2004 SUMMARY REPORT
of
SUMMERHILL ESTATES LAKE

Lake County, Illinois

Prepared by the

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EXECUTIVE SUMMARY

Summerhill Estates Lake is a small, glacial lake located in unincorporated Freemont Township. The lake has a surface area of 49.9 acres and an estimated mean and maximum depth of 3.2 and 6.3 feet, respectively. There is no managing body for the lake, which is used for fishing, swimming and aesthetics by approximately ten lakeside residents.

Water quality parameters, such as nutrients, suspended solids, oxygen, temperature and water clarity were measured and the plant community was assessed each month from May-September 2004. The average phosphorus concentration was double the Lake County median and fluctuated with plant density. Total suspended solids (TSS) concentrations were very low relative to total phosphorus (TP) concentrations, also a result of plant density. The main source of TP and TSS to the lake appears to be internal and is likely a combination of resuspended sediment and plant decomposition. Secchi depths (water clarity) were moderate throughout the summer. They did not correspond with either TSS or TP concentrations but appear to be related to plant density and decomposition. Conductivity levels were quite low but generally increased throughout the summer. Conductivity changes can occur seasonally and even with depth, but over the long term, increased conductivity levels can be a good indicator of potential watershed or lake problems or an increase in pollutants entering the lake if the trend is noted over a period of years.

Summerhill Estates Lake had a relatively diverse plant community, although it was dominated by curly leaf pondweed, duckweed, watermeal and coontail. Six other native species were also present. Curly leaf pondweed (CLPW) is an exotic species and its presence and density dictated many water quality parameters in the early part of the summer. Given the high TP concentration, without the presence of plants in Summerhill Estates Lake, dense algae blooms would likely have dominated and water clarity would have been very poor. According to lakeshore homeowners, after CLPW dies off, the lake does typically experience very dense algae blooms for the remainder of the summer. This did not occur in 2004.

The shoreline along Summerhill Estates Lake was dominated by wetland buffer, prairie and lawn, and was exhibiting erosion along less than 1% of the shoreline. As a result of the domination of buffered shoreline, a large number of bird and waterfowl species, including the Illinois state endangered black tern and black-crowned night heron, and the Illinois state threatened sandhill crane were observed on the lake. Buffer and prairie shorelines should be maintained as much as possible, and manicured lawns should be discouraged. Purple loosestrife and reed canary grass, as well as several other exotic plant species were possibly present along 87% of the shoreline of Summerhill Estates Lake and steps to eliminate these plants should be carried out before they completely take over these areas.

LAKE IDENTIFICATION AND LOCATION

Summerhill Estates Lake is located in unincorporated Freemont Township, just east of Fairfield Rd (T 44N, R 10E, S 19, 20). Summerhill Estates Lake has a surface area of 49.9 acres with estimated mean and maximum depths of 3.2 feet and 6.3 feet, respectively. It has an estimated volume of 157.2 acre-feet and a shoreline length of 1.9 miles. The watershed of Summerhill Estates Lake encompasses approximately 268.3 acres, draining a residential area on the south side and agricultural fields around the rest of the lake (Figure 1). The watershed to lake surface area ratio of less than 6:1 is small. This is positive in that it may help prevent serious water quality problems that often accompany a larger watershed to lake ratio. However, lakes with small ratios often experience more severe water level fluctuations throughout the summer as well as the accumulation of solids and nutrients because lake retention time (the time it takes all the water in the lake to be replaced) is high. It takes nearly 1½ years for all of the water volume of Summerhill Estates Lake to flush out of the lake and be replenished by new water. This can mean extended periods of poor water quality even if there are improvements to new water entering the lake. Water level from the beginning to the end of the summer decreased approximately two feet in Summerhill Estates Lake, which may have affected water quality parameters.

Based on the most recent land use survey of the Summerhill Estates Lake watershed, conducted in 2000, Open Space areas (current and fallow farm fields owned by the Lake County Forest Preserve District) dominate the watershed, making up 64% of the area (Figure 2). Other land uses include Single Family, Transportation and the lake itself (Water) (Table 1, Appendix A). The large amount of agricultural land that surrounds the lake can have negative impacts for many years beyond when the land is actively being farmed because of the potentially high nutrient levels present in the soils. Water exits Summerhill Estates Lake via a creek in the bay (created by a very large beaver dam) on the north end of the lake and flows into Mud Lake before entering Squaw Creek. The lake is located in the Squaw Creek sub basin, within the Fox River watershed.

Summerhill Estates Lake has been identified by the United States Environmental Protection Agency (EPA) as an ADID wetland. The ADID process involves collecting and distributing information on the values and functions of wetland areas. EPA conducts the process in cooperation with the U.S. Army Corps of Engineers and in consultation with States or Tribes. Local communities can use this information to help them better understand the values and functions of wetlands in their areas. The ADID process is intended to add predictability to the wetland permitting process as well as better account for the impacts of losses from multiple projects within a geographic area. One of the recent requirements regarding ADID designation in Lake County is that there must be a 100 foot buffer from the lake for any residential or commercial construction. All except three houses along the south end of Summerhill Estates Lake meet this recent requirement.

BRIEF HISTORY OF SUMMERHILL ESTATES LAKE

Summerhill Estates Lake began as a low, wet area in a farm field that had been dug out and developed approximately 20 years ago. By 2000, beavers had dammed the north part of the lake, creating an enlarged north bay that is currently separated from the rest of the lake (Figure 3). There are ten residences present along the south shoreline of the lake and the surrounding agricultural fields have been purchased by the Lake County Forest Preserve District. No managing body currently exists for Summerhill Estates Lake and any lake issues are addressed by each individual lake owner.

SUMMARY OF CURRENT AND HISTORICAL LAKE USES

Access to Summerhill Estates Lake is limited to homeowners and their guests who have access to the lake via their property. All of the homes around the lake have septic systems. No motors are permitted on the lake, which is used for swimming, fishing and wildlife viewing. The entire northern and eastern sides of Summerhill Estates Lake (as well as 65% of the lake bottom) are owned by the Lake County Forest Preserve District and exist as agricultural fields (partly in use and partly fallow). There is no managing body for the lake and small, individual herbicide treatments are the only management activities that have taken place in the recent past. Currently, the biggest management concerns on Summerhill Estates Lake include excessive curly leaf pondweed growth and algae blooms.

LIMNOLOGICAL DATA – WATER QUALITY

Water samples collected from Summerhill Estates Lake were analyzed for a variety of water quality parameters (See Appendix B for methodology). Samples were collected at a depth of three feet at the deep hole location in the lake (Figure 4). The sharp decrease in near surface water dissolved oxygen (DO) concentration in June and continued low DO concentration in July were the result of the decomposition of a massive amount of curly leaf pondweed (CLPW) throughout the end of June and into July. The decomposition of these plants was likely stripping the water of DO as a result of high biological oxygen demand (BOD). A high BOD means that regardless of the amount of oxygen present, the demand for that oxygen by living organisms (especially bacteria that decompose organic matter such as plants) is very high, and a decrease in DO may occur for a period of time. Photosynthesis does not occur during the night to replace oxygen taken up by respiration, and oxygen concentrations often decline overnight and into the early morning before rebounding by mid-morning. This is especially true in nutrient enriched lakes, such as Summerhill Estates Lake, with large amounts of plant matter decaying that increases BOD. DO concentrations recovered in August and September 2004 when coontail and other native plants replaced the curly leaf pondweed and were present at a lower overall density.

Phosphorus is a nutrient that can enter lakes through runoff or be released from lake sediment. High levels of phosphorus typically trigger algal blooms or produce high plant density. The average total phosphorus (TP) concentration in Summerhill Estates Lake (0.138 mg/L) was double the county median of 0.063 mg/L (Table 2, Appendix A). TP concentrations increased from May to a high of 0.198 mg/L in July before decreasing in August and September, when the lowest TP concentration of the summer occurred (0.106 mg/L). This trend is likely also related to the decomposition of curly leaf pondweed (CLPW) in two different ways: (1) when the plants die and begin to decompose, soluble reactive phosphorus (SRP) is released into the water column. An increase in the SRP concentration between May and June indicates that this was occurring. SRP is a form of phosphorus that is readily available for use by algae cells, duckweed and watermeal. The decomposition of CLPW and release of phosphorus caused a slight increase in the density of planktonic algae, which would have caused an increase in TP in our water samples; (2) when DO decreased as a result of plant decomposition, phosphorus may have been released from the lake sediment via chemical reactions that only occur in a low-oxygen environment. It is unlikely that external sources are controlling TP given the small size of the watershed and the absence of a correlation between monthly rainfall amounts and TP concentrations (Figure 5).

Another reason for the high TP and SRP in the water column was that the lake was nitrogen limited from May-July and was phosphorus limited in August and September. Typically, lakes are either phosphorus (P) or nitrogen (N) limited. This means that one of these nutrients is in short supply relative to the other and that any addition of phosphorus or nitrogen to the lake might result in an increase of plant or algal growth. Most lakes in Lake County are phosphorus limited, but to compare the availability of nitrogen and phosphorus, a ratio of total nitrogen to total phosphorus (TN:TP) is used. Ratios less than or equal to 10:1 indicate nitrogen is limiting. Ratios greater than or equal to 15:1 indicate that phosphorus is limiting. Ratios greater than 10:1, but less than 15:1 indicate that there are enough of both nutrients to facilitate excess algal growth. Summerhill Estates Lake had an average TN:TP ratio of 13:1. This indicates that there was enough nitrogen and phosphorus to promote algae growth during certain months. However, the lake was nitrogen limited during the first part of the summer and phosphorus limited during the second part of the summer. Nitrogen (N) can come from a variety of external sources, but can also be taken from the atmosphere and “fixed” (transformed from an atmospheric form to an organic form) by blue-green algae. This makes nitrogen input virtually impossible to control. Phosphorus input is typically easier to control, but the level of control largely depends on the phosphorus source. The concentration of phosphorus in the water column of Summerhill Estates Lake was likely dependent to some extent on the concentration of available nitrogen. As mentioned above, the lake was nitrogen limited in May and June, meaning that there was not enough N in the water column to sustain algal or floating plant growth. If algae are not growing, they will utilize neither N nor P from the water. However, P continued to be released from decomposing plants and from the sediment, resulting in a build-up of unused P in the water. Typically, in a nitrogen-limited situation, blue green algae will thrive and increase in density because they can take nitrogen from the atmosphere and transform it into a usable form for growth. Once the algae starts growing, SRP is quickly taken up from the water column and

concentrations are reduced. Once the lake became P limited in August and September, TP and SRP concentration did decrease and algae densities were slightly more noticeable. However, this typically happens to a much greater extent in Summerhill Estates Lake (pers. comm., Kathy Kramer) and a dense blue-green algae bloom forms by July. No blue-green blooms were detected throughout the summer of 2004, possibly because of the cool temperatures, as relatively high SRP and TKN concentrations prevailed throughout the summer.

Total suspended solids (TSS) is a measure of the amount of suspended material, such as algae or sediment, in the water column. High TSS values are typically correlated with poor water clarity and can be detrimental to many aspects of the lake ecosystem such as the plant and fish communities. A large amount of material in the water column can inhibit successful predation by sight-feeding fish, such as bass and pike, or settle out and smother fish eggs. High turbidity caused by sediment or algae can shade out native aquatic plants, resulting in their reduction or disappearance from the littoral zone. TSS concentrations in Summerhill Estates Lake were very low in May and June, but increased throughout the summer to a high of 10.0 mg/L in September. Despite this increase, the average TSS concentration in Summerhill Estates Lake (6.1 mg/L) was lower than the county median of 7.9 mg/L (Table 2, Appendix A). The large increase in TSS in the water column between June and July most likely originated from decomposing plant matter. A moderately strong relationship existed between TP and TSS concentrations (Figure 6). TP and TSS increased together at the beginning of the summer. However, TSS continued to increase past August while TP began to decrease in August. The lake had become phosphorus limited in August and September, meaning that enough nitrogen was available during those months for algae to grow. Once the algae started growing, they began utilizing the available SRP that had been released from decomposing plants and sitting unused in the water column. This dramatically reduced SRP concentrations in August and September, but contributed to the increase observed in TSS (Table 2, Appendix A).

It is likely that the algae blooms would have been denser and the TSS concentration would have been much higher without the presence of plants in the lake. Although curly leaf pondweed is an exotic species and contributed to the high TSS and TP concentrations through decomposition, the presence of that plant, as well as native plant species, helped stabilize sediment and compete with planktonic algae for resources. Without these benefits, the high phosphorus concentrations throughout the summer may have resulted in a dense, persistent algae bloom.

The large number of plants and the relatively low TSS concentrations in 2004 resulted in relatively high water clarity throughout the summer. This was illustrated by higher than average Secchi depth measurements that coincided with low TSS concentrations (Figure 7). Average Secchi depth (water clarity) in Summerhill Estates Lake was slightly higher than the County median (3.08 feet). Secchi depth reached a maximum of the lake bottom (6.0 feet) in May before decreasing throughout the summer and reaching a low of 2.56

feet in September. The initiation of the Volunteer Lake Monitoring Program (VLMP) in Summerhill Estates Lake is highly recommended. This is a volunteer program in which a lakeshore homeowner measures Secchi depth bi-weekly or monthly in order to create a historical record of lake water quality.

Phosphorus concentrations can also be used to calculate the trophic state (productivity level) of a lake. The Trophic State Index (TSI) uses phosphorus, chlorophyll *a* (algae biomass) and Secchi depth to classify and compare lake trophic states using just one value. The TSI is set up so that an increase in phosphorus concentration is related to an increase in algal biomass and a corresponding decrease in Secchi depth. High TSI values indicate eutrophic (TSI=50-69) to hypereutrophic (TSI ≥70) lake conditions, typically characterized by high nutrient concentrations, high algal biomass, low DO, a rough fish population, and low water clarity. Summerhill Estates Lake had an average phosphorus TSI (TSIp) value of 75.2, indicating hypereutrophic conditions. This means that the lake is a highly enriched system with relatively poor water quality. The lake ranked 126th out of 161 lakes studied in Lake County since 2000 (Table 3, Appendix A). Because of the high density of plants in Summerhill Estates Lake, some of the characteristics of hypereutrophic lakes were not observed. As mentioned before, rooted, submersed plants improve water clarity by reducing sediment resuspension and competing with planktonic algae for resources.

Most of the water quality parameters just discussed can be used to analyze the water quality of Summerhill Estates Lake based on use impairment indices established by the Illinois Environmental Protection Agency (IEPA). According to this index, Summerhill Estates Lake provides *Full* support of aquatic life and swimming and *Nonsupport* of recreational activities (such as boating) as a result of a high percent plant coverage and nutrient concentrations. The lake provides *Partial* overall use.

LIMNOLOGICAL DATA – AQUATIC PLANT ASSESSMENT

Aquatic plant surveys were conducted every month for the duration of the study (See Appendix B for methodology). Shoreline plants of interest were also recorded. However, no quantitative surveys were made of these shoreline plant species and these data are purely observational. Light level was measured at one-foot intervals from the water surface to the lake bottom. When light intensity falls below 1% of the level at the water surface, plants are no longer able to grow. Using this information, along with a bathymetric map, it can be determined how much of the lake has the potential to support aquatic plant growth. Based on 1% light level, and field observation, Summerhill Estates Lake could have supported plants over 100% of the lake, and plants were observed growing in all parts of the lake in 2004 (Appendix C). The 1% light levels in May and June make it appear as though light could not reach the lake bottom, which typically means that plants cannot grow. However, the extinction of light at three and four feet in May and June, respectively, was the result of shading out by a large density of plants already present.

Curly leaf pondweed, duckweed, watermeal and coontail dominated the plant community in Summerhill Estates Lake during the summer of 2004 (Table 4). Curly leaf pondweed dominated in May and June, after which it naturally died off and was replaced by coontail in July. Duckweed and watermeal dominated throughout the summer in almost all areas of the lake. These two species are very tiny floating leaf plants that can spread throughout an entire lake very quickly. They typically appear in highly nutrient enriched lakes and once they are present, it is nearly impossible to eradicate them. Like curly leaf pondweed, they can contribute to low DO conditions when they decompose and they can also shade out other plant species below the surface. However, duckweed and watermeal differ from CLPW in that they will persist throughout the summer, continuing to die, decompose and regrow long after CLPW has disappeared. Six other plant species (all native) were present throughout the summer, but were not observed in high abundance (Table 4 & 5). Of the 15 emergent plant and trees species observed along the shoreline of Summerhill Estates Lake, eight are invasive species that do not provide ideal wildlife habitat and have the potential to dominate the emergent plant community.

FQI (Floristic Quality Index) is a rapid assessment tool designed to evaluate the closeness of the flora of an area to that of undisturbed conditions. It can be used to: 1) identify natural areas, 2) compare the quality of different sites or different locations within a single site, 3) monitor long-term floristic trends, and 4) monitor habitat restoration efforts (Nichols, 1999). Each floating or submersed aquatic plant is assigned a number between 1 and 10 (10 indicating the plant species most sensitive to disturbance). An FQI is calculated by multiplying the average of these numbers by the square root of the number of these plant species found in the lake. A high FQI number indicates that there are a large number of sensitive, high quality plant species present in the lake. Non-native species were also included in the FQI calculations for Lake County lakes. The average FQI for all 2000-2004 Lake County lakes is 14.3. Summerhill Estates Lake had an FQI of 17.1. Although the plant community was dominated by only four species, this higher than average high FQI reflects the fact that there was a relatively high plant diversity in Summerhill Estates Lake throughout the summer.

Table 4. Aquatic and shoreline plants on Summerhill Estates Lake, May-September 2004.

Aquatic Plants	
Coontail	*Ceratophyllum demersum*
Elodea	*Elodea canadensis*
Common Duckweed	*Lemna minor*
Star Duckweed	*Lemna trisulca*
Curlyleaf Pondweed^	*Potamogeton crispus*
Sago Pondweed	*Potamogeton pectinatus*
Small Pondweed	*Potamogeton pusillus*
Flatstem Pondweed	*Potamogeton zosteriformis*
Softstem Bulrush	*Scirpus validus*
Watermeal	*Wolffia columbiana*
Shoreline Plants	
Queen Anne's Lace^	*Daucus carota*
Purple Loosestrife^	*Lythrum salicaria*
White Sweet Clover^	*Melilotus alba*
Reed Canary Grass^	*Phalaris arundinacea*
Common Reed^	*Phragmites australis*
Kentucky Blue Grass^	*Poa pratensis*
Black-eyed Susan	*Rudbeckia serotina*
Goldenrod	*Solidago* sp.
Common Cattail	*Typha latifolia*
Wild Grape	*Vitis* sp.
Trees/Shrubs	
Box Elder	*Acer negundo*
Honeysuckle^	*Lonicera* sp.
Common Buckthorn^	*Rhamnus cathartica*
Weeping Willow	*Salix alba tristis*
Willow	*Salix* sp.

^Exotic plant or tree species

LIMNOLOGICAL DATA – SHORELINE ASSESSMENT

A shoreline assessment was conducted at Summerhill Estates Lake on July 28, 2004. The shoreline was assessed for a variety of criteria (See Appendix B for methods), and based on this assessment, several important generalizations could be made. Approximately 47% of Summerhill Estates Lake's shoreline is developed. The developed shoreline is dominated by a combination of buffer (50.6%), prairie (20.3%) and lawn (20.7%), while woodland and rip rap make up a small part of the remainder. The undeveloped shoreline consists entirely of wetland buffer (Figure 8). Wetland buffer and prairie are very desirable shoreline types, providing wildlife habitat and, typically, protecting the shore from excessive erosion. Manicured lawn is considered undesirable because it provides a poor shoreline-water interface due to the poor root structure of turf grasses. These grasses are incapable of stabilizing the shoreline and typically lead to erosion. As a result of the dominance of buffer and prairie shoreline types, virtually none of Summerhill Estates Lake's shoreline exhibited erosion.

Although relatively little erosion was occurring around Summerhill Estates Lake, invasive plant species, including reed canary grass, buckthorn and purple loosestrife were probably present along 87% of the shoreline. These plants are extremely invasive and exclude native plants from the areas they inhabit. Both reed canary grass and purple loosestrife inhabit mainly the wetland areas and can easily outcompete native plants. Additionally, they do not provide the quality wildlife habitat or the solid shoreline stabilization that native plants can provide. The relative density of reed canary grass and purple loosestrife was high along the wetland buffer areas of Summerhill Estates Lake and steps to eliminate these plants as well as other exotics should be carried out immediately.

LIMNOLOGICAL DATA – WILDLIFE ASSESSMENT

Wildlife observations were made on a monthly basis during water quality and plant sampling activities (See Appendix B for methodology). Because wildlife habitat in the form of wetland buffer, prairie and other buffered areas was abundant around Summerhill Estates Lake, a large number of wildlife species, including several Illinois state threatened (sandhill crane) and endangered (black tern, black crowned night heron) species, were observed (Table 6). Several immature black crowned night herons were observed throughout the summer, indicating that nesting of these birds is occurring on the lake. Although Summerhill Estates Lake does not provide an abundance of recreational opportunities for its lakeshore residents due to algae blooms and high plant density, it is a quality lake area in that it provides habitat for a diverse collection of plants and animals. It is, therefore, very important that the wetland, prairie and buffer areas around the lake be maintained to provide the appropriate habitat for birds and other animals that can be enjoyed by lake users for many years to come.

Table 6. Wildlife species observed at Summerhill Estates Lake, April-September 2004.

Birds	
Pied-billed Grebe	*Podilymbus podiceps*
Double crested Cormorant	*Phalacroxorax auritus*
Mute Swan	*Cygnus olor*
Canada Goose	*Branta canadensis*
Mallard	*Anas platyrhnchos*
American Wigeon	*Anas americana*
Ruddy Duck	*Oxyura jamaicensis*
Ring-billed Gull	*Larus delawarensis*
Black Tern*	*Chlidonias niger*
Great Egret	*Casmerodius albus*
Great Blue Heron	*Ardea herodias*
Green Heron	*Butorides striatus*
Black-crowned Night Heron*	*Nycticorax nycticorax*
Sandhill Crane[+]	*Grus canadensis*
Killdeer	*Charadrius vociferous*
Red-tailed Hawk	*Bueto jamaicensis*
Mourning Dove	*Falco sparverius*
Belted Kingfisher	*Megaceryle alcyon*
Common Flicker	*Colaptes auratus*
Barn Swallow	*Hirundo rustica*
Tree Swallow	*Iridoprocne bicolor*
Rough-wing Swallow	*Stelgidopteryx ruficollis*
Blue Jay	*Cyanocitta cristata*
Catbird	*Dumetella carolinensis*
Cedar Waxwing	*Bombycilla cedrorum*
Yellow Warbler	*Dendroica petechia*
Common Yellowthroat	*Geothlypis trichas*
Red-winged Blackbird	*Agelaius phoeniceus*
Common Grackle	*Quiscalus quiscula*
House Sparrow	*Passer domesticus*
Northern Cardinal	*Cardinalis cardinalis*
American Goldfinch	*Carduelis tristis*
Chipping Sparrow	*Spizella passerina*
Mammals	
Beaver	*Castor canadensis*
Muskrat	*Ondatra zibethicus*

[+]Threatened in Illinois
*Endangered in Illinois

Table 6. Wildlife species observed at Summerhill Estates Lake, April-September 2004 (cont'd).

Amphibians	
Bull Frog	*Rana catesbeiana*
Reptiles	
Painted Turtle	*Chrysemys picta*
Snapping Turtle	*Chelydra serpentina*

+Threatened in Illinois
*Endangered in Illinois

EXISTING LAKE QUALITY PROBLEMS

- *Lack of a Quality Bathymetric Map*

  A bathymetric (depth contour) map is an essential tool in effective lake management, especially if the long term lake management plan includes intensive treatments, such as fish stocking, dredging, chemical application or alum application. No bathymetric map currently exists for Summerhill Estates Lake. Morphometric data obtained in the creation of a bathymetric map is necessary for calculation of equations for correct application of many types of lake management techniques.

- *Lack of Participation in the Volunteer Lake Monitoring Program (VLMP)*

  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 establishment of a VLMP on Summerhill Estates Lake would provide valuable historical data and enable lake managers to create baseline information and then track the improvement or decline of lake water quality over time.

- *High Nutrient Levels*

  Mild algae blooms occurred on Summerhill Estates Lake throughout the summer, but did not dominate the lake due to a high density of aquatic plants. The blooms largely consisted of planktonic algae and were caused by high phosphorus concentrations. According to local homeowners, the blooms are typically much worse in July and August after curly leaf pondweed plants have died off. The lack of severe algae blooms in 2004 may have been the result of a much cooler, drier summer. It was determined that phosphorus is primarily originating from internal sources (sediment resuspension and decomposition of plant material). The presence of organic detritus and algae led to a decrease in water clarity and an increase in TSS over the course of the summer. Since decomposition of a large density of plant matter is the primary source of TP and SRP to Summerhill Estates Lake, it is recommended that management of specific plant species be addressed in order to potentially remove this plant material from the lake.

- *Excessive Aquatic Vegetation*

  One key to a healthy lake is a healthy aquatic plant community. Summerhill Estates Lake is plagued by nuisance densities of several plant species. Curly leaf pondweed dominated the plant community in May and June, while coontail, duckweed and watermeal dominated throughout the remainder of the summer. Although these plant species are providing benefits to the lake by competing with algae and stabilizing lake sediment, high TP and TSS levels and low Secchi depths occur when they begin to decompose. They may also be negatively impacting the fish community.

- *Invasive Shoreline Plant Species*

  Numerous exotic plant species have been introduced into our local ecosystems. Some of these plants are aggressive, quickly out-competing native vegetation and flourishing in an environment where few natural predators exist. The outcome is a loss of plant and animal diversity. 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 and purple loosestrife are typically found along wetland areas and can quickly dominate all other plant species. Buckthorn, purple loosestrife and reed canary grass (along with several other exotic species) are probably present along 87% of the Summerhill Estates Lake shoreline, and attempts should be made to control their spread.

POTENTIAL OBJECTIVES FOR THE SUMMERHILL ESTATES LAKE MANAGEMENT PLAN

I. Create a Bathymetric Map, Including a Morphometric Table
II. Participate in the Volunteer Lake Monitoring Program
III. Establish Aquatic Plant Management Techniques
IV. Eliminate or Control Invasive Species

Objective I: Create a Bathymetric Map, Including a Morphometric Table

A bathymetric (depth contour) map is an essential tool in effective lake management since it provides information on the morphometric features of the lake, such as depth, surface area, volume, etc. The knowledge of this morphometric information would be necessary if lake management treatments such as herbicide application, fish stocking, dredging, alum application or aeration were part of the overall lake management plan. Summerhill Estates Lake does not currently have a bathymetric map. Maps can be created by the Lake County Health Department – Lake Management Unit or other agencies for costs that vary 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:

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> Chicago, IL 60606
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Objective III: Establish Aquatic Plant Management Techniques

All aquatic plant management techniques have both positive and negative characteristics. If used properly, they can all be beneficial to a lake's well being. If misused or abused, they all share similar outcomes - negative impacts to the lake. Putting together a good aquatic plant management plan should not be rushed. Plans should consist of a realistic set of goals well thought out before implementation. The plan should be based on the management goals of the lake and involve usage issues, habitat maintenance/restoration, and limitations of the lake. For an aquatic plant management plan to achieve long term success, follow up is critical. A good aquatic plant management plan considers both the short and long-term needs of the lake. The management of the lake's vegetation does not end once the nuisance vegetation has been reduced/eliminated. It is critical to continually monitor problematic areas for regrowth and remove as necessary. An association or property owner should not always expect immediate results. A quick fix of the vegetation problems may not always be in the best interest of the lake. Sometimes the best solutions take several seasons to properly solve the problem. The management options covered below are commonly used techniques that are coming into wider acceptance and have been used in Lake County. There are other plant management options that are not covered below as they not are very effective, 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 (which dominated in May and June) and elodea, will be bound by physical factors such as substrate type and light availability. Plants such as curly leaf pondweed and coontail, (present in Summerhill Estates Lake) grow to cover 100% of the water's surface. This causes 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 maintenance of in water clarity. Turbidity could decrease and clarity remain high due to sediment stabilization by the plant’s roots. Algal blooms could be reduced due to decreased resource availability and sediment stabilization. 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 may 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 the to lack of quality forage fish habitat and reduced predation. Predation will decrease due to the difficulty of finding prey in the dense stands of vegetation. This will cause an explosion in the small fish population and with food resources not increasing, growth of fish will be reduced. Decreased dissolved oxygen levels, resulting from high biological oxygen demand from the excessive vegetation, will also have negative impacts on the aquatic life. Wildlife populations may be negatively impacted by these dense stands of vegetation. Waterfowl may have difficulty finding quality plants for food or 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 curly leaf pondweed plants die back in July and when other plant species 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.

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 60^0F. This is the time of year when the plants are most actively growing and before seed/vegetative propagule formation. Follow-up applications should be done as needed. When choosing an aquatic herbicide it is important to know what plants are present, which ones are problematic, which plants are beneficial, and how a particular herbicide will act upon these plants. The herbicide label is very important and should always be read before use. 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.

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 compete with algae for resources, can directly contribute to an increase in blooms.

After the initial removal, there is a possibility for regrowth of vegetation. Upon regrowth, weedy plants such as Eurasian watermilfoil and coontail quickly reestablish, form dense stands, and prevent the growth of desirable species. This causes a decrease in plant 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.

Costs
Since curly leaf pondweed, coontail, and several other plant species appear to be providing some sediment stabilization and competing with algae for resources, it would not be desirable to remove all the plants from the lake. Therefore, spot treatments of Aquathol K® would be effective in the spring to treat curly leaf pondweed. However, if treatment is too late, Small and Flatstem pondweeds will also be impacted. Aquathol K® is a contact herbicide that affects only the plants with which it comes into contact and will cause rapid plant death and dieback within about a week. It is very short-lived in the environment and provides short-term control. However, since curly leaf pondweed does not persist through the summer, it is an effective herbicide in controlling curly leaf pondweed density early, possibly without the need for multiple treatments later in the summer. The early treatment of curly leaf pondweed will be beneficial in two ways: It will reduce the amount of plant material decomposing and releasing phosphorus into the water column and it will reduce the number of turions formed. Turions are

structures released from the curly leaf pondweed plants that sink to the lake sediment, overwinter, and give rise to new plants in the spring. If the plants are consistently removed before turions are given the chance to form during the early summer, the density of curly leaf pondweed can eventually be reduced. For spot treatment of coontail, 2,4-D is a very effective systemic herbicide that is biologically dicot specific. This is very advantageous in aquatic plant management where coontail is a dicot and many of the more beneficial plants are monocots. 2,4-D is available in liquid or granular form and is taken up very quickly by the plant. The granular form reduces drift of the chemical to off-target areas. Currently, approximately 100% of the lake is covered with nuisance plants in the spring and somewhat less as the summer continues. The LMU recommends that 30-40% of the lake remain vegetated in order to provide fish habitat and sediment stabilization. Private homeowners on Summerhill Estates Lake can treat approximately 20 acres along the southwest shore of the lake. At a cost of $150-173/gallon and a recommended rate of 1-2 gallons/acre foot (AF) for Aquathol K®, herbicide treatment of curly leaf pondweed would cost $9,000-$20,800. At a rate of $350-$425/surface acre (SA), treatment of 2,4-D would cost $7,000-$8,500 depending on the size of the treatment area and type of chemical form used.

Objective IV: Eliminate or Control Invasive Species

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

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 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.

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

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

Pros

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

<u>Option 3: Herbicide Treatment</u>
Chemical treatments can be effective at controlling exotic plant species. However, chemical treatment works best on individual plants or small areas already infested with the plant. In some areas where individual spot treatments are prohibitive or 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® or Round-up™), cost approximately $100 and $65 per gallon, respectively. Only Rodeo® is approved for water use. A Hydrohatchet®, a hatchet that injects herbicide through the bark, is about $300.00. Another injecting device, E-Z Ject® is $450.00. Hand-held and backpack sprayers costs from $25-$45 and $80-150, respectively. Wicking devices are $30-40.