

Part 2

Feasibility Study of Kinkaid Lake

Murphysboro, Jackson County, Illinois

INTRODUCTION

Pursuant to the information collected and the conclusions derived from the Diagnostic Study (Part 1) of this report, a Feasibility Study was undertaken to investigate potential alternatives for restoring the water quality and enhancing the recreational and aesthetic qualities of Kinkaid Lake. A management plan was also developed for consideration as a Phase 2 Clean Lakes Program implementation project. The Illinois EPA funded 60 percent of the study under the Illinois Clean Lakes Program (ICLP), with the remaining 40 percent funding contributed by the Kinkaid-Reed's Creek Conservancy District (KRCCD). The Illinois Environmental Protection Agency was also responsible for grant administration and program management. Cochran & Wilken, Inc. completed the Feasibility Study, with assistance from the Illinois Department of Natural Resources, and the Illinois Environmental Protection Agency.

A. Identification of Water Quality and Use Impairment Problems

The following discussion is a summary of the water quality and use impairment problems in Kinkaid Lake that were identified in the diagnostic section of this report.

1. Sedimentation and Shallow Water Depths

The most recent lake sedimentation survey, which was conducted by Cochran & Wilken, Inc. in 2002 and 2003, revealed that approximately 719 acre-feet (1,160,025 cubic yards) of accumulated sediment had been deposited in the select areas of the lake that had been surveyed. For the areas surveyed, this represents a total water storage capacity or volume loss of approximately 51.4 percent from the original capacity in 1970. Most of the accumulated sediment is in the upper end of the lake near the Route 151 bridge area (sub-areas A through D). Approximately 596 acre-feet (961,366 cubic yards) of sediment have accumulated and contributed to shallow water conditions ranging from essentially dry land to 10 feet in depth. Other shallow areas surveyed within the lake included Sharp Rock Falls, Hidden Neck, Cochran Bay, Harris Bay, Levan Bay, Raymond Neck, Graff Bay, Raymond Bay, and Imhoff Neck. Collectively, these sub-areas (sub-areas E through M) were found to have approximately 123 acre-feet (198,659 cubic yards) of sediment deposition.

The accumulated sediments, which are high in organic content and nutrient rich from watershed influxes as well as the deposition of dead and decaying algal and macrophyte material, create a loosely compacted substrate over the bottom of the lake. This loose bottom sediment can be resuspended by bottom feeding fish, high wind conditions, boat turbulence, and storm flows. As a result of this sediment-induced turbidity, the water quality in Kinkaid Lake can be impacted by elevated suspended solids levels and decreased water transparencies. Removal of these excessive accumulated sediments, particularly in the shallow upper end of the lake, would provide improved fish spawning habitat by restoring more desirable bottom conditions, and would provide improved trapping capability for suspended solids and nutrients entering the lake. Figure 24 in Part 1 provides an aerial photograph that illustrates the locations

of the sedimentation survey transects and lake segments that were completed in 2002-03 by Cochran & Wilken, Inc.

2. Turbid Water

As noted previously in the Diagnostic Study portion of this report, turbidity or murkiness is affected primarily by the presence of suspended solids such as soil particles, resuspended bottom sediments, and both living and dead plant/animal matter. During the lake's primary recreational use period from April through September, water clarity, as measured by Secchi disk transparency, averaged 58.9-inches at Site 1, 45.6-inches at Site 2, and 37.3-inches at Site 3 in 2003. These Secchi transparencies were less than their historical averages, which averaged 75.6-inches at Site 1, 51.3-inches at Site 2, and 38.5-inches at Site 3 in 1985 and 1994. The aesthetics of the lake are reduced by the brown, green and/or murky water appearance. Increased turbidity can also inhibit the growth of aquatic vegetation by limiting light penetration into the water column. The macrophyte survey indicated that the population of rooted, aquatic vegetation was sparse and/or degraded.

The factors that have contributed to the turbidity of Kinkaid Lake's water include excessive phytoplankton (i.e., blue-green algae) growth, a degraded macrophyte community, watershed runoff, and shoreline erosion. Analyses of phytoplankton during the year of baseline monitoring indicated high counts of algae in the water column. Among the three monitoring sites (i.e., Site 1, Site 4, and Site 9), the average standing crops ranged from a low of 14,903 to 29,539 algal units per milliliter, and the predominant algae present was the nuisance, blue-green species (particularly *Gomphosphaeria lacustris* and *Anacystis montana*). During the months of June and July, blue-green algae accounted for 77.4 to 98.7 percent of the total algal population for all sample sites, thus exhibiting clear species dominance. The blue-greens are considered especially undesirable with regards to aesthetics because of their tendency to form as scum and mats, and are not a desirable food source for aquatic species.

Watershed runoff has invariably contributed a significant portion of the sediment and nutrient (phosphorus and nitrogen) loadings to the lake. Shoreline erosion has also

contributed suspended sediment loadings to the lake, which has increased the amount of turbidity and degraded water quality. Fine grained particles (i.e., silt and clay) can remain suspended in the water column for extended periods of time, and resuspended sediments may also release nutrients into the water column, thereby contributing to increased algal growth. Sediment resuspension and turbidity resulting from wind and wave action in shallow, near-shore areas was evident and has reduced the aesthetic quality of Kinkaid Lake.

3. Shoreline Erosion

In 2002-03, a field survey was conducted by Cochran & Wilken, Inc. to evaluate the extent of shoreline erosion that has occurred in order to determine the extent of its contribution to lake water degradation. Shoreline erosion impairs lake usage and access by increasing turbidity, decreasing storage capacity, and/or damaging valuable lakeshore property. The loss of shoreline soils may also jeopardize the stability of infrastructure such as bridges, roads, docks, etc.

As discussed in Part 1, the survey was completed using the three-category classification scheme developed by Illinois EPA. The methodologies used during the survey rated erosion severity by vertical measurements of the eroded zones. An estimate was made to determine the horizontal length of each eroded zone and a vertical measurement was recorded and applied to the following criteria: a bank height of 1.0 to 3.0 feet was classified as slight; greater than 3.0 feet and less than 8.0 feet was classified as moderate; and greater than 8 feet was classified as severe.

It was determined that approximately 65,309.8 meters (214,271 ft.) of shoreline has experienced some degree of erosion. The extent of the erosion varied from slight to severe, and has occurred along shorelines throughout the lake. However, the severe erosion in areas with high, vertical banks has occurred primarily within the main body (i.e., east-central section) of the lake, where the longest fetch distances and highest waves occur. Approximately 4,517.7 meters (14,822 ft.) of shoreline was found to have severe erosion, 25,032.6 meters (82,128 ft.) exhibited moderate erosion and 35,759.4 meters (117,321 ft.) of shoreline was found to have slight erosion. According to the

shoreline survey, approximately 49.46% of the 132.06 km (82.06 miles) shoreline was unprotected and has been negatively impacted by wind and wave erosion. In addition to contributing sediment and turbidity to the lake, uncontrolled shoreline erosion has reduced valuable shoreline property and has impacted aesthetic appeal.

Shoreline erosion can be caused by wind and wave action, pedestrian traffic, water level drawdown, and a lack of near-shore vegetation. The general absence of near-shore vegetation or offshore rocks allows wind induced wave energy to reach the unprotected soils. Since there are many areas with near vertical slopes in excess of 8 to 10 feet in height, the undercutting action of wind and boat waves can induce sudden, substantial slope failures to occur. Several shoreline areas were found to have lateral recession rates (LRR) as much as two-feet per year. There has been approximately 7,320.4 meters (24,017 ft.) of shoreline stabilization implemented with riprap in selected areas of the lake. Figures 25A and 25B in Part 1 contains the shoreline survey for Kinkaid Lake.

4. Unbalanced Aquatic Vegetation Growth

The plant community, which includes both macrophyte vegetation (plants visible and identifiable to the naked eye) and phytoplankton or algae, is an extremely important component of a balanced lake ecosystem. Algae are plants that are typically microscopic and are either free-floating or attached. Although individual algae are microscopic in size, they are often visible when large numbers are present due to their green or blue-green color. The free-floating algae or phytoplankton are most commonly found in eutrophic reservoirs such as Kinkaid Lake. Algae can provide food for aquatic insects, zooplankton and fish, and can also provide oxygen, which is beneficial to all organisms. However, an overabundance of phytoplankton can result in adverse effects such as: shading out and limiting the growth of submersed macrophytes; algal blooms and surface scums that detract from lake aesthetics; night time respiration and/or rapid algal die-offs that can deplete dissolved oxygen levels and severely stress the fish population.

Algal growth is stimulated by high concentrations of nutrients (i.e., phosphorus and nitrogen) in the water column. Measurements of phosphorus and inorganic nitrogen obtained during the baseline-monitoring year did not fall below the levels shown to contribute to nuisance algal growth, such as 0.01 mg/l for inorganic phosphorus and 0.30 mg/l for inorganic nitrogen (Sawyer, 1952), which suggests that algal blooms may be problematic within Kinkaid Lake. As the Phase 1 data suggests and as mentioned, the algal population was excessive during the 2003-04 Phase 1 monitoring year, reaching bloom conditions throughout the summer. When bloom conditions occur, the increased turbidity reduces light penetration and can adversely impact macrophyte growth.

The sources of Kinkaid Lake's high in-lake nutrient concentrations include shoreline erosion and inflows from watershed runoff, internal regeneration, and atmospheric deposition. The phosphorus and nitrogen nutrient budgets that were developed from data obtained during the 2003-04 monitoring year indicate that watershed runoff and shoreline erosion provided nearly all of the phosphorus and nitrogen influx to the lake. Internal regeneration was estimated to have contributed a very small percentage of the total phosphorus and nitrogen influx. This was primarily due to the periodic circulation or mixed conditions that result from high flow conditions within the primarily riverine reservoir system. This flow induced lake aeration and circulation may limit the release of nutrients from the bottom sediment as a result of anoxic conditions during the summer stratification period.

Turbidity (i.e., low water transparencies) along with steep-sloping littoral zones are the primary reason for the sparse and limited aquatic macrophyte population densities within Kinkaid Lake. The sporadic plant populations were generally found to be contained within shallow areas (littoral zones) with water depths of 6 feet or less. As mentioned, the bathymetry of the lake is another basis for the limited occurrences of plant populations, as the plants encountered were generally found to be close to shore as the littoral zones drop off quickly into deeper waters.

While various species were encountered in the littoral zones of the lake, two species were found to be most abundant in the plant survey: water willow (*Decodon verticillatus*) and Eurasian water milfoil (*Myriophyllum spicatum*). The former species is

native and is beneficial to lakes; whereas, the latter species is an invasive, exotic aquatic plant that is generally detrimental to lakes, as it is able to out compete other plant species.

Eurasian water milfoil (EWM) is generally considered to be an extreme nuisance species because of its prolific rate of growth and horizontal spread. Once this species invades an aquatic habitat, it frequently dominates the vegetative community and suppresses or even eliminates the growth of most native species. This reduction in plant species diversity tends to impact the diversity of other aquatic biota within the lake system. Since the majority of the EWM's plant biomass is found at or near the water surface, it can be extremely disruptive to aesthetics and recreational activities such as motor boating, sailing, fishing, and swimming. This species has the ability to sprout a new plant from tiny fragments, which accelerates the rate at which the plant can spread throughout a lake. EWM plants that have been broken apart by watercraft and other recreational activities can drift or be transported to other parts of a lake where they can develop roots and establish a new colony.

While EWM is generally considered to be a noxious, invasive plant species, within Kinkaid Lake it is generally found to be beneficial as the aquatic plant populations are stunted by algal dominance, turbid water conditions, and lack of extensive littoral zones. Benefits of EWM and other aquatic plants in Kinkaid Lake include food, protective cover and spawning areas for fish, waterfowl, insects and some mammals; oxygen production and bottom stabilization; shoreline protection through wave dissipation; and interception of suspended particles in the water column. However, there are portions of Kinkaid Lake, especially near the Marina, where EWM has become overgrown and is considered to be a nuisance to public lake access and various recreational activities.

5. Improve Fishery and Aquatic Community

Kinkaid Lake is considered to have a reasonably good fishery. Ongoing fisheries management efforts have included a regular supplemental stocking program and the enforcement of sport fishing regulations with an emphasis on catch and release, length

restrictions, creel limits, and other fishing methods. Historically, Illinois Department of Natural Resources (IL DNR) has stocked the following species into the lake: muskellunge, walleye, channel catfish, largemouth bass, and threadfin shad.

Recent population and creel census surveys indicate that most of the management objectives are being met. While the fish population in Kinkaid Lake appears to be generally acceptable as a result of fish management efforts and a successful catch and release program, degraded water quality conditions (i.e., turbidity), and a lack of suitable aquatic habitat (i.e., accumulated silt in the upper end of the lake) has stressed the existing fish population. With improvements to water quality, clarity and habitat, Kinkaid Lake can achieve and maintain an improved and stable fish population.

B. OBJECTIVES OF THE LAKE MANAGEMENT PLAN

The goal of the lake management plan for Kinkaid Lake is to address the problems identified in the previous section, to protect and enhance existing lake uses, to increase recreational access and opportunities, and to improve the overall water quality. The lake management plan objectives that have been determined are shown as follows:

Comprehensive Lake Water Quality Objectives

1. Reduce the amount of sediment being delivered to the lake.
2. Remove accumulated sediment that has caused shallow water depths in the upper end and select bays of the lake.
3. Improve water quality for aesthetics and to support a more balanced aquatic plant community.
4. Stabilize and protect eroded shoreline areas.
5. Control Eurasian water milfoil in select areas to improve lake access and recreational opportunities
6. Improve fisheries population and habitat.

The following recreational use improvements will be achieved by addressing the comprehensive water quality objectives listed above.

1. Preserve and enhance existing lake uses for public water supply, fishing, swimming, boating, and aesthetics.
2. Increase local interest by increasing water clarity and improving water quality.
3. Increase the areas available for recreational uses by maintaining and/or increasing the depth in the upper reaches of the lake.
4. Increase the populations and growth of game fish in the lake by improved habitat, combined with continued stocking and fisheries management program.

C. Alternatives for Achieving the Lake Management Plan Objectives

Each of the lake management plan objectives listed above has several alternative approaches or solutions that have been considered. These restoration and protection alternatives are described below with a summary of which would be most feasible for Kinkaid Lake. For most of the objectives, there are one or more restoration alternatives that clearly stand out relative to cost, benefits, and feasibility. Although taking no action whatsoever is also an alternative, the long-term cost of no action is often too high. Delaying any necessary actions could lead to much more expensive projects at a later date as a result of continued degradation and lake eutrophication.

Objective #1: Reduce the amount of sediment and nutrients being delivered to the lake.

Alternative Actions

The Kinkaid Lake watershed is largely comprised of undeveloped, heavily wooded areas with some row crop, pasture, and haylands. The KRCCD and the Jackson County Natural Resource Conservation Service (NRCS) have estimated that

the average slope within the watershed is approximately 10 percent. Table 28 illustrates the varying land slopes within the Kinkaid Lake watershed. The predominately steep slopes within the Kinkaid Lake watershed makes most of the soil susceptible to erosion, especially those soils found in gullies and along stream banks.

Table 28 – Land Slopes within Kinkaid Lake Watershed

Slope Description	Acres	Percent
0 to 5% Slope	12,847	33%
6 to 10% Slope	7,923	21%
11 to 15% Slope	5,656	15%
>15% Slope	12,109	31%
Total	38,535	100%

Source: KRCCD and USDA Jackson Co. NRCS

The Jackson County Soil and Water Conservation District and the USDA-Natural Resources Conservation Service office located in Murphysboro has worked very closely with agricultural producers in the Kinkaid Lake watershed to promote no-till and conservation tillage practices. Agricultural producers make up approximately 38.6 percent of the total land use (grassland at 26.9 percent and cropland at 11.7 percent) within the total watershed. A review of the management efforts through the NRCS and Jackson County Soil and Water Conservation District indicate that the following work had been completed within the Kinkaid Lake watershed through the year 2000 and that ongoing efforts are continuing:

Land Use Conversion (cropland to pasture and hayland)	1,158 acres
Water and Sediment Control Basins and Dry Dams	52 acres
Drop Boxes, Aluminum Weirs, and Block Chutes	11 structures
Terraces	24,430 linear feet
Grassed Waterways	34 acres
Wet Detention Ponds	24 each
Cropland to Conservation Reserve Program	2,200 acres

When implemented in conjunction with conservation tillage, agricultural Best Management Practices (BMP's) (i.e., filter strips, grassed waterways gully stabilization, and sedimentation basins) have been found to be very effective at reducing sediment yield to waterways.

Filter strips are typically a strip of native grasses, trees and/or shrubs that border a stream. They act to slow water flow and allow contaminants like sediment, fertilizers, and pesticides to collect in the vegetated buffer zone. The trapped nutrients are utilized by the vegetation, and cleaner filtered water is allowed to enter the stream and lake. According to the "Lake and Reservoir Restoration Guidance Manual" (USEPA, 1990), properly installed and maintained filter strips or stream side buffer zones are capable of filtering or trapping from 67 to 84 percent of sediment and nutrients from sheet runoff on 4 percent slopes. The NRCS has found that the optimum width for most installations is approximately 66 feet on both sides of the stream.

Grassed waterways can be very effective at preventing gully erosion. They force storm water runoff to flow down the center of an established grass strip while minimizing soil erosion during the process. Besides preventing gully erosion, grass waterways can be effective filters that trap sediment and nutrients. However, they can lose their effectiveness if too much sediment builds up in the waterway. In order to maintain maximum effectiveness, they should be implemented with other practices such as conservation tillage, filter strips, etc.

In addition to the watershed BMP's described above, another alternatives that can be considered for trapping sediment and nutrients are gully stabilization and sedimentation basins that allows storm runoff to be retained and settle out before reaching the main body of the lake. These impoundments are typically constructed with an earthen and/or rock dam that allows excess water to flow over a spillway and then gradually release impounded water through a slotted drop inlet structure with an overflow weir and a debris screen to prevent clogging. In addition to a major sediment and nutrient retention basin constructed on a main tributary or across a narrow section of the upper end of the lake, many smaller gully stabilization projects and sedimentation basins could be constructed across smaller tributaries located further upstream of the lake.

Proposed Actions

The Natural Resources Conservation Service (NRCS) and the Soil and Water Conservation District in Jackson County will continue to work with local land and property owners within the Kinkaid Lake watershed to develop the following best management practices (BMP's): terraces, conservation tillage, vegetated buffer strips, water and sediment control basins, grass waterways. In addition to BMP's, public education programs will also be included, as they are a vital component in connecting with landowners and farm operators to increase public awareness of resource management systems that improve water quality and reduce soil erosion within the watershed. The education and technical assistance will primarily be targeted to watershed residents who have soil, water, plant and resource problems that require assistance. These efforts will include educational and informational material, public meetings, demonstration plots, tours, and site visits.

In March 2005, a grant application for funding from the Illinois EPA's Non-Point Source Pollution Control, Section 319(h) Program was submitted by the KRCCD (see Appendix F). The pending 319-application for the Kinkaid Lake watershed proposed various projects that included three sediment and nutrient control ponds (ranging in size from 2 to 11 acres), 900 linear feet of gully stabilization, 3,000 linear feet of shoreline stabilization, and a public information and education program. The total proposed cost for the projects included in the pending 319-application was \$530,089, with project resources being provided by Federal funding (60%) and State/local funding (40%). State and local matching funding were to be supplied by several sources that included the KRCCD, the Kinkaid Area Watershed Project, Southern Illinois University and KRCCD, Illinois DNR Conservation 2000, and the NRCS for Engineering.

Figure 30 illustrates the proposed locations of the three sediment and nutrient control ponds and the gully stabilization projects from the pending 319-grant application. The proposed watershed projects included in the submitted 319-application were estimated to collectively reduce lake sediment loading by 2,048 tons/year (4,096,000 lbs./year) and lake phosphorus loading by 2,205 lbs./year. Additional sediment and phosphorus loadings reductions to Kinkaid Lake could be achieved, if other lake and

watershed projects (identified within this Report) were to be implemented and completed. However, implementation of future restoration projects and the subsequent level of future sediment and phosphorus loading reductions will depend on the availability of future funding from Federal and State/local sources.

In addition to the pending 319-grant application, other areas within the Kinkaid Lake watershed were identified as having significant gully and tributary stream bank erosion. In a report completed by NRCS (Windhorn, 2000), approximately 36% (approximately 28,200 tons/year) of the sediment entering the lake was a result of significant and extensive gully erosion that is occurring within the watershed. Although numerous potential gully and tributary stream stabilization projects were identified within the upper Kinkaid Lake watershed, it has been determined that many of these eroded areas are located on private lands, which can present significant obstacles in acquiring land access easements and subsequent restoration project implementation. Therefore, four (4) gully and tributary stabilization sites are proposed that are located on public land either owned by the US Forest Service or the IL DNR (Table 29 and Figure 31). The proposed gully and tributary stabilization practices may include, but are not limited to, utilizing vertical posts, horizontal weir boards supported by driven vertical posts, riprap, boundary weirs, check dams, and grade stabilization structures constructed of rock (i.e., riprap) and/or other natural material such as logs. Table 30 provides opinions of probable cost for gully stabilization in the upper portion of the Kinkaid Lake watershed.

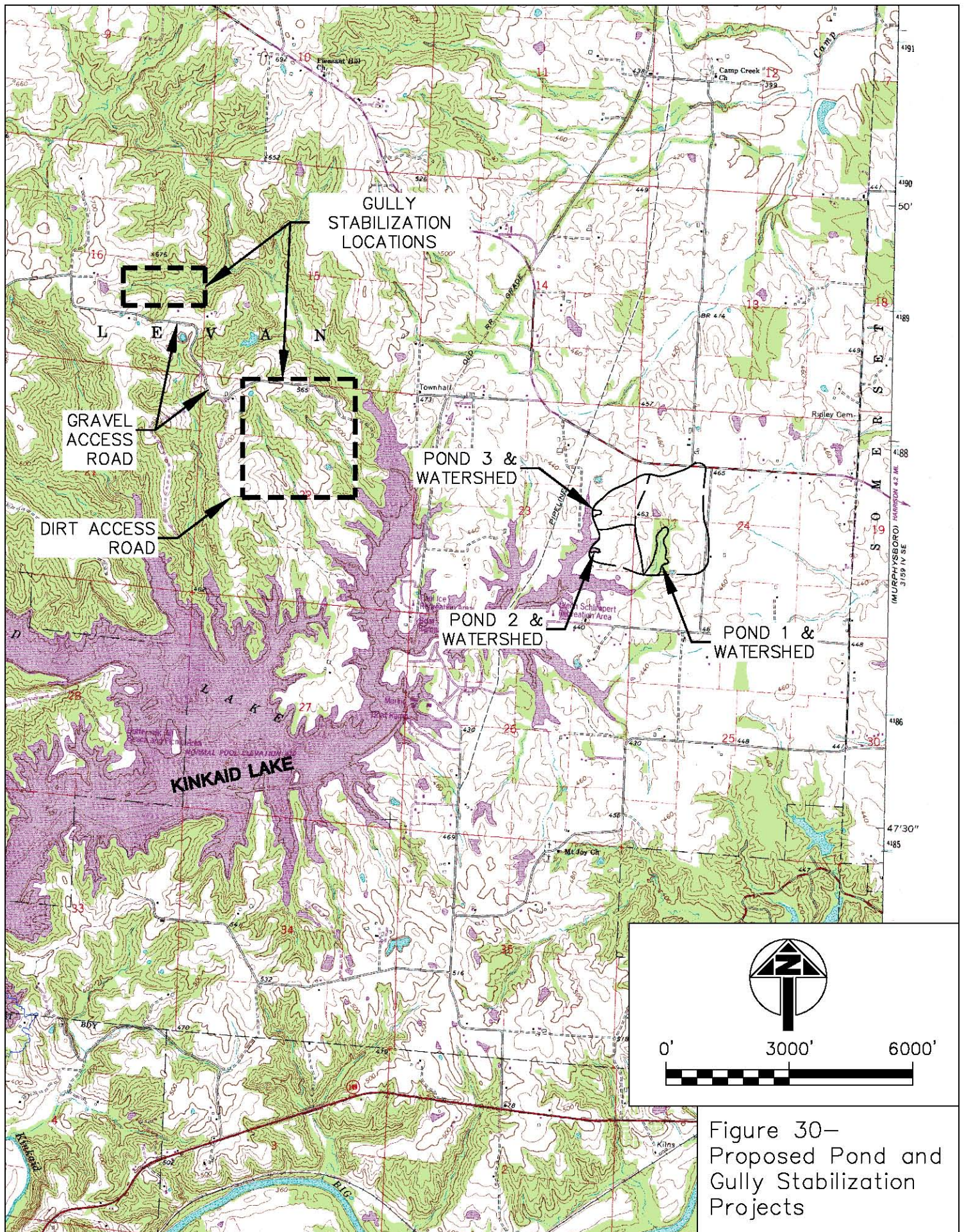


Figure 30—
Proposed Pond and
Gully Stabilization
Projects

Table 29 – Locations of Proposed Gully and Streambank Stabilization Sites

Site	Location	Length (LF)	Ownership
Site 1	T 8S, R 4W, NE 1/4 of Section 9	2,100 LF	USFS
Site 2	T 8S, R 4W, SW 1/4 of Section 3	2,550 LF	IL DNR
Site 3	T 8S, R 4W, NW 1/4 of Section 22	2,000 LF	USFS
Site 4	T 8S, R 4W, NE 1/4 of Section 14	2,100 LF	USFS

Table 30 – Estimated Gully and Streambank Stabilization Costs

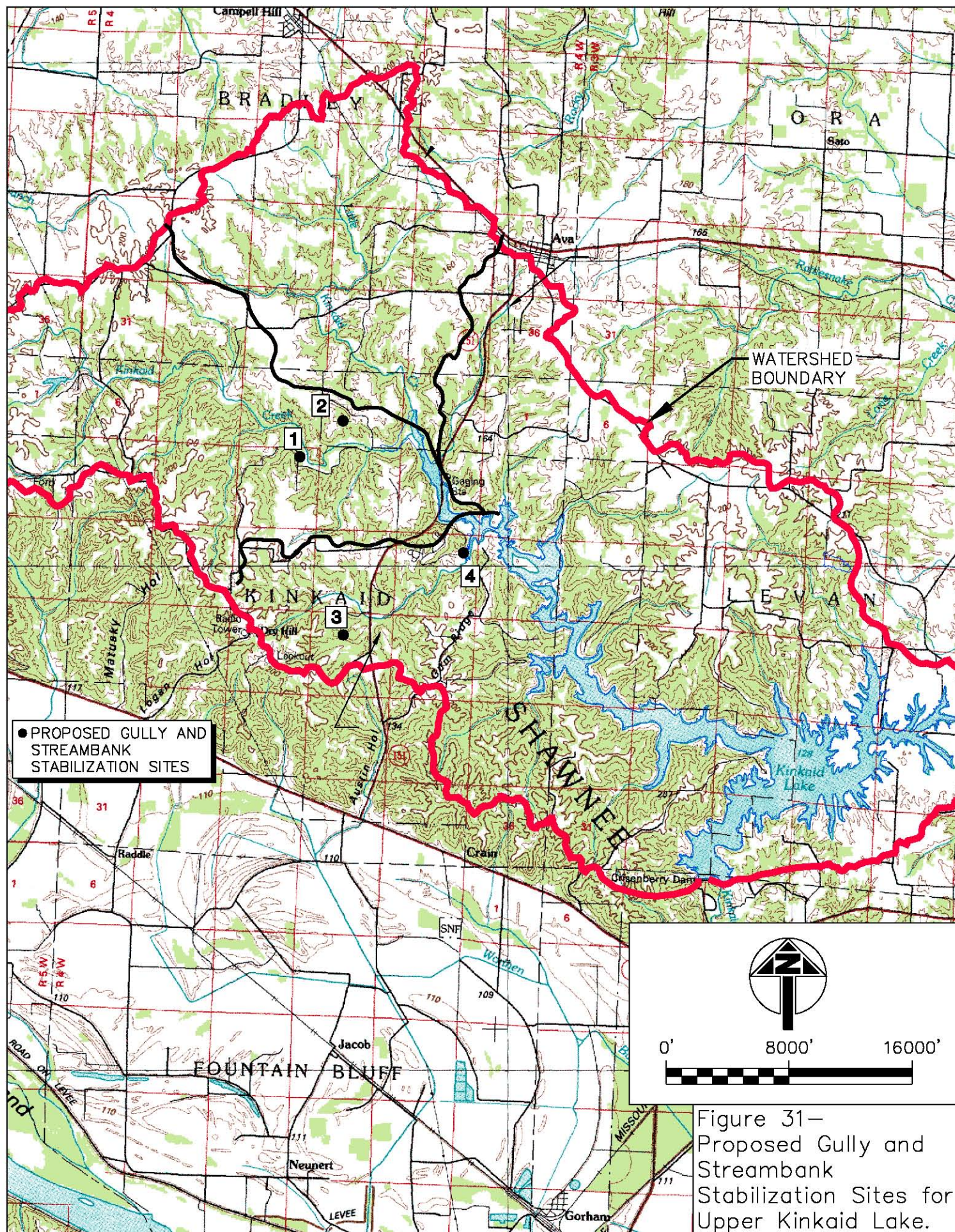
Item	Lineal Feet	Cost/LF	Cost
Gully/Streambank Stabilization	8,750	\$27.50	\$240,625
Total Estimated Gully & Streambank Stabilization Cost			\$240,625
Estimating Contingency (5%)			\$12,031
Engineering Design and Permitting (10%)			\$24,063
Total Costs includes contingency, engineering, and permitting (15%)			\$276,719

In addition to the continued implementation of watershed best management practices (BMP's) and conservation practices, along with selective gully and streambank stabilization, a sediment and nutrient control basin is suggested. The proposed basin would be constructed upstream of the Route 151 bridge that would trap sediment and nutrients from Kinkaid Creek, Little Kinkaid Creek, and Spring Creek and would significantly reduce the amount of sediment and nutrients (particularly phosphorus) that is deposited into Kinkaid Lake. Pending confirmation of the feasibility of this project through further hydraulic and engineering design studies, a semi-circular shaped weir spillway could be constructed using steel sheet pile that would increase the original lake level upstream of the weir by approximately four feet, thus creating additional sediment storage. If the Route 151 sedimentation/nutrient control basin is not determined to be feasible, smaller individual basins could be constructed for Johnson Creek and the aforementioned creeks. Like the larger basin, the small basins would also require hydraulic and engineering design and analysis. Table 31 provides opinions of probable costs for sedimentation basins upstream of the Route 151 Bridge and individual sedimentation basins for Kinkaid Creek, Little Kinkaid Creek, Spring Creek,

and Johnson Creek. If sufficient funding becomes available, these smaller control basins could be constructed in addition to the Route 151 bridge control basin, in order to achieve maximum reduction of sediment and nutrients.

Table 31 – Estimated Sediment and Nutrient Control Basin Costs

Location	Costs	Amounts
Upstream of Route 151	Total Construction Costs	\$840,000
	15% Design & Construction Engineering Costs	\$105,000
	Total Estimate of Probable Cost	\$945,000
Kinkaid Creek	Total Construction Costs	\$497,237
	15% Design & Construction Engineering Costs	\$62,155
	Total Estimate of Probable Cost	\$559,392
Little Kinkaid Creek	Total Construction Costs	\$537,108
	15% Design & Construction Engineering Costs	\$67,139
	Total Estimate of Probable Cost	\$604,247
Johnson Creek	Total Construction Costs	\$549,204
	15% Design & Construction Engineering Costs	\$68,651
	Total Estimate of Probable Cost	\$617,855
Spring Creek	Total Construction Costs	\$293,364
	15% Design & Construction Engineering Costs	\$36,671
	Total Estimate of Probable Cost	\$330,035



Objective #2: *Remove accumulated sediment that has caused shallow water depths in the upper ends of the lake.*

Alternative Actions

The major alternatives for removing sediment accumulation in the upper end and various inlets of Kinkaid Lake include extended water level drawdown, mechanical dredging and hydraulic dredging. According to the 2002 and 2003 sedimentation surveys by Cochran & Wilken, Inc., approximately 1,160,025 cubic yards of sediment have been deposited in the surveyed area over the 35-year life of the lake, which suggests that approximately 33,144 cubic yards of sediment have been deposited on an average annual basis within these areas. This sediment volume includes areas upstream of the Route 151 bridge that have become terrestrial due to excessive sediment deposition above the normal water surface elevation of the lake and selected bays throughout the lake.

As a more cost effective alternative to removing the accumulated sediment from all of the surveyed areas, the prioritization of dredging areas is critical to reducing the total dredging volume. In addition to a reduction in the total dredging volume, implementation of dredging could be completed in phases. The most critical dredging locations include the downstream section of Area D, all of Area A and B (directly upstream of the Route 151 bridge), and a portion of Area C that includes shallow, impacted areas adjacent to the Johnson Creek Recreation Area and Boat Ramp. One additional location to include as the small bay at Area E (Sharp Rock Falls) in order to provide campground access. The total estimated sediment volume in these prioritized locations is 601,624 cubic yards. For estimating purposes, approximately 50 percent of Area D (upstream of the Route 151 bridge) and 25 percent of Area C (Johnson Creek) were included.

a. Lake Water Level Drawdown and Compaction

Lowering the water level and allowing the sediment to dry and consolidate is an alternative for restoring lost water depths in some lakes. However, this treatment alternative is generally a limited solution for excessive sediment deposits. In order to assure optimum drying and compaction, the water level would have to be substantially lowered for a sufficient period of time, longer than the current drawdown period. According to a study completed by Fox et al. (1977), approximately 170 days of exposure to drying conditions would produce a sediment consolidation ranging from 7 to 50 percent, with water losses ranging from 40 to 50 percent. It would be anticipated that the sediment found in the upper arms of Kinkaid Lake would fall in the median range, and would thus be expected to consolidate approximately 25 percent.

In order to effectively reduce sediment volume in the upper end of Kinkaid Lake, water levels would have to be lowered significantly, which is not possible at Kinkaid Lake. However, a drawdown extended well into the spring or even into the summer would be nearly impossible to implement because of the extremely large watershed drainage area. If it were possible, an extended drawdown may have many negative impacts to the aquatic community and would impact the recreational use of the lake.

b. Mechanical Dredging

There are several methods of mechanical dredging or excavation presently available. The lake can either be dredged at normal pool with a dragline, or the water level could be lowered enough to allow low ground pressure excavation equipment into the dry lakebed. There are several advantages to dry lakebed excavation as compared to hydraulic or dragline dredging, such as the elimination of excessive turbidity or resuspended solids, and a smaller quantity of material to remove due to consolidation and compaction. However, there are many disadvantages and problems that could be encountered. The length of time required for the sediment to dewater and consolidate sufficiently enough to support excavation equipment may take longer than expected if

frequent rainfall events occur. Although, this method could be accomplished for a limited dredging project at selected areas in the shallow upper ends of Kinkaid Lake; it is not a feasible option since the watershed drains an extremely large area and would likely cause flooding problems within the dredging area.

Another method of mechanical dredging could be accomplished with a dragline while the lake water level is at normal pool. This is accomplished by extending excavating equipment from shore, or by mounting the equipment on a barge. This method is more practical for smaller lakes or when a large quantity of rocks or debris is anticipated. Although, removal of accumulated lake sediment is inefficient and can leave high percentages of material behind, transportation and storage of the sediment is also very inefficient and labor intensive since it must be handled several times. Once the sediment is removed from the lake, it must be placed on a barge or a truck and transported to the storage area. This repeated handling is generally not cost effective, and can result in sediment losses during transfer. Equipment access for the removal and placement of dredged sediment would also have a negative impact on the lake shoreline. Therefore, mechanical dredging with a dragline would not be considered as a feasible sediment removal method.

c. Hydraulic Dredging

Hydraulic dredging involves a centrifugal pump mounted on a pontoon or hull, which uses suction to pull the loose sediment off the bottom and pump it through a polyethylene pipeline to a sediment retention area. Generally, a cutterhead is added to the intake of the suction line in order to loosen the accumulated or native sediment for easy transport and discharge. A slurry of sediment and water, generally ranging between 10 and 15 percent solids (by weight), can be pumped for distances as much as 10,000 to 15,000 feet or more with the use of booster pump(s). The efficiently pumped sediment slurry must be discharged into a suitably constructed earthen dike-walled containment area with adequate storage capacity. The sediment containment or retention area must be properly designed to allow sufficient retention time for the

sediment particles to settle throughout the project, and allow the clear decant or effluent water to flow through the outlet structure back to the lake.

One of the advantages of hydraulic dredging is the efficiency of sediment handling. The removal, transport and deposition are performed in one operation, which minimizes expenses and potential sediment losses during transport. Another advantage is that the lake does not have to be drained, and most areas can remain open for public use. Most hydraulic dredges are considered portable and are easily moved from one site to another. They are extremely versatile and are capable of covering large areas of the lake by maneuvering with their spud anchorage system and moving the discharge pipeline when necessary.

Proposed Actions

The proposed alternative for removing accumulated sediment from the upper end and the select bays surveyed in Kinkaid Lake is by hydraulic dredging. This method would effectively remove approximately 601,624 cubic yards of sediment from lake segments A through E (see Table 14 and Figure 24 from Part 1). This quantity is based on strategically removing as much accumulated sediment from within these areas as possible in order to realistically maximize the restoration of water depths and storage capacity in critical areas of the reservoir. Table 32 provides the estimates of probable cost to hydraulically dredge approximately 601,624 cubic yards of sediment from the lake.

Table 32 – Estimated Sediment Removal Costs

Opinion of Probable Cost					
	Item	No. Units	Unit Measure	Cost per unit	Cost
1	Hydraulic Dredging	601,624	Cu. Yd.	\$4.00	\$2,406,496.00
	(incl. Confined Detention Facility; CDF)				
Subtotal Construction Costs					\$2,406,496
10% Construction/Change Order Contingency					\$240,650
15% Design/Construction Phase Engineering					<u>\$360,974</u>
Total Estimate of Probable Cost					\$3,008,120

Normally, a maximum dredge cut depth of 8 to 10 feet is considered to be a suitable depth at which to deepen a lake. This maximum cut depth down to the hard, original bottom provides navigational access, minimizes sediment resuspension and controls aquatic vegetation growth. A maximum dredge cut depth that includes removing the soft accumulated sediment down to the original hard bottom at Kinkaid Lake to a depth of at least 10 feet is recommend in order to provide additional storage volume in the upper end of the lake. This will extend the useful lifespan of the project and provide a long-term benefit to the lake.

Approximately 20 to 30 hectares (50 to 75 acres) of land would ideally be required for the retention and dewatering facility. The retention and dewatering site(s) ideally should be located within the watershed so that water from the dewatering site can drain into the lake. Further evaluation and analysis will be required to find a suitable detention site location. The dredged sediment can be beneficially reused as fertile agricultural soil and/or fill, thus maintaining the value of the land.

This sediment removal option would provide the most cost effective improvement in water quality and recreational benefits by removing most of the soft, accumulated sediment from the upper end of the lake and within select bays within the lake. The removal of nutrient rich sediment and detritus will also improve and expand aquatic habitat for fish, macro-invertebrates and other aquatic organisms.

Objective #3: Improve water quality for aesthetics and to support a more balanced aquatic plant community

Alternative Actions

There are several alternatives that can be considered for improving water quality in the lake, which would help to improve aesthetics and support a more balanced aquatic plant community. The aquatic plant community, which includes both algae and rooted macrophytes, has suffered due to high nutrient availability, decreased water clarity or Secchi depth, and limited littoral zones. The high nutrient availability, which is

primarily nitrogen and phosphorus, has provided ample stimulation for excessive algal growth. As a result of the increased algal turbidity and decreased water clarity, nuisance blue-green algae have become the dominant species by being able to out-compete other more desirable algae species. Many species of blue-greens have the ability to regulate buoyancy and therefore can elevate themselves to the optimum level of light transparency. In addition to this capability of buoyancy regulation, many blue-greens, have the ability to fix nitrogen when other available nitrogen source concentrations are limited. Nitrogen gas (N_2) is always dissolved in lake water since it constitutes about 78 percent of the atmospheric gases, but most true algae cannot use it to satisfy their nitrogen demands. Some Cyanophyta (blue-green algae) species can convert nitrogen gas into ammonia by a process called nitrogen fixation.

In addition to the unbalanced algae population, macrophyte vegetation density and diversity has become limited and sparse as a result of the increased algal turbidity that has prevented light from penetrating adequately into the water column and limited littoral zones that have steep slopes and “drop off” into deep water rather quickly.

The primary alternatives for improving water clarity and restoring a more balanced aquatic vegetation population include reducing nutrient availability, restructuring the algae population so that blue-greens are not dominant, and reducing the amount of suspended sediment entering the lake during significant storm events.

Nutrients such as nitrogen and phosphorus can be controlled and reduced in many ways such as: implementing watershed best management practices in the watershed (discussed in Objective #1); minimizing internal regeneration during the summer stratification period; minimizing wind resuspension in shallow, sparsely vegetated areas of the lake.

As discussed previously, external loading of nutrients from watershed sources can be reduced by implementing vegetated filter strips, grassed waterways, constructing nutrient and sediment retention basins, and implementing a nutrient management program.

Internal regeneration of nutrients has been estimated to be a minor component of the overall nutrient budget since summer stratification does not typically develop for extended periods due to the re-occurring natural mixing process, which occurs as a

result of nearly continuous movement of water that flows into the lake from a large drainage area and through the spillway. This near continuous flow pattern apparently mixes the water within deeper portions of the upstream areas of the reservoir and limits the internal release of nutrients by maintaining oxygenated conditions near the bottom.

Water clarity can also be improved by minimizing wind resuspension of sediment and nutrients in shallow water areas. This resuspension can be controlled or reduced by re-establishing a rooted aquatic macrophyte community and by removing soft accumulated sediment from the upper end of the lake. Sediment removal has been discussed thoroughly in a previous section.

Other potential alternatives for reducing nutrient concentrations are nutrient diversion, dilution and flushing, artificial circulation, discharge of hypolimnetic water, and phosphorus inactivation/precipitation. Due to the morphometric and hydrologic features of the lake, it would be technically unfeasible and expensive to undertake a diversion or flow routing system for the control of nutrients. Dilution and flushing has been shown to be effective at reducing the concentration of nutrients in the water column by adding “nutrient poor” water. Flushing reduces algal biomass by increasing the loss rate of cells. However, dilution and flushing are not considered acceptable alternatives for Kinkaid Lake due to the lack of suitable groundwater resources. Furthermore, hypolimnetic discharges are normally not a feasible solution because anoxic conditions normally occur during the summer thermal stratification period when water conservation is critical due to lack of precipitation and excessive water loss from evaporation.

Phosphorus inactivation and precipitation are techniques used to lower concentration of phosphorus in the water column by either precipitating it out or preventing its release from sediments. Aluminum sulfate or sodium aluminate is added to the lake surface in order to precipitate the phosphorus to the lake bottom. Additional aluminum sulfate is added to form a barrier to prevent phosphorus release from the sediment. This alternative is not considered to be feasible since the predominant source of phosphorus loading to the lake stems from the watershed, and dissolved phosphorus concentrations were extremely low in relation to total phosphorus.

Proposed Actions

There are several alternatives that should be implemented in order to improve water quality for aesthetics and to support a more balanced aquatic plant community. The first action is continued and increased soil conservation practices in the watershed that would reduce and minimize sediment delivery to the lake. Since much of the phosphorus entering the lake is bound to sediment, any action that involves controlling sediment delivery will also control phosphorus levels. There has been a considerable amount of work done in the watershed to control erosion and runoff, and this work should be continued in order to insure reduced nutrient levels. In addition, nutrient management practices should be followed throughout the watershed in order to minimize the amount of nitrate leaching. Since approximately 35 percent of the watershed is either in pasture or cropland, the proper management of fertilizer applications will gradually decrease the amount of nitrogen and phosphorus transported to the streams that enter the lake.

Third, the resuspension of soft sediment in the shallow water of the upper end of the lake has been previously addressed with recommendations for removal by dredging. Once nutrient concentrations are lowered and water clarity is improved, there should be a gradual re-establishment of a desirable diversity and growth of rooted macrophytes, which will also minimize sediment resuspension in shallow water. Stabilizing eroded shoreline areas will also help lower turbidity and is discussed in the following section.

Objective #4: Stabilize Eroded Shoreline Areas

The uncontrolled erosion of shoreline areas is another source of sediment and nutrient loading to the lake. As previously described, there are a number of factors that contribute to shoreline erosion at Kinkaid Lake including easily erodible shoreline soil types, fluctuating water levels, heavy visitor usage, lack of nearshore aquatic vegetation and/or rock breakers, and exposure to waves generated by strong winds.

Alternative Actions

Although there has been approximately 24,017 feet of riprap shoreline stabilization work completed at Kinkaid Lake, there is still a significant amount of eroded shoreline that is in need of stabilization (see Figures 25A and 25B in Part 1). Of the total amount of eroded shoreline, there are approximately 14,822 linear feet of severe erosion areas, 82,128 linear feet of moderate shoreline erosion, and 117,321 linear feet of slight shoreline erosion. The typical form of erosion observed at these locations was an exposed and undercut bank that gradually allows the upper reaches of the shoreline slope to collapse. Photographs of these areas are shown in Appendix E.

Technology has developed many new products to control erosion and has improved the older methods. The following were considered when deciding the best approach for the Kinkaid Lake shorelines: riprap (both crushed stone and rounded glacial stone) with filter rock or filter fabric, lunker structures, erosion mats, plastic and natural geowebbs, gabions, railroad ties, interlocking concrete blocks, and natural vegetative stabilization. For slight eroded areas that are not exposed to erosive wind waves and long lake fetch distances, vegetative covering is a method of shoreline stabilization that can provide protection by reducing wave action and by binding the soil with roots. In addition to the erosion control benefits, vegetative stabilization requires little or no maintenance, is aesthetically pleasing, provides habitat and can be cost effective. However, as previously stated, vegetative shoreline stabilization with no hard armoring is generally effective only in areas that are not subjected to long fetch distances and erosive wave action.

Riprap is the most feasible and cost effective alternative to solve the moderate to severe erosion problems observed on the banks of Kinkaid Lake, most of which are between three to eight feet and greater in height. The advantages of riprap include its reliable longevity, ease of installation and relatively inexpensive cost over large areas. All riprap should be installed using either filter stone or filter fabric to prevent washout from behind the installed riprap (see Figures 32 and 33).

Figure 32. Riprap Shoreline Protection with Geotextile Fabric



Figure 33. Example of Offshore Riprap Breakwater



Proposed Actions

As a result of the shoreline erosion survey, it has been determined that the following stabilization measures should be implemented. Riprap and filter fabric should be used for all severely and moderately eroded shoreline, which is a total of approximately 96,950 linear feet. Riprap should be placed along the undercut bank of the shoreline two (2) feet below and two (2) feet above normal pool (spillway elevation) at a 2 to 1 slope. When possible, bare areas above the riprap would be graded to a 3 to 1 horizontal to vertical slope and seeded. However, the eroded shoreline at Kinkaid Lake is typically bordered by wooded growth at or near the shoreline. Thus, flattening the slope of the shoreline will be generally difficult or impractical in most cases. Once the toe of the slope is protected from further undercutting, by structural methods, the eroded slope will gradually slough until a state of equilibrium is reached. The estimated base cost for 96,950 feet of riprap stabilization using Gradation RR4 broken stone riprap is approximately \$60 per linear foot, plus allowances for contingencies, engineering, and permitting.

Since the total linear foot distance of moderate and severe shoreline erosion is so large, it is logical to prioritize the recommended implementation areas and to complete the prioritized installations in a series of phases. This approach will more effectively utilize available funding from grants and cost-share sources to target the most severe and rapidly eroding shoreline areas that are exposed to maximum wind and boat induced wave erosion.

Since the shoreline erosion categories are based on bank height (i.e., moderate 3 to 8 feet and severe 8 feet and greater), the prioritized areas should include moderate and severe erosion areas that are exposed to maximum wave energy. For estimating purposes, a recommendation is made that all of the 14,822 lineal feet of severe (i.e., >8 feet bank heights) and 50 percent of the 82,128 lineal feet of moderate (i.e., 3 to 8 feet bank heights) shoreline erosion should be stabilized and protected. The estimated 41,064 lineal feet of moderate shoreline erosion shall be prioritized according to severity of undercutting and exposure to maximum wind fetch and boat induced wave action. The remaining moderate and slight erosion area shall be monitoring on an annual basis

in order to document erosion severity and lateral recession rates. A summary of the proposed shoreline stabilization costs for Kinkaid Lake are shown in Table 33 as follows:

Table 33. Proposed Shoreline Stabilization Costs

Degree of Erosion	Length of Shoreline	Stabilization Method	Estimated Cost
Severe	14,822 l.f.	Riprap (\$60/lf)	\$889,320
Moderate	41,064 l.f.	Riprap (\$60/lf)	\$2,463,840
Total Estimated Shoreline Stabilization Cost			\$3,353,160
Estimating Contingency (5%)			\$167,658
Engineering Design and Permitting (10%)			\$335,316
Total cost including estimating, engineering design, and permitting (15%)			\$3,856,134

Severely eroded shorelines can be stabilized with riprap placed at the toe of the eroded slopes. In the process, an offshore breakwater is created, which minimizing or eliminating wave erosion and allows an opportunity for transitional wetlands to become established (see Figure 33). However, these wetlands are often “transitional” as the steep eroded banks continue to slough, gradually filling in the newly created wetland area. Sloughing and sediment deposition will continue until the bank reaches equilibrium and becomes stabilized. While present, the transitional wetlands provide many habitat opportunities that will help filter and trap nutrients and sediment, which helps to reduce loading to the lake.

Shoreline stabilization work on this scale will require a Joint Application Permit from the Army Corps of Engineers, the Illinois Environmental Protection Agency, and the Illinois Department of Natural Resources, particularly for riprap placed as fill material beneath the normal water level. The benefits of shoreline stabilization would include reduced sediment and nutrient loading and turbidity, expanded shoreline habitat, improved aesthetic appearance, and prevention of further loss of valuable shoreline.

Objective #5: Improve Fisheries Population and Habitat for improved recreational opportunities

Alternative Actions

Although the fish population at Kinkaid Lake is considered to be good with several imbalances and negative conditions such as excessive siltation and loss of habitat, excessive blue-green algae, excessive Eurasian water milfoil growth, and lack of bottom structure suitable for habitat, there are many areas that could be improved. Fisheries management efforts have included supplemental stocking, size regulations and catch limits in order to reduce smaller fish and increase the sizes of individuals. However, with the degraded water quality and clarity, the decline of diverse, native species within the macrophyte community and the dominance within the algal community by blue-greens, there has been an impact to the overall balance and health of the fish population. As discussed previously, nutrients entering the lake must be controlled and minimized in order to improve water clarity, restructure the algae population and allow desirable, native macrophytes to become re-established. The decrease in available nitrogen and phosphorus will help to diversify the algae population and shift it away from blue-green dominance which will in turn benefit the fish population.

Proposed Actions

The fishery at Kinkaid Lake will certainly benefit from the improved water quality from reduced nutrient inputs, and from the continued supplemental stocking and fishing regulations currently in effect. Although the implementation of soil conservation measures in the watershed through the EPA 319 Program will only slightly improve water clarity, it will allow for a slightly more diverse algae population and will help to promote a more desirable macrophyte vegetation growth.

The Illinois DNR fisheries management plan includes continued sampling and monitoring, annual stocking efforts, enforcement of current regulations, and the

installation of various fish attracters/habitat structures to provide improved fishing opportunities. These management practices should be continued and include:

- 1) Annual spring fish population analysis consisting of eight (8) 30-minute electrofishing samples;
- 2) Annual spring trap netting for Muskie to determine population status and to tag sampled fish for future monitoring;
- 3) Annual spring gill netting to determine the condition of the walleye fishery;
- 4) Periodically sample spillway basin after periods of heavy rain to determine effectiveness of fish barrier;
- 5) Annually stock 2,750 Muskie (10 to 12-inches), 1,000 to 5,000 threadfin shad (3-inch), and 55,000 walleye (2-inch);
- 6) Annually drain and stock various fish species from three (3) existing fish rearing ponds. The type of fish raised and stocked will vary according to the current needs, as determined from fish sampling efforts throughout the lake; and
- 7) Annually add fish attracters/habitat structures to provide cover and concentrate fish and improve angler opportunities.

It is recommended that additional fish attracters/habitat structures should be installed. Rather than placing evergreen trees, which decompose quickly and can introduce unwanted nutrients into the lake, other more durable methods are recommended such as wooden log cribs, concrete block or rock rubble piles, stake beds, plastic structures, bundled piping, etc. are recommended. The estimated costs are anticipated to be \$250 each or more for log cribs, AquaCribs ©, and/or large riprap rubble mounds. It is recommended that a minimum of 20 or more structures or structure groupings be located and installed under the direction of the IDNR fisheries biologist. The total cost for the structures is estimated to be as much as \$10,000, plus an additional 15 percent for planning, engineering and technical consultation. Examples of potential fish attracters/habitat structures are shown in Figures 34 and 35.

Figure 34. Fish Attractor/Habitat Structure Alternatives

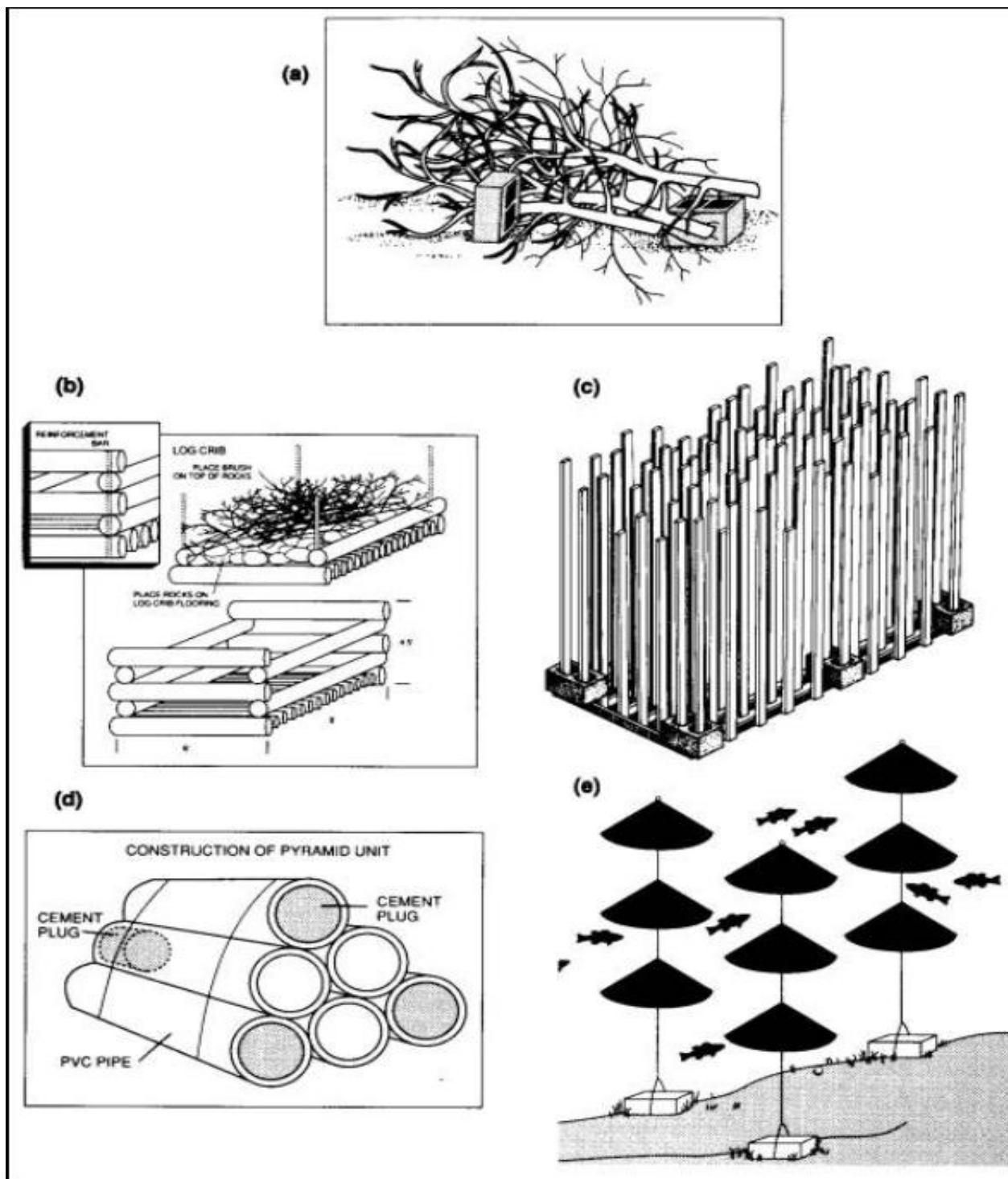


Figure 35. Log Crib and AquaCribs© Fish Attractors/Habitat Structures



Objective #6: Control invasive exotic plant species, Eurasian water milfoil (*Myriophyllum spicatum*), in select areas to improve access and recreation opportunities

Alternative Actions

As discussed previously, the aquatic plant community in Kinkaid Lake is heavily dominated by phytoplankton, particularly blue-green algae. Despite the algal dominance in Kinkaid Lake, several aquatic plant species were encountered in the Kinkaid Lake aquatic macrophyte surveys; however, the overall abundance of aquatic macrophytes was reduced throughout the lake. The dominant aquatic macrophyte species encountered were water willow (*Decodon verticillatus*) and Eurasian water milfoil (*Myriophyllum spicatum*). The first of these species is a native and is beneficial to lakes, but is typically found in shallow, littoral waters less than 2.5 feet deep near the shoreline. The second species, as mentioned previously, is an invasive, exotic plant species that is generally considered to be detrimental to lakes.

As noted within the Diagnostic Section of this Report, the “unbalanced aquatic vegetation” or stunted aquatic macrophyte populations in Kinkaid Lake can be attributed to several factors. These naturally occurring phenomena include increased lake turbidity from soil erosion and subsequent sediment transport within the watershed to the lake; nutrients (i.e., nitrogen and phosphorus) transported from the watershed to the lake; and direct sediment and nutrient delivery from shoreline erosion. In turn, these naturally occurring incidents within the watershed and lake have allowed and promoted phytoplankton (primarily blue-green algae) dominance over rooted, aquatic macrophytes. In addition, the lake’s natural bathymetry and lack of extensive littoral zones (i.e., shorelines that quickly drop off into deep waters) prohibit the widespread growth of aquatic macrophytes throughout the lake. Given these existing lake conditions, it is not surprising that limited aquatic plant diversity was observed in Kinkaid Lake; and therefore, the argument can be made for Kinkaid Lake that any plants, native or invasive, can actually be beneficial in many areas. This has been found to be the

case where narrow strips of this exotic, non-native plant species provide a food source and habitat for the local fauna (i.e. insects, fish, and mammals).

Conversely, the expanded growth and dominance of Eurasian water milfoil (EWM) within certain areas of the Kinkaid Lake, especially near the Marina could interfere with swimming and boating, negatively impact fish habitat, and reduce the aesthetic value of the lake system. In these shallow, susceptible areas of the lake, it is imperative that control measures be implemented to either eradicate or significantly reduce existing or potential macrophyte populations, particularly for Eurasian water milfoil (EWM).

The management alternatives for direct in-lake control of aquatic macrophytes include mechanical harvesting, hand and other manual removal methods, sediment removal and rototilling, sediment covers or benthic barriers, and herbicide treatments. Mechanical harvesters offer relatively fast reduction in EWM biomass; however, the plant quickly regrows and the artificial creation of a large number of fragments can enhance the spread of the plant (Aiken *et al.*, 1979; Bates *et al.*, 1985; Newroth, 1985). Mechanical harvesters cut and remove most of the plant and deposit the debris on land. Three or four harvests per year may be necessary to keep the plant “under control” and it quickly grows back when harvesting is stopped (Truelson, 1985). In Ontario, Painter and Waltho (1985) reported that the timing of the harvests was very important and that two “cuts or harvests” were adequate for short-term control, if they were carefully timed during the growing season. Given the likelihood that harvesting would fragment and spread EWM to other sites, this option is not recommended.

Underwater tilling and cultivating uproot the plants and allow them to float away, which is more effective in clearing a site of EWM than harvesting (Maxnuk, 1985). It is, however, a slow and costly operation that frees a large number of plant fragments that are then able to spread to new sites. The British Columbia Ministry of Environment developed a barge mounted rototilling machine called a rotovator to remove EWM roots. Underwater tiller blades churn up to 8 inches into the sediment and dislodge buoyant EWM roots. Floating roots may then be collected from the water. Control with rotovation, generally extends two or more growing seasons.

Diver-operated dredges operate like underwater vacuum cleaners to remove plants etc. from the bottom. Such devices are also slow and costly to operate and hence only suitable for limited infestations in selected areas (Newroth, 1985; Truelson, 1985). Diver removal by hand is another technique that is geared to smaller areas, such as near the Kinkaid Lake Marina. The Workshop on Management of Eurasian Milfoil in Northern Latitudes that was sponsored by the Freshwater Foundation and the Minnesota DNR in 1990 recommended Diver removal by hand only for specific sites less than one acre or for wider spread infestations at low densities. It was estimated that approximately one acre consisting of 4,840 plants (+/-) would require 440 diver-hours at a 1990 cost of \$13,200 per acre.

Sediment covers or benthic barriers consisting of polyethylene, polypropylene, fiberglass, and burlap can be effective EWM control methods. However, due to the relatively high cost of material and installation and the direct long-term impact to habitat, covers or barriers are feasible only in small areas such as around docks or in swimming areas.

Selective aquatic herbicide treatments of various types have also been found to be effective for eradicating or controlling EWM. Aquatic herbicides are sprayed directly onto floating or emergent aquatic plants or are applied to the water in either a liquid or pellet form. Systemic herbicides are capable of killing the entire plant. Contact herbicides cause the parts of the plant in contact with the herbicide to die back, leaving the roots alive and capable of re-growth. Non-selective herbicides will generally affect all plants that they come in contact with. Selective herbicides will affect only some plants (often dicots - broad leafed plants like EWM will be affected by selective herbicides, whereas monocots - like Brazilian elodea may not be affected). Because of environmental risks from improper application, aquatic herbicides are regulated and have certain restrictions.

A widely used aquatic herbicide for many broadleaf species, such as EWM, is 2,4-D (Navigate® or AquaKlean®). As a selective systemic herbicide, it effectively controls broadleaf plants with a relatively short contact time, but does not generally harm the desirable native pondweeds or water celery. When used at the label rate of 100 pounds per acre in granular form, 2,4-D has shown to be selective to EWM, leaving

native aquatic species relatively unaffected. Diquat (Reward®) is a non-selective contact herbicide that will act on a very short contact time. It causes a rapid die-off of the shoot portions of the plant it contacts, but is not effective on roots, rhizomes or tubers, requiring subsequent applications. Diquat will bind to particulate and dissolved organic matter, which restricts its use in some water bodies. Endothall (Aquathol®) is another non-selective contact herbicide. Unlike Diquat (Reward®), it is not affected by particulates or dissolved organic material. However, it should not be used in tank mixtures with copper, as it can have an antagonistic reaction with chelated copper compounds. Fluridone (Sonar®) is a nonselective systemic aquatic herbicide. It requires very long exposure times but may be effective at very low concentrations. Fluridone is widely used for both hydrilla and EWM management. Liquid Sonar appears to work best where the entire lake or flowage system can be managed, however, several fluridone pellet products are available for selective, spot treatments or high water exchange areas. Although fluridone is considered to be a non-selective herbicide, when used at low concentrations, it can be used to selectively remove EWM. Some native aquatic plants, especially pondweeds, are minimally affected by low concentrations of fluridone. Glyphosate (Rodeo®) is not effective on submersed plants, and triclopyr is not yet labeled for general aquatic use, so neither compound will receive additional attention.

Proposed Actions

For select control of EWM in Kinkaid Lake, granulated 2,4-D (i.e. Navigate® or AquaKlean®, etc.) and fluridone pellets (i.e., Sonar SRP or Precision Release) have been found to be selective and effective towards the eradication and control of EWM. In addition, both products can be applied in a very controlled manner within the localized areas and water depths specified without significant drift beyond the target zones. Since Kinkaid Lake is a public water supply, in addition to being a recreational use reservoir, regulatory approval will be required prior to any use of selective herbicides. If approved for use, the estimated cost for the application in the Marina area is approximately \$350 per acre. It is anticipated that with an initial spring application (April

1 to May 1), a significant reduction in EWM growth can be achieved. Since the results are typically variable, a reduced amount of re-growth can be expected and a reduced follow up application in the spring of 2007 is recommended. For estimating purposes, 100 percent of the original treatment area should be re-treated. Although it is probable that variable re-growth of EWM will occur in subsequent years, the consecutive spring applications are expected to greatly reduce the EWM density and overall plant community dominance. Approximately 20 acres lie within a depth of ten feet within the eastern portion of Kinkaid Lake, in and around the Marina. At a cost of \$350 per acre, 20 acres would be treated in the spring of 2006 and the same 20 acres would be treated as a follow up in the spring of 2007 at an estimated cost of \$14,000 per treatment. The actual area to be re-treated in the spring 2007 application would be surveyed to determine the extent of the re-growth. In future years, selective re-treatments should be implemented on an as-needed basis.

As mentioned, since Kinkaid Lake is a public water supply, the use of chemical measures/pesticides to control EWM in select areas of Kinkaid Lake may not be permitted. Therefore, underwater tilling and/or manually pulling and uprooting EWM from select areas around the Marina could be completed as an alternative.

D. Benefits Expected from Implementation of Lake Management Plan

Once implemented, the recommended alternatives in the proposed lake management plan will generate a wide range of water quality improvements and recreational use benefits for Kinkaid Lake, which include:

- 1) A reduction in the amount of sediment and nutrients entering the lake. It is estimated that changes in tillage practices and the manipulation of conservation practices in the watershed, combined with the construction of the upstream sediment and nutrient control basin(s) will reduce the incoming sediment and nutrient load (particularly phosphorus) (NRCS and Cochran & Wilken, Inc.).
- 2) Although not recommended for immediate implementation as part of this Clean Lakes project, the removal of accumulated sediment from the upper end of the

lake will provide an increased lifespan of recreationally usable water depth. It is estimated that by removing approximately 601,624 cubic yards of accumulated sediment from the shallow, upper end of the lake, combined with a reduced sediment load from the watershed, that the usable lifespan of the upper areas of the lake will be significantly increased.

- 3) Stabilized shoreline areas will reduce sediment and nutrient loading and to prevent further degradation and loss of valuable shoreline. An estimated 14,822 feet of severely and 41,064 feet of moderately eroded shoreline is proposed for stabilization out of a total of 214,271 feet of eroded shoreline. This will stabilize approximately 26 percent of the eroded shoreline and reduce sediment and phosphorus loading and turbidity. More importantly, it will protect valuable shoreline for continued recreational enjoyment.
- 4) A more balanced aquatic vegetation community can be achieved with a more diverse algae population that is no longer dominated by nuisance blue-greens and an increased macrophyte growth in the littoral zone for aquatic habitat. The reduction in sediment loading will also reduce phosphorus loading considerably, since most phosphorus entering the lake is bound to sediment particles. Nitrogen concentrations will be reduced by the continued implementation of BMP's within the watershed including streamside filter strips and grass waterways, combined with nutrient management.
- 5) A more balanced fish population can be achieved through improved water quality, the continuance of the existing fisheries management program, and expanded fish habitat. The more diverse algal population will provide a better food source for zooplankton and grazers, which will in turn benefit the entire fish population. A healthier, more balanced aquatic plant community will provide improved habitat and the fish habitat structures will also benefit the fish population and fishing opportunities.
- 6) Improved water quality will also enhance lake aesthetics. The removal of nutrient rich sediment and the reduction of nutrients entering the lake, together with the habitat improvements and shoreline stabilization will improve the water clarity

and overall water quality of the lake. These improvements will provide increased aesthetic enjoyment to the user population.

Table 34 shows the current use estimates for Kinkaid Lake, along with the projected use and benefits following the lake restoration program. Prior studies completed by the Illinois DNR Planning Division have estimated that a 20 percent increase in total lake usage can be expected with the implementation of a lake restoration program that will improve and protect water quality, fisheries and recreational opportunities. The economic value was calculated using a multiplier of 1.5 as suggested by Griffith and Associates (1990). It is estimated that the proposed restoration program will generate a total of \$11,610,000 in economic benefits over a ten-year period, and does not include the probable increase in revenues for area merchants as a result of greater lake usage.

A report prepared by JACA Corporation (1980) for the USEPA assessed the economic benefits derived from 28 projects in the Section 314 Clean Lake Program. The report found that a total return in benefits of \$4.15 per total project dollar was realized. The projects produced benefits in 12 categories that included recreation, aesthetics, flood control, economic development, fish and wildlife, agriculture, property value, public health, public water supply, education, research and development cost, and pollution reduction. The report also indicated that while many benefits could not be measured in monetary terms, the success of many Clean Lakes Program projects appears to have been a catalyst for other community activities.

Table 34. Projection of Benefits

Recreational Use	Baseline Usage(a)	Projected Usage(a)	Change in Usage(a)	Value of Baseline Usage(b)	Value of Projected Usage(b)	Value of Annual Increment(b)	Value of Benefit(c) (10 Year)	Total Economic Benefit Using 1.5 Economic Multiplier
Combined Usage	500,000	600,000	100,000	\$3,870,000	\$4,644,000	\$774,000	\$7,740,000	\$11,610,000

(a) - in annual user days unless otherwise noted

(b) - in current dollars

(c) - net present value over duration of benefits

Source: Kinkaid-Reed's Creek Conservancy District
Illinois DNR Planning Division
Griffith and Associates

E. Phase 2 Monitoring Program

Table 35 presents the proposed water quality-monitoring program for a one-year period following completion of the proposed lake restoration activities. This program is essentially the same as that conducted under the Phase 1 study except that no sediment or fish samples will be analyzed.

Table 35. Proposed Phase 2 Water Quality Monitoring Program for Kinkaid Lake

Parameter	Sampling Frequency
Total Phosphorus	M,S,T
Dissolved Phosphorus	M,S
Ammonia-Nitrogen	M,S,T
NO ₂ +NO ₃ -Nitrogen	M,S,T
Kjeldahl-Nitrogen	M,S,T
Total Suspended Solids	M,S,T
Volatile Suspended Solids	M,S
Turbidity	M,S
pH	M,S,
Alkalinity	M,S
Conductivity	M,S
Chlorophyll a, b, c	M,S
Phytoplankton	M,S
Transparency - Secchi Disc	M,S
Diss. Oxygen/Temperature Profile	M,S

Key: M = monthly in-lake & tributary sampling (12 times per year by Kinkaid-Reed's Creek Conservancy District)

S = summer in-lake & tributary sampling (Apr., June, July, Aug., & Oct. by Illinois EPA)

T = Storm event tributary sampling (as required by KRCCD and Cochran & Wilken, Inc.)

All parameters except Chlorophyll (a, b, c), Phytoplankton, Secchi Transparency and Dissolved Oxygen/Temperature Profiles will be taken one foot below the surface at Sites 1, 2, and 3, and one foot above the bottom at Site 1.

F. Budget and Schedule

The total estimated costs and budget for restoration projects identified within the Phase 1 Report are summarized in Table 36. Under the Clean Lake program, the schedule for the Phase 2 restoration projects would normally be submitted by the end of 2005, and the completed Phase 1 Report would serve as informational backup for the Phase 2 application. The Illinois EPA would review the application in the winter of 2005 and the Phase 2 Grant approval could be anticipated by spring of 2006. However, the implementation of the lake and watershed restoration projects described within this Report and listed in Table 36 will ultimately depend of the future availability of Clean Lakes funding and other funding sources.

Currently, the KRCCD has committed its available match funds to the pending 319-grant application submitted in March 2005 (see Appendix F). In addition, future funding for the Illinois EPA's Clean Lakes Program is uncertain, as current "Clean Lakes" projects are currently being funded through the 319-Non-Point Source Pollution Program. Therefore, rather than committing to the conventional-fixed Clean Lakes Phase 2 budget and schedule, where funding and restoration projects are specified beforehand, a more open and flexible budget and schedule approach is proposed under the 319-program. This more flexible approach will consist of preparing separate, individual 319-grant applications that are based on the findings and recommendations of this Phase 1 Report. This method will allow lake and watershed restoration projects to be identified and grant applications submitted, as various match-funding sources become available.

Several of general criteria are suggested in selecting future lake and watershed restoration projects (see Table 36). Priority should be given to those best management practices that will have the greatest immediate impact on reducing sediment and nutrient (particularly phosphorus) loadings to the lake. Also restoration projects located on public-owned lands tend to be more feasible to implement and complete than those located on privately owned land. Typically, publicly owned lands projects typically have fewer issues with land access, land acquisition issues, etc.

Using this restoration project selection rationale, shoreline erosion has been identified as a critical restoration project. All of the moderately and severely eroded shoreline on Kinkaid Lake is located on public lands that are managed and/or owned by the KRCCD, the Illinois DNR, or the US Forest Service. Another benefit to stabilizing eroded shoreline will include significant sediment and phosphorus loading reductions to the lake. The sediment budget for Kinkaid Lake (see Table 18 in Part 1) indicates that approximately half of the annual sediment load to the lake is generated from shoreline erosion. Also, compared to other forms of erosion within the watershed, shoreline erosion has the greatest sediment delivery ratio (i.e., $SDR = 1$) (see Table 5 in Part 1), where all sediment is directly delivered into the lake. While cost prohibitive to stabilize all areas with eroded shoreline simultaneously, the proposed shoreline-monitoring program would periodically survey and identify the most critical areas of eroded shoreline, and those most critical areas could be completed in phases, as funding is available.

Other watershed restoration projects that have the potential to significantly reduce sediment and nutrient loading include stabilizing additional eroded stream banks and gullies, constructing one or more large-scale sediment and nutrient control basins, and removing excessive sediment from selected areas via hydraulic dredging. Gully and stream bank erosion tend to have higher sediment delivery ratios (i.e., $SDR = 0.9$ and 0.95) than other forms of erosion within the watershed. Several gully and stream bank stabilization projects located on public land were identified and are illustrated in Figure 32. These projects are also easier to implement and complete, as they are located in smaller, more specific areas.

The construction of sediment and nutrient control basin(s) and removal of accumulated sediment in the upper portion of the lake are also needed and would significantly reduce loadings to the lake. However, these large-scale projects may be more challenging to implement and may require additional funding, potentially from the Illinois Department of Transportation (IDOT) or other funding sources.

Table 36. Total Budget for Kinkaid Lake and Watershed Restoration Programs

Potential Restoration Alternatives		Estimated Cost	Funding Source(s)
1.	Watershed Protection		
a)	Filter Strips, Terraces, Grassed Waterways, Nutrient Mgmt., Education,)	N/A	USDA CRP Program (Cost not included Budget)
b)	Sediment Ponds & Gully Stabilization	\$ 318,934	KRCCD and IEPA *
c)	Gully & Streambank Stabil. (8,750 LF)	\$ 252,656	KRCCD and IEPA
	Engineering & Contingency	<u>\$ 24,063</u>	KRCCD and IEPA
	Subtotal	\$ 276,719	KRCCD and IEPA
d)	Sediment & Nutrient Basin at Rt. 151	\$ 840,000	KRCCD and IEPA
	Engineering & Contingency	<u>\$ 105,000</u>	KRCCD and IEPA
	Subtotal	\$ 945,000	KRCCD and IEPA
	Total Watershed Protection Cost	\$ 1,221,719	KRCCD and IEPA
2.	Sediment Removal		
a)	Hydraulic Dredging, Sediment Storage Site & Contingency (601,624 cy)	\$ 2,647,196	KRCCD and IEPA
b)	Engineering & Permitting	<u>\$ 360,974</u>	KRCCD and IEPA
	Total Sediment Removal	\$ 3,008,120	KRCCD
3.	Shoreline Stabilization		
a)	Severe – Riprap (14,822 L.F.)	\$ 889,320	KRCCD and IEPA **
b)	Moderate – Riprap (41,064 L.F.)	\$ 2,463,840	KRCCD and IEPA
c)	Annual Shoreline Monitor. Prog. (3 yrs.)	\$ 30,000	KRCCD and IEPA
d)	Contingencies (5%)	\$ 167,658	KRCCD and IEPA
e)	Engineering and Permitting (10%)	<u>\$ 335,316</u>	KRCCD and IEPA
	Total Shoreline Stabilization Cost	\$ 3,886,134	KRCCD and IEPA
4.	Fisheries Management		
a)	Fish Attractor & Habitat Structures	\$ 10,000	KRCCD and IEPA
b)	Engineering & Technical Assistance	\$ 1,500	KRCCD and IEPA
c)	Supplemental Stocking, Surveys, etc.	<u>N/A</u>	IL DNR and KRCCD
	Total Fisheries Management Cost	\$ 11,500	KRCCD and IEPA
5.	Selective Control of Invasive Macrophytes per treatment (2 treatments proposed)	\$ 14,000	KRCCD and IEPA
	Total Invasive Macrophyte Control	\$ 28,000	KRCCD & IEPA
6.	Lake Restoration Technical Consultation And Phase 2 Report	\$ 35,000	KRCCD and IEPA
7.	Phase 2 Sampling, Monitoring and Lab Analysis by IEPA & KRCCD	\$ 10,000	KRCCD and IEPA (labor for sampling/monitor.)
8.	Public Education Prog. W/ Info. Pamphlet	\$ 15,000	KRCCD and IEPA ***
9.	Direct Labor Costs assoc. w/ 319-Projects	\$ 19,931	KRCCD *
	Total Proposed Phase 2 Budget	\$ 8,554,338	KRCCD and IEPA

* Included in pending 319-grant application submitted in March 2005.

** 3,000 LF of severely eroded shoreline to be addressed in pending 319-grant application.

*** \$10,000 of public education program costs to be included in pending 319-grant application.

As stated, the uncertain future of Clean Lakes funding will likely cause future Kinkaid Lake and watershed restoration projects to be funded through the non-point source pollution, Section 319 program. Given the magnitude of the lake and watershed restoration projects described in Part 2 of this Report and listed in Table 36, it is recommended that future projects are selected based on the availability of future match funds by KRCCD and Federal and State/local funding sources. This “phased” approach will allow individual projects to be completed in a reasonable manner, as funding becomes available.

The suggested work schedule shown in Table 37. Projects presented are listed based on their relative priority. In addition, the proposed project work schedule is based on the assumption that the Illinois Clean Lakes funding will be available and that the grant award would be made in March 2007, which would allow a Project start date of May 2007. The restoration alternatives would be implemented primarily in 2007 and 2008, with post restoration monitoring being completed in the year 2009. If future restoration projects are funded through the Non-Point Source Pollution Program, an alternate work schedule (other than what is proposed in Table 37) will be required as part of subsequent 319-grant applications.

Table 37. Proposed Clean Lakes Phase 2 Project Schedule

Activity	2007												2008												2009												2010																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
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Note - Projected Project Schedule does not include sedimentation basin(s) or sediment removal.

G. Sources of Matching Funds

Soil conservation practices implemented in the Kinkaid Lake watershed will likely be funded through the Illinois EPA's 319 Non-Point Source Pollution Control Program and the USDA Conservation Reserve Program (CRP) administered by the local Jackson County Soil and Water Conservation District. Participating landowners will provide matching funds and the USDA CRP Program will provide the remaining grant funds. The Illinois EPA's 319-Program will provide up to 60% Federal matching funds for implementing lake and watershed restoration practices and projects. The match requested from the 319-Program will depend on the availability of future Clean Lakes funding, which can be used as State/local match funds for additional 319-grant funding.

As mentioned, a Non-Point Source Pollution, Section 319-grant application (see Appendix F) was submitted by the KRCCD in March 2005 for several lake and watershed restoration projects. The total proposed cost of the pending 319-grant application was for a total of \$563,685 with 60% Federal match \$338,211 and a 40% State and local match of \$225,474. Officials for the KRCCD report that additional match funding will be difficult to acquire for this fiscal year, as the KRCCD already has monetary resources that are committed to the pending 319-grant application.

While new Clean Lakes funding is likely to be unavailable, it is possible that the Illinois EPA could collect existing Clean Lakes funds that were previously allocated to other Clean Lake projects, where the owner/sponsor has decided not to complete the projects and/or did not use all of the awarded Clean Lakes grant funds. Those re-collected Clean Lakes resources could be re-allocated to projects at Kinkaid Lake, where multiple restoration projects that were ready to be implemented. For the KRCCD, any re-collected and re-allocated Clean Lakes funds could also serve as additional match funds for watershed restoration projects under the 319-Program.

H. Relationship to Other Pollution Control Programs

It is the intent of the Illinois Clean Lakes Program that Phase 1 Studies and Phase 2 restoration projects should be coordinated with all other applicable programs of

other agencies that deal with water-related environmental concerns. State of Illinois Clean Lakes Program funds are generally limited to those projects that apply an integrated watershed management approach toward improving and protecting the lake's water quality and recreational opportunities.

As stated in the Part 1 of this report, the staff members of the KRCCD have been monitoring Kinkaid Lake since 1979, as part of Illinois EPA's Volunteer Lake Monitoring Program, and the lake has been a part of the Illinois EPA's ambient lake monitoring program since 1977.

In addition, the Big Muddy River watershed (which includes Kinkaid Lake) was listed on the 303(d) for impaired waters in 1998 for the following parameters: manganese, cyanide, sulfates, nitrogen, pH, siltation, low dissolved oxygen, total dissolved solids, and total suspended solids. As a result of the 303(d) listing, a Total Daily Maximum Load (TMDL) Study for the Big Muddy Watershed was initiated and the Final TMDL Reported was submitted in October 2004. An estimated of loading capacity of 13,938 pounds per year (6,343 kg/year) for phosphorus was developed for Kinkaid Lake in order to comply with phosphorus water quality standards of 0.05 mg/l. This loading capacity represents an approximate 43 percent phosphorus loading reduction from current phosphorus loading levels (Camp Dresser and McKee, 2004).

The proposed Phase 2 restoration projects are consistent with Illinois EPA's "Non-Point Source Management Program Report," which has been developed to provide an overview of ongoing and new program initiatives to address the water resource problems identified in the "Illinois Water Quality Report," which is updated biannually. Illinois EPA was required to develop and maintain these two reports as a result of Section 319 of the Clean Water Act.

A Non-Point Source Pollution, Section 319-grant application was submitted by the KRCCD to the Illinois EPA in March 2005 for several lake and watershed restoration projects. The total proposed cost of the pending 319-grant application was for a total of \$563,685 with 60% Federal match \$338,211 and a 40% State and local match of \$225,474.

The Illinois Department of Natural Resources has provided supplemental stocking and ongoing fisheries management assistance prior to 1996 through an

agreement between the KRCCD and Illinois DNR. Also, the Jackson County Soil and Water Conservation District and the USDA Natural Resources Conservation Service continues to provide assistance to landowners in the watershed related to soil and nutrient conservation, and has committed to providing assistance in implementing the watershed land treatment practices through the Conservation Reserve Program.

I. Public Participation Summary

During the project-monitoring period, project updates were included within the published agenda for each KRCCD board meeting. After meeting with KRCCD officials in May 2005 to discuss the findings and recommendations, a public notice was placed in the local newspapers in order to present the findings of the Study and to solicit any questions and/or comments from the local residents. Verbal comments received from KRCCD and the public were generally positive.

A Draft Phase 1 Diagnostic/Feasibility Study Report was submitted in May 2005. Written review comments were provided by Mr. David Fligor of KRCCD, Mr. Gary Raines of CWI, Mr. Shawn Hirst of Illinois DNR, and Ms. Teri Holland of Illinois EPA. Copies of comments received from the review of the Draft Phase 1 Report (submitted May 2005) are provided in Appendix G.

J. Operation and Maintenance Plan

If awarded a Phase 2 Clean Lakes Program grant, the Kinkaid-Reed's Creek Conservancy District will be responsible for the operation and maintenance of all recommended alternatives such as the shoreline stabilization, sediment removal and lake deepening, fisheries management and watershed land treatment practices. Shoreline erosion control measures will be inspected annually and repaired or replanted as required by the Kinkaid-Reed's Creek Conservancy District. Watershed land treatment practices will be coordinated by the Kinkaid-Reed's Creek Conservancy District with the Jackson County Soil and Water Conservation District and the local USDA Natural Resources Conservation District. They will be inspected annually to

insure continued effectiveness and participation in the CRP Program. Fisheries management activities will be continued by the Illinois Department of Natural Resources fisheries biologist on an annual basis. The Kinkaid-Reed's Creek Conservancy District will cooperatively monitor the coordination of the fish habitat structures in cooperation with the Illinois Department of Natural Resources.

K. Permit Requirements

Sediment removal from the upper end of the lake will require a Joint Application Permit from the U.S. Army Corps of Engineers (COE), the Illinois Environmental Protection Agency (IEPA) and the Illinois Department of Natural Resources (IDNR). Since it is recommended to remove the sediment hydraulically while the lake is at normal pool, a Section 401 Water Quality Certification from the Illinois EPA for discharging the clarified effluent water back to the lake will also be needed. Since an upland retention and dewatering site will be required for placement of the dredged sediment, a Phase 1 Archeological Survey will be required and submitted to the Illinois Historic Preservation Agency to insure that no significant cultural resources are present. Structural shoreline stabilization work will also require a Joint Application Permit from the U.S. Army Corps of Engineers and can be included as part of the 404 Permit required for sediment removal. Coordination and consultation with the Illinois Department of Natural Resources, Illinois Environmental Protection Agency, USDA Natural Resources Conservation Service, and the U.S. Fish and Wildlife Service will also be necessary. The permit application process will be initiated after the Phase 1 report is completed, and approval for funding of the Phase 2 Implementation Project is granted.

L. Environmental Evaluation

Will the project displace people?

The project will not displace any people from residences or places of business.

Will the project deface existing residences or residential areas?

The project will have no adverse visual impacts on residential areas. All in-lake and shoreline stabilization requirements will be completed within the Kinkaid-Reed's Creek Conservancy District boundaries. No watershed land treatment practices will impact residential areas.

Will changes in established land use patterns or an increase in development pressure?

The project will not likely lead to changes in established land use patterns as the predominant restoration area is located within the limits of Kinkaid Lake.

Will the project affect prime agricultural land or activities?

There will be no permanent negative impacts on prime agricultural lands from the project. Soil conservation measures applied in the watershed will help maintain soil fertility and control erosion on agricultural lands.

Will the project adversely affect parkland, public land, or scenic land?

Kinkaid Lake and the surrounding land will have enhanced recreational, environmental and aesthetic value as a result of the proposed project.

Will the project adversely affect land or structures of historic, architectural, archeological, or cultural value?

In order to acquire a permit to construct a sediment retention and dewatering pond for the future storage of dredged sediment, a Phase 1 Archeological Survey will be completed to insure that no cultural resources are present.

Will the project lead to a significant long-range increase in energy demands?

There will be no long-term increase in energy demands as a result of the project.

Will the project adversely affect short-term or long-term ambient air quality?

No long-term increase in traffic volume is expected as a result of this project. Occasional short-term increases may occur during the installation of structural shoreline stabilization techniques. All construction equipment is expected to comply with noise and air pollution standards. Very few areas are bordered by residential development. Effects outside the immediate area of the implementation activities are not anticipated.

If the project involves the use of in-lake chemical treatment, will it cause short-term or long-term adverse impacts?

No long-term adverse impacts are expected from the proper application of herbicide to selectively control excessive aquatic vegetation for public access and/or fisheries management purposes.

Will the project involve modification or construction in floodplain areas?

Shoreline stabilization practices would occur within the 100-year floodplain, which borders the lake. Structural shoreline stabilization and protection practices will be primarily utilized, and the planting of terrestrial and near shore emergent and submergent species resistant to erosive forces will be utilized when possible. There will eventually be accumulated sediment removed from the upper end of the lake, and will be completed separately from the Clean Lakes Program work.

If the project involves physically modifying the lakeshore, its bed, or its watershed, will the project cause any short-term or long-term adverse impacts?

No long-term adverse impacts will result from project activities. Shoreline erosion control practices may involve regrading and/or installation of structural practices such as riprap. There may be short-term impacts such as higher localized turbidity, restricted access in certain areas during construction and minimal landscape damage from heavy equipment.

Will the proposed project have a significant adverse effect on fish and wildlife, wetlands, or other wildlife habitat?

No significant adverse effects on fish and wildlife, wetlands, or other wildlife habitat will occur as a result of this project.

Will the project adversely impact threatened or endangered species?

No threatened or endangered plants or wildlife species will be affected by this project.