feet deep, which is extremely different than the conditions found by the LMU in 2002 (61 acres and 5 feet deep). There is no doubt that the lake has increased in size due to various earthen dams and control structures. However, it is unlikely that the lake was ever 9 feet deep. The lake has undergone several changes over the years. Aerial photography shows no development on the northwest corner of the lake in 1993. By 1997 there were a few houses and by 2000 the lots are almost fully built-out. Additionally, the 1993 photo shows an island in the northern bay of the lake neat the outlet. This island is not present in the 1997 or 2000 photo so one can only guess that it was washed downstream or flooded, possibly during the outlet rehabilitation, which increased lake levels. Changes will continue, with development occurring on the northeast and northwest shores.

LIMNOLOGICAL DATA – WATER QUALITY

Water samples collected from Lake Napa Suwe were analyzed for a variety of water quality parameters. Since Lake Napa Suwe is so shallow and is a flow through system, two sampling sites were utilized, one near the inlet (Site 1) and one at the outlet (Site 2) (Figure 1). Water samples at Site 1 were collected from a depth of 3 feet in May and June and at the surface from July through September. Samples at Site 2 were collected from the surface for the entire study. Lake Napa Suwe does not thermally stratify, which means the lake does not divide into a warm upper water layer (epilimnion) and cool lower water layer (hypolimnion) but instead stays well mixed. This is due to the shallow lake morphology, long fetches (the longest distance which wind blows unobstructed across a lake), and lack of aquatic plant growth. This mixing of water is reflected in the dissolved oxygen (DO) concentrations as well as other water quality data such as water temperature, suspended solids and nutrient concentrations. Site 2 (outflow) is more representative of the overall water quality of Lake Napa Suwe. Therefore, the following water quality discussion will focus on Site 2 with references to Site 1 when appropriate. The complete data set for Lake Napa Suwe can be found in Table 1, Appendix A and the multiparameter data located in Appendix C.

Lake Napa Suwe has poor DO concentrations. In order to support aquatic life, DO concentrations should remain above 5.0 mg/L. If DO concentrations drop below this level for a prolonged period of time, negative impacts such as fish kills can occur. In 2002, the average DO concentration at Site 2 was 5.17 mg/L, with concentrations fluctuating throughout the study from 9.08 mg/L (May) to as low as 3.06 mg/L (September). These low DO concentrations are due to the widespread planktonic algae blooms that were present in the lake from May through September. Although algae produce oxygen during biological processes, they consume oxygen when they respire. This along with other factors, such as decomposition (an oxygen consuming process) of dying algae and other organic matter, is creating a high biological oxygen demand (BOD) that is lowering DO concentrations. Another factor affecting the DO problems at Site 2 is the fact that this site is sheltered from the wind, which is preventing the water from mixing (oxygenated). DO concentrations at Site 1, which is not sheltered from the wind, were slightly better. Average DO concentrations at Site 1 were 6.75 mg/L with a maximum concentration of 9.29 mg/L (May) and minimum of 4.96 mg/L (June). Overall, the low DO conditions at both sites may have detrimental effects on other lake quality issues such as fishery health. However, there may be little that can be done to improve the DO conditions in Lake Napa Suwe.

Secchi disk transparency is a direct indicator of water clarity as well as overall water quality. In general, the greater the Secchi disk depth, the clearer the water and better the water quality. Based on Secchi depth, Lake Napa Suwe has *poor* water quality. The 2002 average Secchi depth on Lake Napa Suwe was 0.81 feet, which is significantly lower than the Lake County median Secchi disk depth of 3.81 feet. Monthly readings varied from 1.28 feet (May) to 0.56 feet (July), which was the tenth worst Secchi reading taken by the LMU from 1998-2002 (98 lakes). This poor water clarity is the result of high levels

of suspended organic and inorganic particles. However, this is typical of shallow, flow through systems such as Lake Napa Suwe.

Total suspended solids (TSS) are a measurement of suspended particles such as algae and other organic matter as well as inorganic matter such as silt and clay. In 2002, the average TSS in Lake Napa Suwe was 60.4 mg/L, which is ten times higher than the County median value of 6.0 mg/L. TSS increased from a low of 25.0 mg/L in May to as high as 122.0 mg/L in August, which is twenty times higher than the County median value and the single worst TSS concentration recorded by the LMU from 1998-2002 (500 samples). These high concentrations of suspended particles directly impact clarity (Secchi depth) (Figure 2). Furthermore, many other aspects of lake health, including the aquatic plant community and fishery health are also being negatively affected by high turbidity levels. The calculated nonvolatile suspended solids (NVSS), which is the portion of the TSS that can be attributed to inorganic (soil particles) was 54.3 mg/L. This means that a majority (71%) of the turbidity (TSS) was caused by suspended inorganic particles such as silts and clays. Furthermore, monthly variations in NVSS correspond closely to changes in TSS (Figure 2). The other 29% can be attributed to organic particles such as algae. While the shallow nature of Lake Napa Suwe is at the heart of the turbidity problem, sediment resuspension can also be attributed to carp activity, which according to IDNR reports, appear to be overly abundant in Lake Napa Suwe. Due to their feeding and spawning habits, carp disrupt sediment. Additionally, carp can disturb aquatic plant growth, which stabilize sediment and compete with algae for available resources thus improving water clarity/quality. With no appreciable aquatic plant community (see *Limnological Data – Aquatic Plant Assessment*), algae growth in Lake Napa Suwe is only limited by the availability of nutrients.

Algae need light and nutrients, most importantly carbon, nitrogen (N) and phosphorus (P), to grow. Light and carbon are not normally in short supply (limiting). This means that nutrients (N&P) are usually the limiting factors in algal growth. To compare the availability of these nutrients, a ratio of total nitrogen to total phosphorus is used (TN: TP). Ratios <10:1 indicate nitrogen is limiting. Ratios of >15:1 indicate phosphorus is limiting. Ratios >10:1, <15:1 indicate that there is enough of both nutrients for excessive algal growth. Most lakes in the County are phosphorus limited. In these phosphorus-limited lakes even a small addition of P can trigger algae blooms. In 2002, Lake Napa Suwe had an average TN: TP ratio of 15:1, which means that there are sufficient amounts of both nutrients to support algae growth. This is evident in the season long planktonic algae blooms observed on Lake Napa Suwe during the 2002 study.

Phosphorus concentrations in Lake Napa Suwe are *high*. The average TP concentration during the 2002 study was 0.230 mg/L, which is over four times the median TP concentration for Lake County lakes (0.056 mg/L). As stated previously, high TP concentrations cause nuisance algae blooms, which are contributing to poor water clarity (Figure 3). Additionally, there were also above average concentrations of soluble reactive phosphorus (SRP), which is a readily available form of phosphorus that is easily utilized by algae. SRP is not normally present at detectable levels in the surface waters

of a lakes. The detectable SRP in Lake Napa Suwe can be attributed to the nutrient limitation(nitrogen). Another input of phosphorus may be from sources outside of the lake (external). These external inputs consist of a variety of sources. They can include fertilizer runoff, failing septic systems, geese feces, and erosion. For Lake Napa Suwe, the main outside source of TP could be from stormwater entering the lake. However, water elevation measurements indicate that very little water flowed into Lake Napa Suwe over the course of the 2002 summer, as lake levels remained low and fairly stable after spring rains. Peak TP concentrations were in July and August, which does not correlate with monthly rainfall data from the same time period (Figure 4). This indicates that a majority of Lake Napa Suwe's TP may be from internal sources (sediment resuspension and release from decaying algae).

Nitrate (NO_3-N) and ammonia (NH_3-N) concentrations were below detection limits for much of the study with June the only months with detectable NO_3-N concentrations and June and September the only months with detectable NH_3-N. The detectable concentrations in these months could be due to nutrient release from dying algae during this period. The average Total Kjeldahl nitrogen (TKN) concentration, an organically associated form of nitrogen, was 2.99 mg/L, which is over three times that of the County median concentration of 1.170 mg/L. The highest TKN concentrations were in July, August, and September. This could be due to an increase in algae in the water column during those months, which is supported by a decrease in Secchi depth in these same months along with sharp increases in total volatile solids and SRP concentrations.

Another way to look at nutrient concentrations and how they affect the productivity of a lake is the use of a Trophic State Index (TSI) based on average phosphorus concentrations. The TSI can be based on phosphorus concentration, chlorophyll *a*, and Secchi depth to classify and compare lake productivity levels (trophic state). The phosphorus TSI is setup so the higher the phosphorus concentration, the greater amount of algal biomass and as a result, a higher trophic state. Based on a TSI phosphorus value of 82.6, Lake Napa Suwe is classified as *hypereutropic* ($\geq$70 TSI). This means that the lake is a highly productive system that has excessive nutrient levels and high algal biomass (growth). Field observations reinforce that Lake Napa Suwe is *hypereutrophic* and does have high nutrient concemtrations as well as high algal biomass. For comparison, most lakes in the County are eutrophic (TSI values $\geq$50 <70). Out of all of the lakes in Lake Country studied by the LMU since 1998, Lake Napa Suwe ranks 99 out of 103 lakes based on phosphorus TSI (Table 2, Appendix A).

TSI values along with other water quality parameters can be used to compare water quality standards as well as use impairment indexes established by the Illinois Environmental Protection Agency (IEPA). These standards rate a given lake based on several water quality parameters. Based on above average phosphorus concentrations, Lake Napa Suwe was listed as having a *Moderate* violation of Illinois water quality standards. Additionally, there were violations based on high nitrogen and nitrate concentrations, high suspended solids concentrations (NVSS), low DO levels, and exotic

invasive species (Eurasian water milfoil and curly leaf pondweed). Based on IEPA Swimming Use Index, Lake Napa Suwe is categorized as *Nonsupport*. This is due to poor Secchi disk readings and high phosphorus levels, which lead to high algal biomass (increased turbidity) and decreased visibility. Lake Napa Suwe's average Secchi disk was only 6.6 inches, which is well below the IDPH's recommendation of 48 inches. Based on the Recreational Use Index, Lake Napa Suwe was also categorized as *Nonsupport*. This is due to a high TSI value and high levels of suspended solids, which result in poor visibility and contribute to an overall reduction in use of the lake. Based on the Aquatic Life Use index, Lake Napa Suwe provides *Partial* support despite the fact that there is almost no aquatic plant community. Based on the average of all of the use impairment indices, Lake Napa Suwe is listed as providing *Nonsupport* for Overall Use.

LIMNOLOGICAL DATA - AQUATIC PLANT ASSESSMENT

A healthy aquatic plant population is critical to good lake health. Aquatic vegetation provides important wildlife habitat and food sources. Additionally, aquatic plants provide many water quality benefits such as sediment stabilization and competition with algae for available resources. Aquatic plant growth on Lake Napa Suwe is almost *nonexistent.* This was despite the fact that there was adequate light penetration throughout most of the lake. Poor substrate type and carp activity may be possible explanations for the lack of growth. Visual observations confirm that the substrate may be too rocky in some areas to support growth. However, even the parts of the lake with a more suitable substrate did not have much growth. Some of the only places that did support plants were the shallow embayments. The presence of carp may be another possible explanation. Due to their disruptive feeding habits, carp uproot aquatic vegetation preventing establishment. As a result, Lake Napa Suwe is experiencing a variety of water quality problems including poor clarity, increased turbidity, nuisance algae blooms, and poor fishery health.

Aquatic plant surveys were conducted every month for the duration of the study (Table 3) (*Appendix A* for methodology). Shoreline plants of interest were also observed. However, no surveys were made of these shoreline species and all data is purely observational. The extent to which aquatic plants grow is largely dictated by light availability. Surveys revealed that aquatic plants grew only in about 10% of the lake. For overall lake health it is considered beneficial to have aquatic plant coverage between 30-40% of the bottom area. Additionally, the plant population is unbalanced with a few undesirable species making up the majority of the population (Table 4). The nuisance aquatic weeds Eurasian water milfoil and coontail were the most frequent plants sampled (22% and 18%, respectively). Other species that are more desirable, such as bladderwort (4%), sago pondweed (3%), and flat stem pondweed (1%) were found much less frequently.

Table 3. Aquatic and shoreline plants on Lake Napa Suwe, May-September 2002.

<u>*Aquatic Plants*</u>	
Coontail	*Ceratophyllum demersum*
Common Duckweed	*Lemna minor*
Star Duckweed	*Lemna trisulca*
Eurasian Water Milfoil	*Myriophyllum spicatum*
Curlyleaf Pondweed	*Potamogeton crispus*
Sago Pondweed	*Potamogeton pectinatus*
Flatstem Pondweed	*Potamogeton zosteriformis*
Common Bladderwort	*Utricularia vulgaris*
Water Meal	*Wolffia columbiana*
<u>*Shoreline Plants*</u>	
Blue Flag Iris	*Iris versicolor*
Blue Vervain	*Verbena hastata*
Common Buckthorn	*Rhamnus cathartica*
Common Cattail	*Typha latifolia*
Common Milkweed	*Asclepias syriaca*
Garlic Mustard	*Alliaria officinalis*
Giant Reed	*Phragmites australis*
Multiflora Rose	*Rosa multiflora*
Narrow Leaved Cattail	*Typha angustifolia*
Purple Loosestrife	*Lythrum salicaria*
Queen Anne's Lace	*Daucus carota*
Reed Canary Grass	*Phalaris arundinacea*
Swamp Smartweed	*Polygonum coccineum*
Sandbar Willow	*Salix interior*
Weeping Willow	*Salix alba tristis*
White Pine	*Pinus strobes*
Wild Grape	*Vitis* sp.

Floristic quality index (FQI) (Swink and Wilhelm 1994) is a rapid assessment metric 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 submersed and floating aquatic plant species (emergent shoreline species were not counted) in the lake is assigned a number between 1 and 10 (10 indicating the plant species most sensitive to disturbance). Nonnative species were also counted in the FQI calculations for Lake County lakes. These numbers are then 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. A low FQI indicates that there are a low number of species and possibly lower quality species present in the lake. In 2002, Lake Napa Suwe has a FQI of 16.3. The average FQI of lakes studied by the LMU in 2000-2002 was 14.2. However, as mentioned previously, the density of these species is very low and the community is skewed, being dominated by low quality species.

LIMNOLOGICAL DATA – SHORELINE ASSESSMENT

Shoreline assessment was conducted at Lake Napa Suwe on July 11, 2002. Shorelines were assessed for a variety of criteria (*Appendix B* for methodology). A large majority (81%) of Lake Napa Suwe's shoreline is undeveloped. A majority of the undeveloped shoreline consisted of wetland (40%) and shrub (38%)(Figure 5). Developed shorelines are dominated by buffer areas (75%) and lawn (24%). The high occurrence of buffered areas on the developed shores combined with the dominance of wetland and shrub areas on the undeveloped shorelines is encouraging, as they contain plants with deep root systems that are less prone to erosion and provide good wildlife habitat. Also noted during the assessment was that there are no seawalls on the lake, which is unusual for a residential lake within Lake County. Seawalls (and rip rap to an extent) are undesirable because of their tendency to reflect wave action back into the lake. This can cause resuspension of near shore sediments, which can lead to a variety of water quality problems. These types (seawall and rip rap) of shoreline are often considered undesirable. However, manicured lawn, which accounted for 25% of the developed shoreline, is also a poor shoreline/water interface. This is due to the poor root structure of turf grasses, which are unable to adequately stabilize soil, which may lead to erosion. Additionally, manicured lawn provides little wildlife habitat.

Shoreline was also analyzed for the presence of erosion. The occurrence of erosion on Lake Napa Suwe is *moderate*. Overall, 14% (2,599 feet) of the shoreline on Lake Napa Suwe had some type of erosion (Figure 6). A majority of the eroded shoreline was assessed as *Slightly* eroded (12%) with some experiencing *Moderate* erosion (2%) and no shoreline was assessed as having *Severe* erosion. The most affected shoreline types, regardless of development, were lawn and shrub areas, which accounted for 12% of total erosion (5% and 7%, respectively). The lawn areas that have experienced erosion were found to be poorly maintained and as stated previously, are prone to erosion due to the

lack of quality root structure. The shrub areas, which are normally less prone to erosion, were found to be overrun with the invasive species common buckthorn and reed canary grass, both of which have poor root systems and offer little stabilization benefit. The residents of Lake Napa Suwe could easily address these *Slightly* eroded areas by establishing well-maintained buffer strips consisting of prairie grasses and wildflowers. Additionally, it would be beneficial to extend these buffers into lake by planting native emergent vegetation such as arrowhead and pickerel weed. Improving the *Moderately* eroded areas would involve more labor-intensive measures (i.e., regrading, bioengineering).

LIMNOLOGICAL DATA – WILDLIFE ASSESSMENT

Wildlife observations were made on a monthly basis during water quality and plant sampling actives (Table 5). All observations were visual. Wildlife habitat on Lake Napa Suwe is above average for a Lake County lake. On many areas around the lake there are healthy populations of mature trees that provide good habitat for a variety of bird species. Additionally, there are large expanses of shrub that provide habitat for smaller bird and mammal species. The dominant shoreline type at Lake Napa Suwe is wetlands, which provide good habitat for a variety of wildlife. Staff frequently observed great blue herons, great egrets, and cormorants. Additionally, LMU staff sighted several pied-billed grebes, a State threatened waterfowl utilizing the lake during spring migration.

One area of concern is the overwhelming presence of invasive species along the shores of Lake Napa Suwe. The exotic, nuisance species: purple loosestrife, common buckthorn, and reed canary grass were found along 76% of the shoreline (Figure 7). These nuisance species should be controlled or eliminated before they spread and become more established displacing more desirable native species such as blue flag iris. These exotic weeds are seldom used by wildlife for food or shelter. Additionally, shoreline habitat should be improved after their removal and include the use of buffer strips to create more naturalized shoreline areas and protect against erosion.

Due to the low DO concentrations and overall shallow depth of Napa Suwe the fishery is probably in poor health. Past IDNR reports found the fishery of Lake Napa Suwe to contain largemouth bass, bluegill, green sunfish, bullheads, carp, and several minnow species. However, these reports go on to state that due to the shallow depth of the lake it is more than likely dominated by species tolerant to low DO conditions, such as carp. LMU observations confirm that carp are overly abundant. Carp can cause a variety of water quality problems including resuspension of sediment and nutrients, disruption of the aquatic plant community, and low DO conditions. Additionally, this disruptive nature slowly deteriorates the quality of the lake's fishery until conditions are only suitable for their own (the carp's) survival. If there are to be any measurable improvements in the water quality of Lake Napa Suwe, the carp problem must be addressed. However, upstream sources such as Drummond Lake, which is also plagued by an excessive number of carp, must also be addressed to avoid reinfestation.

Table 5. Wildlife species observed on Lake Napa Suwe, May – Sept. 2002.

Birds	
Pied-billed Grebe+	*Podilymbus podiceps*
Double-crested Cormorant	*Phalacrocorax auritus*
Mute Swan	*Cygnus olor*
Canada Goose	*Branta canadensis*
Mallard	*Anas platyrhnchos*
Wood Duck	*Aix sponsa*
American Coot	*Fulica americana*
Ring-billed Gull	*Larus delawarensis*
Great Egret	*Casmerodius albus*
Great Blue Heron	*Ardea herodias*
Cattle Egret	*Bubulcus ibis*
Green Heron	*Butorides striatus*
Killdeer	*Charadrius vociferus*
Ring-necked Pheasant	*Phasianus colchicus*
Red-tailed Hawk	*Buteo jamaicensis*
Turkey Vulture	*Cathartes aura*
Mourning Dove	*Zenaida macroura*
Belted Kingfisher	*Megaceryle alcyon*
Common Flicker	*Colaptes auratus*
Downy Woodpecker	*Picoides pubescens*
Eastern Kingbird	*Tyrannus tyrannus*
Barn Swallow	*Hirundo rustica*
Tree Swallow	*Iridoprocne bicolor*
American Crow	*Corvus brachyrhynchos*
Blue Jay	*Cyanocitta cristata*
Black-capped Chickadee	*Poecile atricapillus*
Catbird	*Dumetella carolinensis*
American Robin	*Turdus migratorius*
Cedar Waxwing	*Bombycilla cedrorum*
Red-eyed Vireo	*Vireo olivaceus*
House Sparrow	*Passer domesticus*
Yellow Warbler	*Dendroica petechia*
Common Yellowthroat	*Geothlypis trichas*
Ovenbird	*Seiurus aurocapillus*
Red-winged Blackbird	*Agelaius phoeniceus*
Common Grackle	*Quiscalus quiscula*
American Goldfinch	*Carduelis tristis*
Northern Cardinal	*Cardinalis cardinalis*
House Sparrow	*Passer domesticus*
Northern Cardinal	*Cardinalis cardinalis*
House Finch	*Carpodacus mexic*

Table 5. Wildlife species observed on Lake Napa Suwe, May – Sept. 2002. (cont'd)

Birds (cont'd)	
American Goldfinch	*Carduelis tristis*
Chipping Sparrow	*Spizella passerina*
Field Sparrow	*Spizella pusilla*
Song Sparrow	*Melospiza melodia*
Reptiles	
Painted Turtle	*Chrysemys picta*
Amphibians	
Spring Peepers	*Pseudacris crucifer*
American Toad	*Bufo americanus*
Green Frog	*Rana clamitans melanota*
Leopard Frog	*Rana pipiens*
Western Chorus Frog	*Pseudacris triseriata triseriata*

+Threatened in Illinois

EXISTING LAKE QUALITY PROBLEMS

Lake Napa Suwe has *below average* water quality due to high nutrient and suspended sediment concentrations in addition to low DO levels. These are common problems throughout Lake County especially in shallow, manmade lakes that have an overabundance of carp. Despite the fact that Lake Napa Suwe is a low-use waterbody, these lake quality problems should still be addressed not only to improve conditions in Napa Suwe but also to prevent continual impacts to down stream sources. However, all aspects of Lake Napa Suwe are not in poor condition. The lake does provide good habitat for a variety of wildlife species including State threatened species.

- *Shoreline Erosion*

  The overall occurrence of erosion on Lake Napa Suwe was *moderate*. As stated previously, Lake Napa Suwe has some form of erosion on 14% of its shoreline. The main cause of this erosion is lack of suitable shoreline vegetation. The two most eroded shoreline types were found to be manicured lawn and unmanaged shrub areas. Both of these shoreline types contain shallow rooted vegetation, which are unable to properly stabilize the soil. Erosion is contributing to water quality problems such as sedimentation, nutrient enrichment and nuisance algae blooms. If left unattended, the erosion problem will continue to worsen, further aggravating related water quality issues. For this reason, shoreline erosion on Lake Napa Suwe should be addressed immediately. Depending on the severity of erosion, corrective techniques on Lake Napa Suwe include the use of regrading, rip rap, biologs, and buffer strips. Individual property owners (along with the new developments) should promote and implement the use of more naturalized shoreline types such as buffer strips of deep-rooted native vegetation. These buffers should extend into the lake utilizing emergent vegetation, which will help to dissipate wave action. This will benefit not only the water quality of Lake Napa Suwe, but also improve the wildlife habitat surrounding the lake.

- *Invasive Species Management*

  Three exotic invasive species, common buckthorn, reed canary grass, and purple loosestrife, were found along the shoreline of Lake Napa Suwe's. All of these species provide minimal food or habitat benefit to wildlife. Furthermore, all three species are extremely aggressive and will displace desirable, native vegetation, which will lead to further loss of food and habitat. Unfortunately all three of these species have become well established along the shores of the lake. However, these noxious weeds can be controlled using several different management techniques. Some infested areas are currently under development. Removal of these species should be included as part of the shoreline development plan in these areas. The cattail fringe is also of some concern. Yearly or alternate year burnings of the cattails would be beneficial in slowing their encroachment and further filling in of the lake. Additionally, these burnings would help control the spread of invasive species such purple loosestrife. Burning should be conducted as early in the year or fall as possible to avoid any conflicts with migrating and/or nesting birds.

- *Unhealthy Aquatic Plant Community*

  One key to a healthy lake is a healthy aquatic plant population, which Lake Napa Suwe does not have. The number of species found in the lake was above average but the densities of these nine species were very low and the community is dominated by low quality species (Eurasian water milfoil and coontail). For overall lake health, it is considered beneficial to have aquatic plant coverage between 30-40% of the bottom area. Lake Napa Suwe has less than 10% coverage. The negative impacts associated with the absence of a healthy aquatic plant community are wide spread and include those on water quality and fishery health. The lack of quality aquatic plants, and subsequent loss of water quality, is more than likely the result of carp activity and substrate type since there is adequate light available throughout the lake. Establishment of a healthy aquatic plant community is essential in improving the overall quality of Lake Napa Suwe. Aquatic vegetation will stabilize sediment and help to reduce algae blooms, which will improve clarity. Additionally, these vegetated areas will provide valuable fish and wildlife habitat. This is a long-term process and involves other management practices such as the elimination of carp, which are possibly the biggest limiting factor in plant growth for Lake Napa Suwe. After the carp problem is brought under control, aquatic revegetation can begin. Since Lake Napa Suwe already has plants (just not enough), once the conditions are right, these plants will expand into other parts of the lake. However, steps must be taken to ensure that Eurasian water milfoil does not dominate the newly expanded plant community.

- *Lake Data*

  The lack of quality lake data is a common problem for many of the lakes in Lake County. This is either due to poor record keeping or lack of involvement on the part of the management entity/residents. Some management of Lake Napa Suwe has occurred in the past, but due to poor record keeping, details of these activities is limited. Additionally, data such as Secchi depth, water fluctuations, and DO profiles are not collected/monitored. Collection of this type of lake data can be very important in making management decisions. This data can be used to track changes (or lack of) in lake quality over many years. Additionally, this data is very important to agencies, such as the LMU, when conducting studies of the lake and allows for a more complete analysis. It is our recommendation that Lake Napa Suwe becomes involved in the IEPA's Volunteer Lake Monitoring Program (VLMP). This program uses volunteers to collect bimonthly lake data for the

IEPA. This program is worth the time and effort and provides valuable information about the lake.

- *Lack of a Bathymetric Map*

  There has never been a bathymetric (contour) map made for Lake Napa Suwe. These maps can be of great use to fishermen as well as lake managers. Bathymetric data can show where possible problematic areas may be located (i.e., shallow areas). Bathymetric maps can also provide volumetric data that can be utilized for management techniques such as aeration, dredging, and volumetric applications of products such as herbicides and rotenone (a fish toxicant). These practices cannot be properly executed without a good bathymetric map and accompanying data. These maps can be easily made using different methods. All lakes in the County should have a current, good quality bathymetric map and Lake Napa Suwe is no exception.

POTENTIAL OBJECTIVES FOR A LAKE NAPA SUWE MANAGEMENT PLAN

I: Shoreline Improvement and Erosion Control
II: Eliminate or Control Invasive Species
III: Conduct a Fishery Assessment
IV: Volunteer Lake Monitoring Program
V: Create a Bathymetric Map with Morphometric Table

OPTIONS FOR ACHIEVING THE LAKE MANAGEMENT PLAN OBJECTIVES

Objective I: Shoreline Improvement and Erosion Control

Erosion to shorelines on Lake Napa Suwe is an increasing problem. Shoreline erosion 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. During the 2002 survey of Lake Napa Suwe a moderate portion of shoreline was found to be eroded (approximately 14% or 2,599 feet). These areas should be addressed as soon as possible in order to avoid further deterioration.

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.

<u>Option 2: Install Rock Rip Rap</u>

Rip rap is the term for using rocks to stabilize shorelines. Size of the rock depends on the severity of the erosion, distance to rock source, and aesthetic preferences. Generally, four to eight inch diameter rocks are used. *The use of rip rap should be viewed as a last resort* after other alternatives such as biologs have been tried or are inappropriate. Rip rap can be incorporated with other erosion control techniques such as plant buffer strips. If any plants will be growing on top of the rip rap fill will probably be needed to cover the rocks and provide an acceptable medium for plants to grow on. *It is imperative that filter fabric be used under the rip rap to provide quality, long lasting results.* Prior to the initiation of work, permits and/or surveys from the appropriate government agencies need to be obtained (see costs below). Rip rap is best used for areas of **moderate erosion** and gentle to moderately sloped shores (<2:1). If rip rap is to be used on shorelines steeper than 2:1, then grading must be done in order to reduce grade to ≤ 2:1, preferably 3:1. *Every effort should be made to use more natural, less intrusive methods of shoreline stabilization (buffer strips and biologs).* However, the site must be prepared (grading, etc.) accordingly.

Pros

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

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

Cons

A major disadvantage of rip rap is the initial expense of installation and associated permits. Installation is expensive since a licensed contractor and heavy equipment are generally needed to conduct the work. Permits are required if replacing existing or installing new rip rap and must be acquired prior to work beginning. If any fill material is placed in the floodplain along the shoreline; compensatory storage may also be needed. Compensatory storage is the process of excavating in a portion of a property or floodplain to compensate for the filling in of another portion of the floodplain. While rip rap 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 way due to rising water levels or wave action. On the other hand, larger boulders are more expensive to haul in and install.

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

Costs

Cost and type of rip rap used depend on several factors, but average cost for installation (rocks and filter fabric) is approximately $30-45 per linear foot. Based on assessed *moderately* eroded shoreline, Lake Napa Suwe would need approximately 384 linear feet of rip rap. This would come to a cost of approximately $11,520 – $17,280. The steeper the slope and severity of erosion, the larger the boulders that will need to be used and thus, higher installation costs. In addition, costs will increase with poor shoreline accessibility and increased distance to rock source. Costs for permits and surveys can be $1,000-2,000 for installation of rip rap, depending on the circumstances. Additional costs will be incurred if compensatory storage is needed. Contact the Army Corps of Engineers, local municipalities, and the Lake County Planning and Development Department.

Option 3: Buffer Strips

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 shorelines with **slight erosion** and 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 more 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 or rip rap. Furthermore, it is our recommendation that buffer strips be established along all applicable shorelines of Lake Napa Suwe regardless of shoreline type.

Buffer strips can be constructed in a variety of ways with various plant species. Generally, buffer strip vegetation consists of native terrestrial (land) species and emergent (at the land and water interface) species. Terrestrial vegetation such as native grasses and wildflowers can be used to create a buffer strip along lake shorelines. Table 6 gives some examples, seeding rates and costs of grasses and seed mixes that can be used to create buffer strips. Native plants and seeds can be purchased at regional nurseries or from catalogs. When purchasing seed mixes, care should be taken that native plant seeds are used. Some commercial seed mixes contain non-native or weedy species or may contain annual wildflowers that will have to be reseeded every year. If purchasing plants from a nursery or if a licensed contractor is installing plants, inquire about any guarantees they may have on plant survival. Finally, new plants should be protected from herbivory (e.g., muskrats) by placing a wire cage over the plants for at least one year.

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

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

Pros

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

The buffer strip will stabilize the soil with its deep root structure and help filter run-off from lawns and agricultural fields by trapping nutrients, pollutants, and sediment that would otherwise drain into the lake. This may have a positive impact on the lake's water quality since there will be less "food" for nuisance algae and "weedy" aquatic plants. 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. Weevils need proper over wintering habitat such as leaf litter and mud which are typically found on naturalized shorelines or shores with good buffer strips. Many species of amphibians, birds, fish, mammals, reptiles, and invertebrates have suffered precipitous declines in recent years primarily due to habitat loss. Buffer strips may help many of these species and preserve the important diversity of life in and around lakes.

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

Cons

There are few disadvantages to native shoreline vegetation. Certain species (i.e., cattails) can be aggressive and may need to be controlled occasionally. If stands of shoreline vegetation become dense enough, access and visibility to the lake may be compromised to some degree. However, small paths could be cleared to provide lake access or smaller plants could be planted in these areas.

Costs
If minimal amount of site preparation is needed, costs can be approximately $10 per linear foot, plus labor. Cost of installing willow posts is approximately $15-20 per linear foot. Based on the 2002 assessment, *slightly* eroded shoreline, Lake Napa Suwe would need approximately 2,215 linear feet of buffer strip. This would come to a cost of approximately $22,150. It is advisable that buffer strips be planted on all appropriate shoreline areas on Lake Napa Suwe. However, some of this shoreline would be better suited for use of biologs incorporated with buffer vegetation (see *Option 4* below), which includes the use of buffer strips. The labor that is needed can be completed by the property owner in most cases, although consultants can be used to provide technical advice where needed. This cost will be higher if the area needs to be graded. If grading is necessary, appropriate permits and surveys are needed. If filling is required, additional costs will be incurred if compensatory storage is needed. The permitting process is costly, running as high as $1,000-2,000 depending on the types of permits needed.

Option 4: Install Biolog, Fiber Roll, or Straw Blanket with Plantings
These products are long cylinders of compacted synthetic or natural fibers wrapped in mesh. The rolls are staked into shallow water. Once established, a buffer strip of native plants can be planted along side or on top of the roll (depending if rolls are made of synthetic or natural fibers). They are most effective in areas where plantings alone are not effective due to already severe erosion. These products are best used in areas on more **moderately** eroded shorelines or areas with highly erodable soil types. Many times biologs are used in conjunction with vegetated buffer strips as an alternative to rip rap.

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. Based on *moderately* eroded shorelines, Lake Napa Suwe would need 384 linear feet of one of the above products on the moderate eroded areas of shoreline. This would cost approximately $9,600 – 13,440. 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 II: Eliminate or Control Invasive Species

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

Purple loosestrife is responsible for the "sea of purple" seen along roadsides and in wetlands during summer. It can quickly dominate a wetland or shoreline. Due in part to an extensive root system, large seed production (estimates range from 100,000 to 2.7 million per plant), and high seed germination rate, purple loosestrife spreads quickly. Buckthorn is an aggressive shrub species that grows along lake shorelines as well as most upland habitats. It shades out other plants and is quick to become established on disturbed soils. Reed canary grass is an aggressive plant that if left unchecked will dominate an area, particularly a wetland or shoreline, in a short period of time. Since it begins growing early in the spring, it quickly out-competes native vegetation that begins growth later in the year. Control of purple loosestrife, buckthorn, and reed canary grass are discussed below. However, these control measures can be similarly applied to other exotic species such as garlic mustard (*Allilaria officianalis*) or honeysuckle (*Lonicera* spp.) as well as some aggressive native species, such as box elder (*Acer negundo*).

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

Option 1: No Action

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

Pros

There are few advantages with this option. Some of the reasons exotics were brought into this country are no longer used or have limited use. However, in some cases having an exotic species growing along a shoreline may actually be preferable if the alternative plant is commercial turfgrass. Since turfgrass has shallow roots and is prone to erosion along shorelines, exotics like reed canary grass or common reed (*Phragmites australis*) will control erosion more effectively. Native plants should take precedent over exotics when possible. Table 6 (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 monoculture. 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.

<u>Option 2: Hand Removal</u>

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

Pros

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

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

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

Option 3: Herbicides

Treatment with herbicides is one of the best options for controlling **mature stands** of invasive species, such as buckthorn and purple loosestrife, on Lake Napa Suwe. 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. The label is the law. Table 7 (Appendix A) contains herbicides that are approved for use near water for control of nuisance vegetation. Included in this table are rates, costs, and restrictions on use.

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
See Table 7 (Appendix A) for herbicide rates and prices. Total cost to treat the limited amount of purple loosestrife and other invasive species on Lake Napa Suwe would be minimal and could be done by individual homeowners. Hand-held and backpack sprayers costs from \$25-\$45 and \$80-150, respectively. Wicking devices are \$30-40. For other species, such as buckthorn, a device such as a Hydrohatchet®, a hatchet that injects herbicide through the bark (about \$300) may be needed. Another injecting devise, E-Z Ject® is \$450. Hand-held and backpack sprayers costs from \$25-\$45 and \$80-150, respectively. Wicking devices are \$30-40. A low cost alternative to specialized spray equipment is the use of household spray bottles (commonly used for window and bathroom cleaners). These bottles can be purchased at department stores for minimal costs. However, after there use for herbicide application they should not be used for anything else. Similarly, spray canisters like those used to apply lawn chemicals also provide lower costs alternatives to commercial spray equipment.

Objective III: Fishery Rehabilitation

<u>Option 1: Conduct a Fisheries Assessment</u>

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

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

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

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

Option 2: Carp Removal

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

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

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

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

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

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

Pros

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

Cons

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

Costs

As with most intensive lake management techniques, a good bathymetric map is needed so that an accurate lake volume can be determined (for costs see *Objective V: Create Bathymetric Map with Morphometric Table*). To achieve a concentration of 6 ppm, which is the rate needed for most total rehabilitation projects (remove carp, bullhead and green sunfish), approximately 307 gallons of rotenone would be needed based on the approximate volume of Lake Napa Suwe. This would come to a total cost of between $15,367 – 20,025. In waters with high turbidity and/or planktonic algae blooms such as Lake Napa Suwe, the ppm may have to be higher which will further increase costs. An IDNR fisheries biologist will be able to determine if higher concentrations will be needed. To reduce costs the lake could be drawn down to reduce the volume that is being treated.

Objective VI: 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 sediment 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:

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Objective V: Create a Bathymetric Map and Morphometric Data

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 lakes in Lake County do have a bathymetric map, but they are frequently old, outdated and do not accurately represent the current features of the lake. Lake Napa Suwe does not have a bathymetric map. If management activities intensify, Lake Napa Suwe should consider having a detailed bathymetric map made. 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.