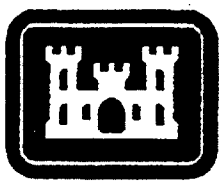

US Army Corps of Engineers
Memphis District

Mississippi River Commission

REELFOOT LAKE TENNESSEE AND KENTUCKY

VOLUME 1

FINAL FEASIBILITY REPORT

&

FINAL ENVIRONMENTAL IMPACT STATEMENT

SEPTEMBER 1999

EXECUTIVE SUMMARY

Reelfoot Lake, Tennessee and Kentucky Feasibility Report

The purpose of this report is to present the findings of a Feasibility Study of water and related land resources problems in the Reelfoot Lake area. The Feasibility Study was initiated in January 1995 following certification of the Reconnaissance Report in December 1994. The Reconnaissance Report stated that Federal interest existed and that feasible alternatives could be developed to address the planning objectives for the study. The Feasibility Study consisted of a detailed analysis of various alternative plans to select the most beneficial and cost effective solution to the various problems identified in the area.

The study area is located east of the Mississippi River about 120 miles north of Memphis, Tennessee and 6 miles east of Tiptonville, Tennessee, in Lake and Obion Counties, Tennessee and Fulton County, Kentucky. Reelfoot Lake, formed by the earthquakes of 1811–1812, covers approximately 15,500 acres at a pool elevation of 282.2 NGVD in Tennessee and Kentucky. Reelfoot Lake is a nationally significant and unique natural resource. It is the largest natural freshwater lake in Tennessee and one of the largest in the country. The lake provides nesting and feeding habitat for the Bald Eagle, a threatened species, while providing one of the most highly productive fisheries in the area. Also, Reelfoot Lake is located within the Mississippi Flyway and is widely used by waterfowl. The North American Waterfowl Management Plan (NAWMP), an international treaty between the U.S., Canada, and Mexico, has identified the Lower Mississippi River Delta as a "priority habitat range." Reelfoot Lake was also identified as a "key area" for waterfowl in the Lower Mississippi Valley Joint Venture, which is under the auspices of the NAWMP.

Flood control and drainage improvements in the basin have dramatically impacted the quality of fish and wildlife habitat. Construction of the Mississippi River levees in the 1930s stopped the almost annual recharge of the lake by overflow from the Mississippi River. Construction of a spillway and Running Reelfoot Bayou stabilized water level fluctuations of Reelfoot Lake and provided drainage for surrounding areas. The resulting land clearing and conversion to agriculture practices on lands surrounding the lake contributed to an unusually high rate of sediment deposition in the lake, which is reducing the value of the lake's aquatic habitat and the lake's value as a flood attenuation system.

The Feasibility Study examined the potential benefits and costs of various features designed to restore and protect the environment (both terrestrial and aquatic) in the Reelfoot Lake area. The selected features, which exhibit the highest levels of environmental benefits, were combined into a recommended plan. The recommended plan includes construction of an alternative spillway, bridge, inlet and outlet channels, circulation channels within Reelfoot Lake, a sediment basin on Reelfoot Creek, restoration of Shelby Lake and construction of waterfowl management units, and improvements at Lake Isom National Wildlife Refuge. The recommended plan also

includes implementation of a water level management plan for Reelfoot Lake which is expected to improve aquatic habitat within the lake.

The draft Feasibility Report and DEIS recommended Plan 5b for implementation. During the public review period, strong opposition to the Reelfoot Lake water level management aspect of Plan 5b was presented. After supplemental meetings and discussions, a revised recommended water level management plan for Reelfoot Lake was developed. This plan addresses the major concerns of impacts to farming and tourism while providing a stable lake level during times of fish spawning. A comparison of the draft report recommendations (Plan 5b) and the current recommendations are presented in the following table.

Features	**Draft Report (Plan 5b)**	**Final Report (Proposed Plan)**
New spillway	Included	Included
Circulation Channels	Included	Included
Sediment Retention Basin	Included	Included
Shelby Lake and waterfowl areas	Included	Included
Lake Isom improvements	Included	Included
Changes in water level management at Lake Isom NWR	Included (see Table 29 of main report)	Included (see Table 29 of main report)
Seasonal flowage easements in vicinity of Lake Isom	104.7 acres	104.7 acres
Changes in water level management of Reelfoot Lake	Included (see Table 30 of main report)	Modified but included (see Table 30 and the listing below of proposed management)
Seasonal flowage easements around Reelfoot Lake in TN and KY	Included	None
First Cost (1 Oct 98 P.L.)	$30.0 million	$27.8 million
Fully Funded Cost	$35.3 million	$32.6 million
OMRR&R	$189,200	$189,200
Annual Costs (AAE) @ Current Interest Rate (7.125%)	$2.7 million	$2.5 million
Terrestrial Benefits	1,469 AHUV	1,469 AHUV
Aquatic Benefits	6,270 AHUV	4,414 AHUV
Waterfowl Benefits	13,397,000 WUD	6,272,000 WUD

The net environmental benefits of the recommended plan are reduced by 5 annual habitat unit values (AHUVs) and approximately 7,125,000 waterfowl lays (WUDs) from Plan 5b. This reduction in benefits is primarily because the g and summer high pool would not be raised to the level originally proposed. ever, the recommended plan is a more implementable plan. The plan addresses erns from farming interests by providing for lowering Reelfoot Lake to its ner time elevation by March 15 instead of the current April 15 schedule so fields repared earlier for spring planting. Also, the proposal for raising the Reelfoot an additional 0.3 feet is no longer included in the water level management plan. erns about impacts of a drawdown are addressed by initially lowering the lake ree feet as opposed to four. A three foot drawdown would be similar to that ucted in 1985. Additional drawdowns are proposed to be phased in at levels up ur feet depending on the performance of the previous drawdown. The revised r level management plan which provides for a stable lake level from March 15 to 1 will benefit fish spawning. The proposed water level management plan for foot Lake is as follows:

On a yearly basis:	
November 15 - March 1:	Allow Reelfoot Lake to fluctuate up to elevation 283.2
March 1 - March 15:	Lower Reelfoot Lake to elevation 282.7
March 15 - July 1:	Hold Reelfoot Lake at elevation 282.7
July 1 - November 15:	Allow Reelfoot Lake to fluctuate up to elevation 282.7
Every 5 to 10 years:	
June 1 - July 15:	Lower Reelfoot Lake to the drawdown elevation *
July 15 - November 15:	Hold Reelfoot Lake at the drawdown elevation *
November 16 - March 1:	Allow Reelfoot Lake to refill up to elevation 283.2
March 1:	Manage Reelfoot Lake elevation according to "yearly basis" schedule listed above

* Initial drawdown of 3'. Future drawdowns of up to 4' as needed.

Full implementation of the recommended plan is expected to produce net ronmental benefits of 1,469 terrestrial annual habitat unit values (AHUV's), 4 aquatic AHUV's, and 6,272,000 waterfowl use days. The estimated first cost

(1 October 1998 P.L.) of the recommended plan is $27,802,000 and the estimated average annual cost is $2,466,100. The fully funded cost of the recommended plan is currently estimated at $32,597,000.

Corps Civil Works Ecosystem Restoration Guidance, Chapter 4, Section VIII, ER 1105-2-100 dated 2 October 1997 identifies the restoration of ecosystems or parts thereof, and their associated ecological resources as a priority project purpose. Although it is not necessary for project authorization, priority is given to restoration where a Corps project contributed to the degradation of the ecosystem. The fish and wildlife habitat resources at Reelfoot Lake are nationally significant, and they have greatly declined from modern historic conditions. Construction of Corps projects (the Mississippi River levees and improvements to Running Reelfoot Bayou) contributed in part to the degradation. The degraded resources will not be restored to a greater level than modern historic conditions. Construction of the features identified, along with implementation of the recommended water level management plan, is necessary to prevent the continuing decline of these natural resources and to protect the public's investment in over 33,000 acres in the Reelfoot Lake area including two national wildlife refuges, a state wildlife management area, and a state park. Construction of these features would utilize the Corps interdisciplinary planning, engineering, design, and construction expertise to restore and protect nationally significant fish and wildlife habitat.

The State of Tennessee, acting through the Tennessee Wildlife Resources Agency, has indicated a willingness to participate on a cost shared basis in implementation of the recommended plan. It has been concluded that the predicted environmental benefits of the recommended plan outweigh the estimated costs and therefore, the project is feasible and has Federal interest.

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Reelfoot Lake, Tennessee and Kentucky Feasibility Report

INTRODUCTION

This report presents the results of the Reelfoot Lake, Tennessee and Kentucky, Feasibility Study. This feasibility study has been conducted with the Tennessee Wildlife Resources Agency (TWRA) participating as the local sponsor on a 50 percent cost sharing basis. The feasibility study is based on the results of the Reelfoot Lake, Tennessee and Kentucky, Reconnaissance Study which concluded that there was Federal interest in proceeding to feasibility level studies and that feasible alternatives could be developed to meet the planning objectives consistent with applicable laws and regulations.

STUDY AUTHORITY

Recognizing the concerns of Federal and state agencies, local officials, and individuals, the U.S. Senate and House of Representatives passed resolutions on August 2 and 8, 1984, respectively, requesting the Chief of Engineers "to review the report on the Mississippi River and Tributaries project. . . and other pertinent reports with a view to determining whether any modifications of the recommendations contained therein are advisable, with particular reference to the need and feasibility of improvements in the vicinity of Reelfoot Lake, Tennessee, in the interest of flood control, sediment control, water quality, water supply, fish and wildlife preservation and enhancement, recreation, regional development, and allied purposes". Funds were provided to the U.S. Army Corps of Engineers, Memphis District, in December 1985 to conduct the reconnaissance portion of the investigation. The reconnaissance report was completed in May 1988 but was not certified at that time.

Subsequent to the completion of the reconnaissance report in May 1988, revisions occurred to the Corps of Engineers budget guidance, which elevated the restoration of fish and wildlife habitat as a priority output of the Corps of Engineers. In particular, Policy Guidance Letter No. 24, dated March 7, 1991, allowed the Corps of Engineers to recommend fish and wildlife restoration activities "if justified and: (1) a Civil Works project has contributed to the degradation . . . or (2) restoration can be most cost effectively accomplished through modification of an existing Civil Works project...". By letter dated April 9, 1992, the state of Tennessee, acting through the Tennessee Wildlife Resources Agency, requested that the U.S. Army Corps of Engineers, Memphis District, update the May 1988 reconnaissance report to include fish and wildlife habitat restoration in addition to other Corps outputs.

Updating of the May 1988 reconnaissance report was initiated in November 1992 and completed in November 1993. The reconnaissance report was certified in December

1994. The reconnaissance report concluded that construction of previous Corps of Engineers projects (the Mississippi River Levees and improvements to Running Reelfoot Bayou) had contributed in part to the degradation of nationally significant fish and wildlife resources at Reelfoot Lake. The reconnaissance report identified a recommended plan for restoration of the fish and wildlife resources and recommended proceeding into a cost shared feasibility study for more in-depth evaluations of the benefits and costs of implementing the recommended plan. Subsequent to completion of the reconnaissance report and initiation of the feasibility study, the linkage of a Corps project to the environmental degradation was no longer required for a determination of Federal interest.

PURPOSE AND SCOPE OF STUDY

The purpose of the feasibility study is to conduct a thorough investigation of the problems and needs of the area, develop alternative plans to address these problems and needs and to select the optimum plan based on the projected benefits. The feasibility report serves to document the findings of the feasibility study. The results are based upon the analysis of both data collected during the feasibility study and historical data accumulated from previous studies and/or other sources. The geographic study area is comprised of the Reelfoot Lake vicinity which, for this study, was interpreted as Reelfoot Lake, the surrounding area, and the areas downstream which were once periodically flooded by the Mississippi River before construction of the Mississippi River levees. Technical designs for this study include biological, engineering, and economic evaluations of various alternatives along with required real estate and planning evaluations. A draft Environmental Impact Statement was also prepared to accompany this study.

OTHER STUDIES AND PROJECTS IN THE AREA

Prior Studies and Reports

House Document No. 757, 79th Congress, 2d Session. This document contains a report dated April 16, 1946 which recommended draining impounded runoff and seepage in the vicinity of Lake No. 9 by enlargement and realignment of the existing drain from below French Point to Lake No. 9 and construction of a new ditch south of Black Bayou; thence southeasterly along Black Bayou to Reelfoot Lake. This work was authorized by the Flood Control Act of July 24, 1946.

Senate Document No. 160, 83d Congress, 2d Session. This document contains a report dated June 17, 1954 which recommended cleaning out and enlarging 16.5 miles of the Bayou du Chien channel from southwest of Hickman, Kentucky, to Reelfoot Lake. It also authorized the enlargement of Running Reelfoot Bayou from the spillway at Reelfoot Lake to the upper end of work already authorized on this channel and

modification downstream to the Obion River. This work was authorized by the Flood Control Act of September 3, 1954.

House Document No. 308, 88th Congress, 2d Session. This document contains a report dated November 30, 1959 which recommended that the improvements in the Reelfoot Lake area be completed as authorized and sedimentation surveys be continued on Reelfoot Lake. This work was authorized by the Flood Control Act of October 27, 1965.

House Document No. 414, 91st Congress, 2d Session. This document contains a review report on the Western Tennessee Tributaries, Tennessee and Kentucky. Dated April 15, 1969, it was prepared in response to a resolution adopted June 19, 1963 by the committee on public works of the House of Representatives, United States Congress, to determine whether any modifications were advisable at that time with respect to flood control and drainage in Lake and Obion Counties, Tennessee, and Fulton County, Kentucky. The plan of improvement recommended in the review report consisted of the enlargement and realignment of Bayou du Chien from an existing gravity outlet in the southwest corner of Hickman, Kentucky to a point just north of the Kentucky highway 94 crossing over Bayou du Chien. From here the plan called for a diversion channel to the Lake No. 9 channel in the Fish Pond area, enlargement of the Lake No. 9 channel through Lake No. 9 to a pumping station to be constructed just north of the Tennessee state line, and approximately two miles of channel construction to facilitate drainage from the northwest corner of Lake County, Tennessee to the pumping station. The plan also included an earthen plug in the Bayou du Chien channel immediately downstream of the diversion channel. Resolutions adopted by the House and Senate Public Works Committees in December 1970 approved the project for flood protection on the Western Tennessee Tributaries, Tennessee and Kentucky, in accordance with the recommendations of the Secretary of the Army and the Chief of Engineers in House Document Number 91-414.

Reelfoot Lake, Tennessee and Kentucky, Reconnaissance Report, May 1988. This report presented the findings of a study of water and related land resources problems in the Reelfoot Lake drainage basin. The study determined that the existing spillway limits the availability of acceptable water level management options for Reelfoot Lake. Additionally, the topography and land use of the basin has resulted in an unusually high rate of sediment deposition in the lake. The results of the study concluded that increased flooding, decreased lake depths and storage capacity, increased aquatic vegetation, deteriorated water quality, undesirable changes in fish species composition and boating access problems had occurred at Reelfoot Lake. The report presented three feasible comprehensive plans of improvement to address problems and needs of the area. The report concluded that construction of an alternative spillway, vegetative clearing with selective cleanout on Running Reelfoot Bayou, enlargement of the Bayou du Chien channel from Hickman, Kentucky, to the Upper Blue Basin of the lake, and a pumping station on Harris Ditch at the mainline Mississippi River levee would provide flood control benefits to offset most of the costs of the plans. At the time of submittal of the report, the Department of the Army policy stated that projects which did not rely on high

priority outputs of flood control or commercial navigation for project justification would not be budgeted for during times of large budget deficits. Consequently, the results of the report were not certified at that time.

Reelfoot Lake Water Level Management Final Environmental Impact Statement (EIS). This U.S. Fish and Wildlife Service EIS, June 1989, examined six water level management options at Reelfoot Lake including: (1) No action, (2) Dynamic Water Level Fluctuation, (3) Major Drawdown, (4) State law, (5) Raise Permanent Pool One Foot, and (6) Integrated program of Dynamic Water Level Fluctuation Combined with Periodic Major Drawdowns (Preferred Alternative). The preferred alternative recommended maintaining at least a 2 foot seasonal fluctuation between elevations 280.0 and 284.0 NGVD each year with periodic (every 5 to 10 years) drawdowns of 4 feet with the present water control structure or up to 8 feet with a new water control structure. Following a drawdown, the lake would gradually refill and be held at elevation 283.2 NGVD until June 1 of the following year. The report concluded that the preferred alternative would have both short term and long term impacts (beneficial and adverse). However, it provides the best long term water level management option for the lake. The Federal Register filing date for this FEIS was July, 1989.

Reelfoot Joint Venture Plan, North American Waterfowl Plan. This plan was prepared under the guidelines of the North American Waterfowl Management Plan to protect and enhance wetland habitat critical to waterfowl populations. The plan recommended the construction of a 1,200 acre sediment retention basin on Reelfoot Creek, an alternative spillway at Reelfoot Lake, and combinations of dikes, weirs, terraces, water control structures, wells, culverts, reforestation, and other facilities at Long Point Expansion, West Bank, East Bank, Lake Isom, Lake No. 9, Shelby Lake, and Fish Pond in the vicinity of Reelfoot Lake. It also recommended acquisition, protection and restoration of 18,000 acres of wetlands. The plan proposed a joint venture with state and Federal agencies to achieve protection and enhancement of the critical habitat. This plan was jointly prepared by members of the Corps. Memphis District: FWS, Cookeville, TN.; Kentucky Department of F. & W. Resources; and TWRA.

Existing Projects

A number of existing projects, including three constructed by the Corps of Engineers, have played a significant role in the evolution of the environment of the basin to its present condition.

1. Mississippi River Levees. One of the first projects to affect Reelfoot Lake was the construction of the main line Mississippi River levees, by the Corps of Engineers, in the early 1900's. The main line Mississippi River levee was authorized by the Flood Control Act of 15 May 1928 and subsequent amendments. The levee serves as the drainage divide along the northern edge of the Reelfoot basin. The construction and subsequent modification of Mississippi River levees has stopped the almost annual overflow of the Mississippi River into Reelfoot Lake. The construction of the main line levee from Hickman, KY to the area known as the Tiptonville Dome, near Tiptonville.

TN, was the first to influence the hydraulic regime of Reelfoot Lake. The construction of this section of levee stopped the overflow from the Mississippi River which historically, recharged and flushed the lake. The construction of this section of the mainline levee was completed around 1930. The mainline levee was extended 16 miles between the Tiptonville Dome and the Obion River between 1939 and 1940. The levee was then extended 23 more miles between 1951 and 1960.

2. Outlet Channel. Running Reelfoot Bayou, which is the outlet from Reelfoot Lake, extends generally southward from the spillway approximately 16 miles to the Obion River. Flood control improvements on Running Reelfoot Bayou, authorized by the Flood Control Act of 24 July 1946 and 3 September 1954, as modified, were completed by the Corps of Engineers in 1959. The project basically consisted of channel enlargement for Running Reelfoot Bayou. Prior to the project, operation of the spillway was limited by the flow that could be released into Running Reelfoot Bayou. Flooding in the area south of Reelfoot Lake (i.e. Shelby Lake and Lake Isom) also occurred more frequently due to limited channel capacity and backwater stages from the Obion River.

The completion of the enlargement of Running Reelfoot Bayou enabled water elevations in Reelfoot Lake to be lowered more quickly than before the project. Reduced flooding in the downstream areas caused a long term "drying effect" on the Shelby Lake and Lake Isom areas. Due to increased flood control capabilities, seasonal flooding around the perimeter of the lake was reduced resulting in an increase in clearing of wetlands for farming activities. The habitat provided by these wetlands was lost. Of greater importance to the lake, the loss of the wetlands resulted in the loss of the wetland functions that helped to maintain Reelfoot Lake. These wetland functions include the ability to store and gradually release flood waters and trap sediment.

3. Flood Control. The Western Tennessee Tributaries, Tennessee and Kentucky project, formulated and designed by the Corps of Engineers in response to legislation described under "Prior Studies and Reports", included a double 6-foot by 9-foot gated box culvert and a 500 cfs pumping station at the Mississippi River levee just north of Lake No. 9, a diversion channel to divert upper Bayou du Chien to the pumping station, additional channel work in the areas north and south of Lake No. 9 and water control structures. A control structure on Bayou du Chien north of Reelfoot Lake would allow normal low flows from upper Bayou du Chien to drain into the lake but would divert flood flows to the Lake No. 9 gravity outlet and pumping station. Another control structure would maintain the level of Lake No. 9. Partial improvement of the channel north of Lake No. 9 and construction of a gravity outlet and pumping station near the north end of Lake No. 9 in Kentucky were completed by the Corps of Engineers under Section 201 of the Flood Control Act of 1965 with corresponding Senate and House Resolutions in 1970.

In 1917, the State of Tennessee constructed a levee and an "overflow" spillway along the south shore of Reelfoot Lake to control water levels. This was followed by construction of a drainage canal (now Running Reelfoot Bayou) southward from the spillway to the Obion River. In 1931, the Tennessee Fish and Game Commission (now

TWRA) constructed a new concrete spillway. A steel radial gate was added to the spillway in 1948.

Sediment retention basins have been constructed upstream of Kirby Pocket and Samburg, Tennessee by the Obion Forked Deer Basin Authority. An additional eight of fifteen proposed sediment retention basins have been constructed east of Reelfoot Lake through the cooperative efforts of the Natural Resources Conservation Service, TWRA, and the Tennessee Department of Environment and Conservation.

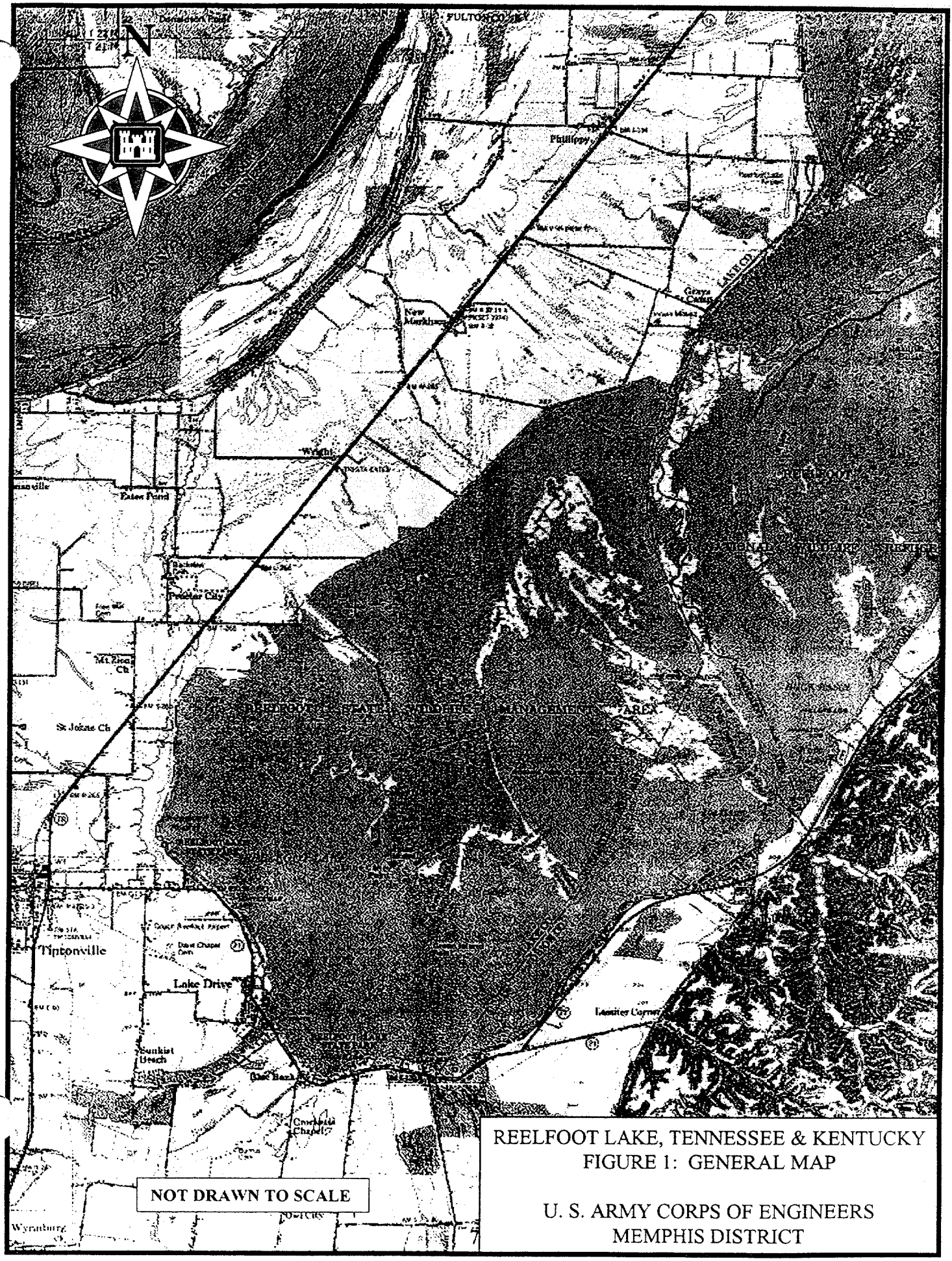
Flood control has been a primary purpose of each of the above projects. The present Reelfoot Lake spillway was constructed to increase the discharge capacity. The radial arm gate increased the discharge capacity even more and the work on Running Reelfoot Bayou provided the outlet channel to carry the increased discharge from the spillway improvements. These improvements also provided increased water level management capabilities to minimize the adverse impact of lake storage losses resulting from sediment deposition.

PLAN FORMULATION

History of Reelfoot Lake

Reelfoot Lake was formed by the New Madrid earthquakes of 1811 and 1812 and now covers approximately 15,500 acres at a pool elevation of 282.2 NGVD. The intensity of the major quakes of the 1811-1812 series has been estimated to be among the strongest to occur on the North American continent in historic times (Smith & Pitts, 1982). The lake formed by the earthquakes is the largest natural freshwater lake in the state of Tennessee and one of the largest in the nation. It is located east of the Mississippi River, approximately 120 miles north of Memphis, Tennessee and about 6 miles east of Tiptonville, Tennessee, in Lake and Obion Counties, Tennessee, and Fulton County, Kentucky. The majority of the open water in the lake lies in the state of Tennessee, however, the upper portion of the lake, marshland, and drainage basin lie in the state of Kentucky. Figure 1 shows a general map of the Reelfoot Lake area.

Prior to the formation of Reelfoot Lake, it is generally accepted that the area was an extensive forested wetland. Notable characters such as David Crockett were attracted to the Reelfoot Lake area. Some Confederate survivors of the Battle of Island Number 10 took cover in the swamps of Reelfoot Lake to avoid being captured during the Civil War (Smith & Pitts, 1982). The Tennessee Division of Archaeology has recorded numerous distinct sites. A number of these sites are eligible for listing in the National Register of Historic Places (Johnson, et al. 1988).



REELFOOT LAKE, TENNESSEE & KENTUCKY
FIGURE 1: GENERAL MAP

U. S. ARMY CORPS OF ENGINEERS
MEMPHIS DISTRICT

By the mid 1800's, the Tiptonville area to the west of the lake had begun to develop as a shipping and receiving point for river traffic and slowly expanded into an agriculturally based community. Many large plantations were thriving on timber sales and cotton production. With the agricultural and associated commercial development in the area, the importance of Reelfoot Lake as a storage area for the attenuation of floods became apparent. At the same time, Reelfoot Lake was gaining notoriety for its rich natural resources. Commercial fishing and market hunting increased, contributing to the area's recognition by sportsmen.

Construction of the Mississippi River levees in the early 1900s impacted the Reelfoot Lake basin significantly. The levees stopped the seasonal overflow of the Mississippi River into Reelfoot Lake and the surrounding basin. With the construction of the levees and the reduced flooding from the Mississippi River, an increase in the conversion of land from forests to agricultural purposes occurred which included extensive clearing of forested areas. This, in turn, resulted in a decline in fish and wildlife habitat in the Reelfoot Lake basin.

As agricultural and recreation interest increased and the lake's surrounding areas began to develop, conflicts occurred. With the continued clearing of upland and bottomland forests for crop production, the natural filling of the lake with sediment from the incoming drainage was greatly accelerated, causing the rapid succession of open water areas to densely vegetated wetlands and swamps. The sediment deposition in the lake decreased the flood control storage capacity of the lake and thus caused increased flooding.

National Significance

Reelfoot Lake and the surrounding wetlands are nationally significant for several reasons. The first reason is the unique size and history of Reelfoot Lake. It is the largest natural lake in the state of Tennessee and its unique history of formation by the earthquakes of 1811 and 1812 are well known. All seasonally flooded bottomland hardwood forests are nationally significant resources. Reelfoot Lake is also nationally significant because of its location. It is located within the area known as the Mississippi Flyway and provides valuable habitat for nationally significant migratory waterfowl species. The third reason the lake is nationally significant is because it is the home of a large number of wintering Bald Eagles. The Bald Eagle is a threatened species which, by law, makes it a nationally significant resource. The Bald Eagles return each year to winter at Reelfoot Lake because of the wetland habitat and the productive fishery that exists at Reelfoot Lake. Reelfoot lake has also been listed as a *Threatened National Natural Landmark* by the National Park Service, U. S. Department of the Interior (1988). In addition, the Tennessee Water Quality Control Board recently approved Outstanding National Resource Water status for Reelfoot Lake and associated wetlands. This new status essentially assures that any project or activity that might adversely impact the lake waters would fall under intense scrutiny. However, the features of this project are designed to protect and improve water quality.

Problems and Opportunities

The Feasibility Study was conducted in a manner that would utilize the data and information that was gathered during the Reconnaissance Study along with significant amounts of additional data and studies which were gathered/performed during the Feasibility Study. Several meetings were held which involved the sponsor and other interested groups and/or individuals to investigate their perceptions of the problems that are occurring at Reelfoot Lake. In a general sense, the problems that have been identified during the feasibility study closely resemble those that have been identified in prior studies.

Problems

Loss of Aquatic Habitat. The most critical problem that has been identified at Reelfoot Lake is the loss of aquatic habitat. The loss of aquatic habitat within the lake is due to two specific problems. These problems are 1) excessive amounts of aquatic vegetation within the lake and 2) deposition of sediment which are occurring within the lake. The increasing aquatic vegetation clearly results in a reduction of the open water habitat within the lake. The deposition of sediment reduces the depth of the water which in turn reduces the overall volume of aquatic habitat. The sediment deposition problems are particularly critical within the upper basins of the lake.

The hypereutrophic condition that is occurring at Reelfoot Lake can be partly identified by the excessive plant growth that is occurring throughout the lake. The various species of aquatic plants that thrive seasonally within the lake are choking out the open water aquatic habitat. The massive plant growth inhibits circulation of water between the four main basins of the lake and reduces the fish habitat. The decaying plant material contributes to an accumulation of excessive residual nutrients on the lake bottom. The residual material accumulations combined with high sediment levels create a soft, fluffy bottom on the lake which is not highly productive habitat for fish spawning.

Sediment deposition is slowly filling Reelfoot Lake. The sediment is primarily the result of runoff from agricultural areas that flows into the lake. The swift flowing, sediment laden runoff from Reelfoot Creek and other tributaries entering the lake drop their load of sediment into the lake once the flow reaches the calm water of the main pools. As the sediment is deposited, the lake becomes shallower which, in turn, encourages additional aquatic plant growth. The additional residual material from this plant growth causes the lake to fill faster. The sediment deposition problem is most prevalent in Buck Basin and Upper Blue Basin however, deposition of sediment is occurring throughout the lake.

Declining Water Quality. Water quality in Reelfoot Lake is effected by several factors. One of the major factors is the sediment laden runoff from agricultural fields that surround the lake. This runoff contains high amounts of agriculture related nutrients such as nitrogen and phosphorus which effect water quality parameters and also encourages plant growth. Sampling and monitoring of water quality throughout the lake indicate that many parameters such as dissolved oxygen level, temperature, biochemical oxygen demand,

ammonia, suspended solids, and pH level do not meet accepted criteria. More specific data on the measurement of these criteria is included later in this report.

Loss of Waterfowl Habitat. The next major problem that has been identified at Reelfoot Lake is the loss of waterfowl habitat. This loss of habitat includes both open water habitat and forested wetland habitat. Historically, the lake was surrounded by vast swamps and seasonally flooded hardwood forests. These areas provide excellent waterfowl habitat. The loss of waterfowl habitat currently occurring is mainly due to the draining and clearing of wetland areas for agricultural and timber harvesting purposes. These practices have occurred throughout the Reelfoot Lake area.

Reelfoot Lake, along with the various wetlands that surround the lake, is an important part of the Mississippi Flyway. This flyway extends south from the headwaters of the Mississippi River through the midsection of the country to the Louisiana Gulf Coast. Millions of migrating waterfowl follow this route each year during their annual migration. Reelfoot Lake and the surrounding wetlands serve as a resting and feeding area for the waterfowl on their journey. The huge loss of wetlands that has occurred in the Reelfoot Lake area, along with many other areas in country, emphasizes the need to protect and restore these remaining areas of wetland habitat.

Reduced Water Level Management Capability. The water level in Reelfoot Lake is currently controlled by a spillway structure on Highway 22 east of Tiptonville, TN. The existing spillway cannot be repaired to function in the manner that it was built to function. The structure experiences underseepage, has structural cracks, and has exceeded its design life. The structure does not have the outlet capacity to draw down the lake in an acceptable time period. The spillway is a stop log structure which also has one rotating radial gate (Tainter gate). Stop logs can be added in one foot increments to raise the water elevation. The top of the stop logs are at elevation 282.2 NGVD. The radial gate can be opened to allow additional flow through the structure when needed. However, because the spillway is a stop log structure and the radial gate is in a state of disrepair, it lacks the capability to either raise or lower the water elevation in the lake in an efficient and effective manner. This lack of capability severely restricts the water level management capability for Reelfoot Lake and essentially prevents the implementation of advanced water level management techniques for the improvement of the aquatic environment.

Opportunities

Improved Recreational Opportunities. Reelfoot Lake and the surrounding area are used extensively for numerous types of public recreational activities. These activities vary from fishing and hunting, eagle and wildlife observation, camping, hiking and various day-use activities. The Reelfoot Lake State Park, located on the southern shore of the lake adjacent to the existing spillway site, is a popular site for public gatherings. As the problems mentioned above continue to occur, the recreational opportunities will slowly decline as the natural resources of the area diminish. The opportunity exists to increase the current level of recreational activities by restoring the natural resources of the area to a more historic level. In particular, fishing, a very popular recreational

activity at Reelfoot Lake, can be improved by addressing the problem of loss of aquatic habitat.

Existing Conditions

General Description of the Project Area. Reelfoot Lake is located within the Mississippi Alluvial Plain in portions of Lake and Obion counties in northwest Tennessee and a section of Fulton County in southwest Kentucky. The lake is situated between the Mississippi River to the west and north and loess bluffs and upland hills to the east. With a surface area of approximately 15,500 acres at a pool elevation of 282.2 feet NGVD, Reelfoot Lake is the largest natural lake in Tennessee. Approximately 10,200 acres of the lake are open water and the remaining acreage is marsh and swamp. The lake can be generally divided into three distinguishable basins - Blue Basin, Buck Basin, and Upper Blue Basin. It has one incorporated area, Samburg, Tennessee - a very small community with the following attributes: located, centrally, at the point of intersection of Bluff Road and State Highway 22; less than 350 residential and non-residential structures; less than 500 residents; no industry, excluding tourism associated with the lake; and a primary source of income for residents is the Reelfoot Lake economy and the Lake County state prison.

The Reelfoot Lake area contains approximately 31,256 acres of publicly owned land and water. The Reelfoot State Park, Tennessee Department of Environment and Conservation (formerly Tennessee Department of Health and Environment), owns and manages 279 acres of land; and the Tennessee Wildlife Resources Agency (TWRA) owns and manages the 18,700-acre Reelfoot Wildlife Management Area. The U.S. Fish and Wildlife Service (USFWS) manages the 10,427-acre Reelfoot National Wildlife Refuge (NWR); the USFWS leases 7,847 acres from the State of Tennessee for the Reelfoot NWR and owns the remaining 2,580 acres (541 acres in Tennessee and 2,039 acres in Kentucky). In addition, the USFWS owns and operates the 1,850-acre Lake Isom NWR which is located approximately five miles south of Reelfoot Lake.

Climatology. A weather station at Reelfoot NWR, Samburg, Tennessee, has collected sufficient climatological data for the calculation of normal (i.e., average value over 1951-1980 time period) average monthly temperatures and normal monthly precipitation totals (NOAA 1989,1990). The two warmest months are usually July (79.9 degrees F) and August (78.0 degrees F), and the coolest months are most often January (34.9 degrees F) and February (38.8 degrees F). Typically, the wettest months at Reelfoot Lake are March (5.05 inches) and May (4.89 inches); and the driest months are September (3.08 inches) and October (2.55 inches). The Reelfoot Lake watershed receives an average of 49 inches of precipitation annually (McIntyre et al. 1986).

Hydrologic Characteristics. Reelfoot Lake was subjected to flood waters from the Mississippi River until a levee was constructed along the east bank of the river between 1910 and 1920, preventing surface inflow from the river. Prior to the construction of the levee, flood waters from the river could induce lake levels as much as 10-12 feet above normal. A highway (now Tennessee Hwy. 22) was constructed along the southern shore of the lake between 1915 and 1919; this highway effectively restricted the natural drainage of

the lake. During this same time period an 80-foot spillway was built at a controlling elevation lower than the natural outlets. In 1929, the Tennessee Legislature authorized the construction of the existing spillway. This spillway, completed in 1931, was built at an elevation of 282.2 feet NGVD. The State of Tennessee granted responsibility of controlling lake levels to the USFWS in 1941. The USFWS maintained water levels at Reelfoot Lake as close to 282.2 feet NGVD as possible for several decades.

The Reelfoot Lake Water Level Management Final Environmental Impact Statement was issued by the U.S. Department of the Interior Fish and Wildlife Service in July 1989. This EIS evaluated the water level management practices that have occurred at Reelfoot Lake in the past and made recommendations concerning future practices. The USFWS preferred alternative from the 1989 EIS was an "Integrated Program of Dynamic Water Level Fluctuation Combined with Periodic Major Drawdown". This management plan has not been fully implemented. However, in 1991, an Interim Water Level Management Plan was implemented and is the current practice at Reelfoot Lake. The interim plan allows for the water level in the lake to fluctuate to elevation 283.2 during the non-growing season (November 15 – April 15) and to approximately elevation 282.7 the remainder of the year before opening the spillway gates.

At the normal pool elevation of 282.2 feet NGVD, Reelfoot Lake has a surface area of approximately 15,500 acres, an average depth of about 5.2 feet, and a volume of approximately 80,300 acre-feet. The Reelfoot Lake watershed is approximately 240 square miles. Reelfoot Creek and Indian Creek, originating in the uplands east of the lake, and Bayou du Chien, which drains alluvial bottomlands to the north, are the major tributaries to Reelfoot Lake. The lake outlet, Running Reelfoot Bayou, is located at the south end of the lake. Outflow from the lake into the bayou is controlled by a flashboard gated spillway and radial gate.

The three upper geohydraulic units in the Reelfoot Lake vicinity (in descending order) consist of a water-table aquifer, about 100 to 200 feet of Mississippi River alluvium; a confining unit, approximately 250 feet of fine sand and clay; and Memphis Sand, approximately 600 feet of highly permeable sand (TWRA 1985, Johnson et al. 1988). Precipitation is the principle source of recharge for the alluvial water-table aquifer. Other sources of recharge for the alluvial aquifer are surface runoff and underflow from the uplands east of the lake, seepage from the Mississippi River and its tributaries, and seepage from Reelfoot Lake. (TWRA 1985, Johnson et al. 1988)

Water Quality. Reelfoot Lake has been identified as a hypereutrophic lake (Johnson et al. 1988, USFWS 1989). Hypereutrophic lakes are in an advance stage of eutrophication and are characterized by poor water quality and excessive plant growth. The aging process at Reelfoot Lake has been greatly accelerated by human activities. Agricultural and silvicultural activities have increased erosion on lands adjacent to the lake and, thus, increased sediment deposition into the lake. Since most of this sediment is eroded from agricultural fields, large amounts of agriculture-related nutrients, such as nitrogen and phosphorus, enter the lake (USFWS 1989). According to Denton (1987), nonpoint pollution

is severely impacting Reelfoot Lake; and the principal source of nonpoint pollution is erosion from the uplands east of the lake.

Sedimentation studies (Tenn. Dept. of Health and Env. 1984, Denton 1986, McIntyre et al. 1986) were conducted at Reelfoot Lake to determine sedimentation rates, identify and quantify sediment sources, and develop measures that could be implemented to reduce sedimentation. Based on sedimentation rates, it was projected that Blue Basin, Buck Basin, and Upper Blue Basin would become too shallow (2-foot water depth) for most uses in 210, 110, and 60 years, respectively. It was estimated that collectively 93.4% of the sediment entering the lake was being transported by Reelfoot Creek (85.2%), Indian Creek (6.5%), and Bayou du Chien (1.7%). However, sediment-retention basins have been constructed on Indian Creek and a lake tributary that enters Buck Basin at Kirby Pocket since these studies were conducted. Also, several watershed lakes have been constructed in the uplands east of Reelfoot Lake.

Denton (1987) documented and interpreted the results of water quality monitoring in the Reelfoot Lake area by the Tennessee Department of Health and Environment (now Tennessee Department of Environment and Conservation) from 1976 through 1986. Data were collected from sampling stations in Reelfoot Lake, Reelfoot Creek, Indian Creek, and Running Reelfoot Bayou to measure numerous water quality parameters. A Water Quality Index (WQI) was used to compare parameter measurements to water quality criteria (i.e., values assigned to parameters that represent levels needed to protect water quality), compare parameter measurements among sampling stations, and establish water quality parameters of concern. Only data collected from January 1984 through December 1986 were used in the WQI since the purpose was to assess the current water quality status.

Two sampling stations were established in each of the three major basins of the lake - Blue Basin, Buck Basin, and Upper Blue Basin. Although measurements of specific water quality parameters varied among the six stations, The WQI evaluation indicated that water quality was best in Blue Basin and poorest in Upper Blue Basin. Most of the Reelfoot Lake parameters of concern were associated with eutrophication. These parameters included light transmission (Secchi disk), chlorophyll "a", biochemical oxygen demand, low dissolved oxygen, and high pH. High levels of nitrates and phosphorus, causative agents of eutrophication, were also highly ranked parameters of concern in the lake.

Reelfoot Creek had the poorest water quality of the three lake tributaries sampled. Mean values of four parameters (nitrate, phosphorus, suspended solids, and copper) exceeded water quality criteria; and significant water quality criteria violations were recorded for dissolved oxygen, pH, and fecal coliform bacteria. Significant levels of mercury, zinc, and nickel were also recorded at the Reelfoot Creek sampling station. Fecal coliform bacteria levels in Bayou du Chien consistently exceeded the criterion; and the criteria for mercury, copper, and zinc were surpassed at this station. Water quality at the Indian Creek sampling station was surprisingly good. Temperature and fecal coliform bacteria exceeded the criteria in only one and two samples, respectively. Copper, zinc, and mercury surpassed the criteria in 14% of the samples taken from Indian Creek; and phosphorus and suspended solids exceeded the criteria in 13% of the samples.

Since significant levels of mercury, zinc, nickel, and copper have been recorded; there is reasonable concern for the implications associated with sediment exposure during a drawdown. For this reason, the monitoring plan that will be completed prior to project implementation will be fully coordinated with FWS, TWRA, TDEC, and EPA.

At the Running Reelfoot Bayou (lake outlet) station, fecal coliform bacteria and chlorophyll "a" exceeded the criteria in 67% and 40% of the samples, respectively; and nitrates and phosphorus exceeded the criteria in 50% of the samples. Dissolved oxygen, temperature, biochemical oxygen demand, ammonia, and suspended solids did not meet water quality criteria. Also, pH levels above and below the criterion value range were observed at this station.

Geology and Topography. The Reelfoot Lake watershed is located within the Mississippi Embayment section of the Gulf Coastal Plain. The Reelfoot Lake area is characterized by several physiographic features - the lake itself; the Mississippi River alluvial floodplain; Tiptonville Dome, an elliptical-shaped rise extending from Proctor City, Tennessee, south to Tiptonville, Tennessee; a bluff line east of the lake that crosses the watershed along a northeast-southwest axis; and uplands east of the bluffs.

The "basement" of the embayment is formed by Paleozoic rocks ranging in age from Cambrian to Pennsylvanian. Upper Cretaceous deposits are located above the Paleozoic rocks; these sediments (primarily marine origin) consist of sands, clays, chalks, and marls. The Upper Cretaceous deposits are overlain by Tertiary Sediments. The Wilcox Group (Fort Pillow Sand) and the Claiborne Group (Memphis Sand) are major Tertiary aquifers in west Tennessee. The largest aquifer in west Tennessee, the Memphis Sand, is contained in the Claiborne Group; the Memphis Sand comprises the lower and middle portions of the Claiborne Group. The Jackson Formation is located just above the Memphis Sand. The Jackson Formation is the oldest exposed formation in the Reelfoot Lake watershed, and it can be seen along the base of the bluff line.

East of the bluff line, Pliocene terrace deposits of sand and gravel lie above the Jackson Formation. These terrace materials were deposited by streams ancestral to the Mississippi River. The Pliocene deposits have a maximum depth of 30 feet, thinning eastward. A layer of loess covers the terrace deposits; the loess is about 80 feet thick along the western edge of the uplands, thinning to the east.

Mississippi River alluvial deposits, Quaternary in age, overlay the Jackson Formation west of the bluff line. These sediment deposits are from 100 to 200 feet thick and consist of intermixed lenses and layers of silt, gravel, and clay. The Mississippi River alluvium is an important source of ground water in the Reelfoot Lake area.

Vegetation. Most of the historically vast forested wetlands of the Reelfoot Lake drainage basin have been cleared and drained for agricultural purposes. Only small remnants of bottomland hardwood forests and forested swamps exist immediately adjacent

to Reelfoot Lake and Lake Isom, along some drainages, and within low-lying areas that are unsuitable for farming and other development.

The vegetated wetlands associated with the Tennessee portion of the Reelfoot Lake area, including Lake Isom NWR, were quantified using Tennessee Wetland Inventory maps generated by the TWRA; and the wetlands within the Kentucky portion of Reelfoot Lake were measured from National Wetland Inventory maps produced by the USFWS. The wetland classification utilized by both map types was based on Cowardin et al. (1979). Study area wetlands were then placed into five general vegetative categories - bottomland hardwood forest, forested swamp, scrub/shrub swamp, persistent marsh, and submersed macrophytes. Although not identified on the wetland inventory maps, nonpersistent marshes exist in the Reelfoot Lake area (Henson 1990d) and were included as a sixth vegetative category.

Bottomland hardwood forests are forested wetlands characterized by broad-leaved deciduous trees that are 20 feet tall or taller. Common tree species include green ash (*Fraxinus pennsylvanica*), American elm (*Ulmus americana*), hackberry (*Celtis occidentalis*), eastern cottonwood (*Populus deltoides*), sycamore (*Platanus occidentalis*), sweetgum (*Liquidambar styraciflua*), red maple (*Acer rubrum*), silver maple (*A. saccharinum*), pecan (*Carya illinoensis*), and various oaks (*Quercus* spp.). The Reelfoot Lake area contains approximately 13,139 acres of bottomland hardwood forest. These forests grow in temporarily, seasonally, semipermanently, and permanently flooded sites; and sites that are intermittently exposed.

Baldcypress (*Taxodium distichum*) trees, at least 20 feet tall, dominate the forested swamps in the Reelfoot Lake area. Approximately 7,750 acres of forested swamps exist within the study area, and the water regimes of these swamps range from seasonal to permanently flooded. Permanently inundated baldcypress trees occur in portions of all three basins of the lake. The trunks of most of the permanently inundated trees have developed swollen buttresses; and these trees, with the exception of those growing in very shallow water, exhibit varying levels of decadence due to water stress (Henson 1990a).

Scrub/shrub swamps are dominated by woody vegetation less than 20 feet in height; these swamps contain true shrubs, young trees, and shrubs or trees that are small or stunted due to environmental conditions. Water regimes of scrub/shrub swamps in the study area vary from temporarily to permanently flooded. Major shrub and tree species found in these swamps include buttonbush (Cephalanthus occidentalis), swamp rose (Rosa palustris), red and silver maple, baldcypress, and black willow (*Salix nigra*). There are about 326 acres of scrub/shrub swamp in the study area.

Persistent marshes at Reelfoot Lake occur on sites with water regimes ranging from temporarily to permanently flooded; and they are characterized by rooted, emergent vegetation (i.e., erect herbaceous hydrophytes, excluding mosses and lichens) that usually remains standing at least until the start of the next growing season. Rose mallows (*Hibicus lasiocarpos* and *H. militaris*), southern smartweed (*Polygonum densiflorum*), swamp smartweed (*P. hydropiperoides*), common cattail (*Typha latifolia*), groundnut (*Apios*

americana), swamp loosestrife (*Decondon verticillatus*), primrose willow (*Ludwigia leptocarpa*), water-willow (*Justicia americana*), and giant cutgrass (*Zizaniopsis miliacea*) are among the plants common to these marshes (Henson 1990a). The Reelfoot Lake area contains approximately 2,700 acres of persistent marsh.

Nonpersistent marshes are dominated by emergent vegetation that falls below the surface of the water or to the surface of the substrate at the conclusion of the growing season. According to Henson (1990d), typical plant species that occur in the nonpersistent marshes of Reelfoot Lake include American lotus (*Nelumbo lutea*), spatterdock (*Nuphor luteum*), white water lily (*Nymphaea odorata*), water smartweed (*P. amphibium*), southern smartweed, swamp smartweed, and pickerel weed (*Pontedera condata*). An estimated 536 acres of nonpersistent marsh was identified at Reelfoot Lake in 1986 (Henson 1990d).

Submersed macrophytes are vascular plants that grow primarily on or below the surface of the water for the majority of the growing season during most years. Henson (1990c) lists coontail (*Ceratophyllum demersum*) and curlyleaf pondweed (*Potamogeton crispus*) as abundant, and small pondweed (*P. pusillus*) and fanwart (*Cabomba caroliniana*) as common submersed macrophytes in the lake. Only 188 acres of submersed macrophytes were delineated on the wetland maps; however, it is important to note that submersed macrophyte zones can very drastically in size from year to year. In fact, curlyleaf pondweed entirely covered Buck and Upper Blue basin in the spring of 1993.

In addition to the aforementioned vegetative groups, small free-floating macrophytes are prevalent in the study area. Mosquito fern (*Azolla caroliniana*), smaller duckweed (*Lemna minor*), giant duckweed (*Spirodelia polyrhiza*), columbia watermeal (*Wolffia columbia*), and papillary watermeal (*W. papulifera*) are abundant in many nonpersistent marshes, swamps, and ditches (Henson 1990d). A thick cover of floating macrophytes often obscures submersed macrophytes, particularly in very shallow areas (Henson 1990c).

Vast shallow-water areas created by sedimentation, nutrient-rich agricultural runoff, and stable water levels have provided conditions at Reelfoot Lake that are conducive to abundant aquatic plant growth (Tenn. Dept. of Health and Envir. 1984, TWRA 1985, Johnson et al. 1988, USFWS 1989). Encroachment of emergent aquatic plants into former open-water areas and expansion of woody vegetation into shallower regions provide evidence that ecological succession is rapidly occurring at the lake (USFWS 1989). Henson (1990b) studied vegetational succession at Reelfoot Lake; the following paragraph briefly summarizes some of his findings.

> *Since the early 1960's, extensive monotypic marshes of giant cutgrass have been replaced to a large extent by marsh-swamp transitional species of herbs, vines, shrubs, and immature trees. Southern smartweed competes with giant cutgrass and other persistent emergent species along shallow margins of marsh-swamp transitional zones and low-lying areas of persistent marsh. Southern smartweed also slowly induces edge encroachment into open water by trapping organic and inorganic material. Former giant cutgrass marshes have succeeded to marsh-swamp vegetation*

with little expansion of this grass into new areas; therefore, persistent marshes have declined drastically in recent years. Sediment deposition will continue to promote the invasion of aggressive competitor species, such as southern smartweed, into shallow areas of giant cutgrass marsh, converting these areas to nonpersistent marsh. These areas of nonpersistent marsh will gradually succeed to scrub/shrub swamps; and, in turn, these scrub/shrub swamps will slowly convert to forested swamps.

Although aquatic plants in Reelfoot Lake provide protective cover for young fish and furnish great amounts of food for fish and waterfowl (Johnson et al. 1988), excessive aquatic plant growth has been a problem in the lake for many years (Baine and Yonts 1937, Gersbacher and Norton 1939, Baker 1940, Steenis and Cottam 1945). Overly abundant aquatic vegetation impacts dissolved oxygen concentrations (Baine and Yonts 1937, Gersbacher and Norton 1937), inhibits water circulation (Johnson et al. 1988), and contributes to the accumulation of excessive residual nutrients (USFWS 1989). In addition, aquatic vegetation encroaches into open water areas; and heavy aquatic plant growth interferes with boating, fishing, and other water-related recreational activities.

Steenis and Cottam (1945) conducted experimental cuttings of aquatic pest plants at the lake in search of a method(s) by which to control obnoxious vegetation and encourage growth of plant species more palatable to waterfowl. They concluded that Hochney underwater cutters could be used to at least partially control giant cutgrass, spatterdock, and American lotus. However, they warned that control of one obnoxious species may result in the emergence of another aquatic pest plant that was formerly suppressed.

Burbank (1963) identified giant cutgrass, spatterdock, and American lotus as the primary aquatic pest plants in Reelfoot Lake. He reported that attempts to control giant cutgrass prior to 1948 with an underwater cutter and by burning were terminated. Underwater mowing was discontinued because stumps frequently damaged the cutters, and burning was halted because complete root kills were never obtained. Burbank (1963) also evaluated the herbicidal treatment program at Reelfoot Lake that began in 1948. He concluded that herbicides had been helpful in controlling lotus; and although cutgrass acreage had been reduced very little over the 14 years of herbicide treatments, he implied that herbicides may have possibly prevented the spread of this species into new areas. Spatterdock had not been targeted for control and had only recently been considered a pest species. Unfortunately, spatterdock invaded areas where cutgrass had been eliminated or reduced. Some experimental herbicide applications were made on spatterdock but were ineffective.

Curlyleaf pondweed, an exotic species, was first discovered in Reelfoot Lake in 1959 (Cypert 1967). According to Cypert (1967), this plant spread rapidly after introduction and occupied approximately 2,000 acres of the lake by 1967. Experiments by the Reelfoot NWR and the Tennessee Game and Fish Commission (now TWRA) in 1964 revealed that Diquat herbicide would kill curlyleaf pondweed. However, it was thought that herbicidal control of this plant would probably have to be limited to small areas, such as boat trails,

since the wide distribution and aggressiveness of curlyleaf pondweed made eradication or control of this plant with herbicides appear impractical. (Cypert 1967)

The TWRA introduced 30,000 white amur (*Ctenopharyngodon idella*), an exotic fish, into Reelfoot Lake in 1983 in an attempt to control submersed vegetation (Johnson et al. 1988). All submersed macrophytes declined drastically at all areas sampled within two years after stocking (Sliger and Henson 1987). Sliger and Henson (1987) reported that curlyleaf pondweed and coontail were dominant at all sample sites before the white amur introduction, but these plants were no longer pests two years after white amur introduction. However, curlyleaf pondweed and coontail increased during 1987, prompting white amur restocking (Henson and Sliger 1993). The TWRA released an additional 79,402 fish from 1988 through 1991. Submersed macrophytes recolonized most of the previously cleared areas by 1990, and populations in some zones approached or surpassed levels that existed prior to white amur introduction in 1983. (Henson and Sliger 1993).

Coontail, and southern smartweed have been major aquatic pests in Reelfoot Lake during recent years (Dr. Wesley Henson, U. Tenn. at Martin, pers. comm.). Coontail is presently the most prolific aquatic pest plant in the lake. The vegetation problem is most severe in Buck Basin and Upper Blue Basin. Although the amount of area infested with vegetation varies annually, Buck and Upper Blue basins were completely choked with coontail during the spring of 1993 (Paul Brown, Reelfoot WMA, pers. comm.). Coontail normally reaches maximum biomass during the principle fishing period (March-June) at the lake; this often makes large areas of the lake inaccessible to fishermen. During late June/early July coontail quickly replaces curlyleaf pondweed and becomes the dominant aquatic plant during summer and fall. Coontail often becomes widespread, but does not become as densely matted as curlyleaf. At present, southern smartweed is not a problem in the lake because a severe freeze in 1989 killed most of the plants growing in shallow water areas; however, populations of southern smartweed are beginning to reestablish in these areas (Dr. Henson, pers. comm.).

According to Dr. Henson (pers. comm.), two other aquatic plants, water pennywort (*Alternanthera philoxeroides*) and Eurasian watermilfoil (*Myriophyllum spicatum*), could become pests in the future. Water pennywort has been increasing in abundance since 1986 and will probably become a pest in shallow areas of the lake. Eurasian watermilfoil is present in the watershed lakes east of Reelfoot Lake and could very possibly invade the lake itself.

Dr. William C. Zattau, Chief, Aquatic Plant Control Operations Support Center, Corps of Engineers (COE), Jacksonville, Florida, visited Reelfoot Lake at the request of the Memphis District, COE, to examine and evaluate the aquatic plant problem. In his site-investigation report (see Appendix A), Dr. Zattau recommends an integrated approach to controlling aquatic vegetation in the lake that would include water-level manipulation, mechanical control, and the use of systemic herbicides.

Fish and Wildlife. Reelfoot Lake is one of the most productive commercial and sport fishing lakes in Tennessee (USDI 1989); its reputation as an outstanding fishing lake

began in the early 1890's (Johnson et al. 1988). Although fishes in the lake are presently abundant and diverse, the percent composition (biomass) of game fish has declined over the years while the percent composition of non-game fish has increased (Johnson et al. 1988).

The TWRA has attributed this decline in the sport fishery chiefly to habitat deterioration caused by sedimentation (organic and inorganic) and stable lake levels. Sedimentation and stable water levels have provided conditions favorable for abundant aquatic plant growth. The excessive plant growth has created massive accumulations of organic sediment in many portions of the lake. Low dissolved oxygen levels associated with this organic substrate limit or prevent production of benthic invertebrates, an important link in the fish food chain. Furthermore, the soft organic substrate is unsuitable as spawning habitat for game species such as largemouth bass (*Micropterus salmoides)*, crappie (*Pomoxis* ssp.), and bluegill (*Lepomis macrochirus*) that require a solid bottom for successful spawning. Overabundant vegetation in the lake reduces the amount of suitable habitat for sport fish and impacts the foraging capability of game fish since it furnishes dense protective cover for prey fish.

Eleven game fish species, 11 non-game fish species, and 13 prey fish species were collected by the TWRA during 1991 surveys (Broadbent 1991). Sport fish collected included white crappie (*P. annularis*), black crappie (*P. nigromaculatus*), bluegill, largemouth bass, and yellow bass (*Morone mississippiensis*). Gizzard shad (*Dorosoma cepedianum*), brook silverside (*Labidesthes sicculus*), and golden shiner (*Notemigonus crysoleucas*) were among the most abundant prey species collected. Common non-game fish included freshwater drum (*Aplodinotus grunniens*), common carp (*Cyprinus carpio*), and channel catfish (*Ictalurus punctatus*).

Crappie and bluegill are the most sought after game fish in the lake; sport fishing accounts for approximately 322,806 recreational man-days annually. Crappie and catfish are the most important commercial fishes in Reelfoot Lake; collectively, they represent about 99% (219,234 lbs.) of the total commercial harvest.

The lake, its associated wetlands, and adjacent cleared lands also provide habitat for numerous wildlife species. Forty-seven species of mammals inhabit the Reelfoot Lake area (USFWS 1989). Important game mammals include white-tailed deer (*Odocoileus virginianus*), gray (*Sciurus carolinensis*) and fox (*S. niger*) squirrels, swamp (*Sylvilagus aquaticus*) and eastern cottontail (*S. floridanus*) rabbits, Virginia opossum (*Didelphis virginiana*), and raccoon (*Procyon lotor*). Mink (*Mustela vison*), muskrat (*Ondatra zibethicus*), beaver (*Castor canadensis*), river otter (*Lutra canadensis*), raccoon, opossum, woodchuck (*Marmota monax*), long-tailed weasel (*Mustela frenata*), striped skunk (*Mephitis mephitis*), red (*Vulpes fulva*) and gray (*Urocyon cinereoargenteus*) foxes, bobcat (*Lynx rufus*), and coyote (*Canis latrans*) comprise the study area's furbearers. Non-game mammals consist of three shrew and one mole species, nine bat species, and 16 non-game rodent species.

Nearly 250 species of resident and migratory bird species inhabit the study area (USFWS 1989). The Reelfoot Lake area provides important habitat for migratory and

resident waterfowl. From 1982 through 1998, peak winter populations of ducks and geese have averaged approximately 132,700 and 72,600, respectively. FWS and TWRA managers feel that the upswing in geese populations is typical of the area and flyway increases because geese are foraging on agricultural land, However, duck populations are steadily declining for Reelfoot Lake and Lake Isom. The higher average number is attributed to the acquisition and management of Black Slough WMA and private water management efforts near the lake. The mallard (*Anas americana*) is the most common dabbling duck inhabiting the study area, followed by the American widgeon (*Anas americana*) and gadwall (*Anas strepera*). The ruddy duck (*Oxyura jamaicensis rubida*) and ring-necked duck (*Aythya collaris*) are the most common diving ducks. Other ducks found within the area include the black duck (*Anas rubripes*), American green-winged teal (*Anas crecca carolinensis*), blue-winged teal (*Anas discors*), wood duck (*Aix sponsa*), and northern shoveler (*Anas clypeata*). The Canada goose (*Branta canadensis*) is by far the most common goose at Reelfoot Lake. Other study area game birds include the wild turkey (*Meleagris gallopavo*), northern bobwhite (*Colinus virginianus*), and mourning dove (*Zenaida macroura*).

Shorebirds, gulls, terns, marsh and wading birds, and almost 150 species of songbirds occur in the study area. The American kestrel (*Falco sparverius*); red-tailed (*Buteo jamaicensis*), red-shouldered (*B. lineatus*), and broad-winged (*B. platypterus*) hawks; barred (*Strix baria*), common screech (*Otus asio*), and great horned (*Bubo virginianus*) owls; osprey (*Pandion haliaetus*); and bald eagle (*Haliaeetus leucocephalus*), a federally listed threatened species, are among the raptors that inhabit the Reelfoot Lake area. In fact, Reelfoot Lake winters one of the largest concentrations of bald eagles east of the Mississippi River.

In addition, many reptilian and amphibian species inhabit the Reelfoot Lake area (USFWS 1989). The reptiles are represented by 11 turtle species, six lizard species, and 24 snake species. Study area amphibians consist of 15 species of salamanders and 13 species of toads and frogs.

Endangered and Threatened Species. The only federally listed endangered species occurring in the study area is an avian species, the interior least tern (*Sterna antillarum axthalassos*). Interior least terns nest and feed primarily on the Mississippi River, but these terns occasionally feed in the open water areas of the lake. Reelfoot Lake supports one of the largest concentrations of wintering bald eagles (threatened) in the eastern United States; a peak population of 200 or more eagles is reached annually from late January through February. Bald eagles historically nested at Reelfoot Lake, but no confirmed reports of successful nests were recorded from 1962 through 1987 (Johnson et al. 1988). In an effort to reestablish a nesting population of bald eagles in the Reelfoot Lake area, a eagle hacking program was initiated in 1981 by the TWRA and the Tennessee Ornithological Society (Robert Hatcher, TWRA, pers. comm.). According to Robert Hatcher (pers. comm.), the program was terminated in 1988 after the goal of 43 successfully hacked eagles had been met. Successful nesting has been observed in the study area every year since 1988 (Robert Hatcher, pers. comm.).

The USFWS is also reviewing the status of several species in the Reelfoot Lake area to determine their candidacy for future listing as endangered species (USFWS 1989; Jodi Jenkins, USFWS, pers. comm.). These status review species consist of two mammalian species, eastern woodrat (*Neotoma floridana*) and Rafinesque's big-eared bat (*Plecotus rafinesquii*); two avian species, Bachman's sparrow (*Aimophila aestivalis*) and Bewick's wren (*Thryomanes bewickii*); one reptilian species, alligator snapping turtle (*Macrolemys temminckii*); and two plant species, smooth leafcup (*Polymnia laevigata*) and lake cress (*Armoracia lacustris*).

In addition to the species listed or under status review by the USFWS, numerous plant and animal species are considered by the states of Tennessee and Kentucky to be endangered, threatened, or in need of management.

Recreation. Outdoor recreation, both consumptive and non-consumptive, is a vital component of the local economy. An estimated $3,832,062 are expended annually on study area recreational activities. See Economic Appendix for the complete recreational use analysis.

Consumptive recreation accounts for approximately 72% (343,555 man-days) of the total annual recreational use. In fact, fishing is by far the single most popular recreational activity in the study area; about 322,806 man-days are annually spent fishing. Although the percentage of total recreational time expended hunting is much less than that expended fishing, hunting is considered an important outdoor sport in the study area since it accounts for about 20,749 recreational man-days annually.

Non-consumptive outdoor activities comprise approximately 28% (136,645 man-days) of the annual recreational use. The most popular non-consumptive recreational activities are eagle observation tours, sightseeing, general wildlife observation, and camping, respectively.

Significant Habitat. Significant habitat in the vicinity of Reelfoot Lake consists of the following:

1. Natural aquatic habitat
2. Endangered species habitat
3. Habitat for species managed by international treaties (i.e. waterfowl)
4. Wetlands
5. Bottomland Hardwoods

The current 15,500 acres of surface water at Reelfoot Lake provides the largest natural freshwater lake in Tennessee and one of the largest in the nation. The lake and its surrounding area provide natural aquatic habit, wetlands and bottomland hardwoods which are utilized by 11 game fish species, 11 non-game fish species, 13 prey fish species, 47 species of mammals, 41 reptile species, 28 amphibian species, 150 species of songbirds, and numerous species of migratory birds, game birds and raptors. The lake and its ecosystem also provide nesting and feeding areas for the bald eagle, a federally listed threatened

species. In fact, the lake winters one of the largest concentrations of bald eagles east of he Mississippi River. The least tern has also been known to utilize the area.

Due to shallow lake depths in many areas and numerous tree stumps throughout the lake, the lake does not lend itself to some recreational activities such as water skiing, swimming and similar activities. However, the lake does lend itself to other forms of consumptive and non-consumptive recreation such as fishing and eagle watching.

Natural aquatic habitat is a significant resource because it is essential for many forms of life. It has an unusually high productivity and diversity. It is the only lake in the country with sport fishery production sufficient to allow the commercial harvest of crappie, a sport fish. Because of its location along the Mississippi Flyway, Reelfoot Lake is utilized by millions of waterfowl during the annual migration. Reelfoot Lake has been identified as critical waterfowl habitat in the North American Waterfowl Management Plan.

The projects previously mentioned, as well as other factors, have contributed to the long term degradation of Reelfoot Lake and its ecosystem. The open water area, in Reelfoot Lake, has decreased 27% in the past seventy years and the bottomland hardwood acreage has decreased 92% since 1910 in Lake County alone. It is important to note that all of the Reelfoot Lake area, except for the Tiptonville Dome, was subjected to periodic flooding before the construction of the Mississippi River levees. This drastic reduction in periodic flooding and bottomland hardwood acreage has significantly reduced the waterfowl habitat within the Reelfoot Lake area.

Future Without Project Conditions

The long term effects of siltation, high turbidity, ponding, poor water quality, and loss of species diversity are still being experienced. Pollution in the form of agricultural- and construction-related erosion; pesticide run-off; sewage and other industrial discharge; and ditching and filling for agricultural, residential, and industrial encroachment will continue to take their toll.

General degradation of the existing environment will result in lowered biological productivity, decreased biodiversity, and overall losses to most plant and animal populations. Most fish and wildlife species will decrease proportionally to the loss in quality and quantity of their respective habitat. Fish populations will decline with the encroachment of marsh and scrub/shrub swamp. Raccoons and other furbearers such as minks, beavers, and muskrats will also decline.

The Tennessee Department of Health and Environment published a report in 1986 entitled *Sedimentation In Reelfoot Lake.* According to this report, Blue Basin will become too shallow for most uses in 210 years and Grassy Bend will become unusable in about 110 years. Upper Blue Basin will become too shallow in about 60 years. Buck Basin, with a deposition rate of 1.1 cm/year, will also become unusable in 110 years.

Specific future-without-project conditions are addressed in the following paragraphs according to resource category.

Hydrologic Characteristics. The existing spillway at Reelfoot Lake is over 60 years old and has outlived its design life. Seepage underneath the structure is significant and the stability of the foundation of the spillway is therefore questionable. Operation of the radial gate is minimized as a safety precaution because of the deteriorated structural condition of the gate and supports. A continued decline in the effectiveness and efficiency of the structure and an eventual complete loss of operability of the radial gate is expected.

At some future date, as the amount of seepage under the structure continues to accelerate, it will not be possible to maintain the current pool elevations now achieved under the Interim Water Level Management Plan. Complete failure of the existing spillway structure and a substantial loss of the lake volume is possible. However, because of the value of the unique environmental resources at Reelfoot Lake, it is expected that some interim maintenance would be performed on the spillway in order to at least maintain the current pool elevations. An estimate of a minimal maintenance activity to the structure would be to stabilize the structure and maintain the pool elevation by placing crushed rock on each side of the spillway up to the crest elevation. This would effectively create an overflow weir structure. This type of maintenance activity would allow the pool elevation to be maintained at the same elevations as the existing condition (282.2 NGVD). The radial arm gate, however, would not be operable. This would result in a loss of some flood control capability in the structure. Also, no drawdown capability would exist under this scenario.

Eventually, the spillway structure will have to be replaced in order to maintain the current water level and flood control capabilities. Since it is not possible to predict the exact time at which the spillway must be replaced and because the structure has already outlived its design life, the position has been taken, for analysis of the future without project condition, that the spillway will be replaced by others during the base year of the analysis period. The cost for replacement of the outlet structure by others is estimated to be 75% of the estimated cost of the proposed alternative spillway feature described later in this report. The 75% estimate is based on replacing the existing structure with one of equal capability. This implies that the future without project hydrologic conditions will be the same as the existing condition (interim water level management plan) for maximum pool elevations. Note that this is strictly an estimate used for the evaluation of benefits and costs of the project.

Water Quality. Future water quality will be affected by such factors as encroachment and expansion of residential, industrial, and agricultural activities; drainage modifications; and the presence or absence of erosion control. These activities will increase the amounts of sediment, pesticides, nutrients, and industrial and residential discharges that actually enter the tributaries.

Another serious aspect of the non-point source pollution problem is the threat of pesticide accumulation in the environment. Runoff from farmland may contain significant quantities of these chemicals in solution and in association with soil particles. Even

relatively low concentrations of these chemicals may pose a serious threat, due to the process of bioaccumulation. Aquatic organisms accumulate pesticides, thus increasing their concentrations. As these organisms are consumed by other organisms, the levels of concentration multiply; therefore, low initial concentrations in the environment may lead to extremely high concentrations in higher organisms.

Vegetation. The severe impact of erosion, sediment drop, and the resultant conversion of wetland "type" from open water to marsh and scrub/shrub swamp has already been discussed in the Existing Conditions section of this report. Because each wetland type possesses similar, identical, and different "functional values", it is important to note that all types of wetlands fulfill certain needs and requirements in a given area. For example, all wetland types provide for groundwater recharge, water purification, and flood retention; these functional values are identical. They diverge in that some provide excellent habitat for certain species, such as: reptiles and amphibians in marshes; wood ducks in forested swamps. It is extremely important, however, that there be a balanced distribution of the quantity of each wetland type for each basin or area. There cannot be too many of one or more types, and not enough of the others.

Fish and Wildlife. Further degradation of the aquatic ecosystem of Reelfoot Lake can be expected in the future. Continued clearing for agricultural purposes, even with the Conservation Reserve Program and improved soil management practices, will result in continued silting and high turbidity levels. This will obviously degrade water quality and result in a loss of productivity. Standing crops of fish will be reduced as the water quality and habitat is further degraded. A shift in species composition and loss of species diversity are also probable.

Table 1

Average 5-Year Peak Waterfowl Populations at the Reelfoot Area

Period	Ducks	Geese
1957 - 61	224,600	21,300
1967 - 71	161,600	28,500
1977 - 81	235,000	68,500
1982 - 86	126,500	66,400
1987 - 91	127,800	68,700
1992 - 96	132,500	72,600

*Population figures are for both Reelfoot and Lake Isom NWR's.

Loss and/or conversion of wetland types obviously means a loss of waterfowl habitat. Wetland loss eliminates those areas needed for resting, nesting, and feeding sites. Aerial waterfowl surveys have been conducted in the Reelfoot area by TWRA and USFWS personnel since the 1950's. Five-year average duck populations for the period 1957 - 1996 are shown in Table 1.

Analysis of Features

Many potential features have been considered during the Reconnaissance and Feasibility Studies to address the problems and opportunities that have been identified at Reelfoot Lake. The formulation and evaluation of these features was performed by a multi-disciplinary planning team in conjunction with the cost sharing sponsor for the Feasibility Study. Many features that were evaluated during the Reconnaissance Study showed little, if any, potential for implementation. In general, these features were not revisited during the Feasibility Study. Instead, the multi-disciplinary planning team concentrated on evaluation

and optimization of the features which potentially exhibited high levels of benefits, addressed the problems and opportunities identified, appeared to be implementable, and carried the cost sharing sponsor's support towards implementation of the project. Based on these constraints, an array of features was formulated, of which, each feature addresses one or more of the problems and opportunities identified in the study. The proposed features include the following:

Problem 1: Loss of Aquatic Habitat.

Use of herbicides to control aquatic vegetation. The use of herbicides to control aquatic vegetation to address the problem of loss of aquatic habitat was evaluated. This method of vegetation control has been used in the past at Reelfoot Lake however, it has not been effective on a long term basis. The major problem causing species of plants within the lake (Curlyleaf Pondweed, Coontail, Water Willow, and Southern Smartweed) are seasonal and cyclic in nature. That is, one species may flourish early in year, die out, and then be replaced by another species later in the year. This cyclic nature limits the effectiveness of herbicides to the particular species in bloom at the time of spraying the herbicide. The annual recurrence of the aquatic plants along with the large number of acres covered by plant mass makes this alternative impractical for implementation.

Use of dredge to remove aquatic vegetation. The use of a dredge to remove aquatic vegetation has been evaluated during the feasibility study. This method is currently used in some areas of Reelfoot Lake to maintain open water around boat ramps and within circulation channels. A small dredge known as a "cookie cutter dredge" is used. This type dredge is small enough to be maneuvered in tight areas and transported easily. This dredge, however, is limited in capacity and effectiveness.

Most of the bottom surface of Reelfoot Lake is covered with tree stumps from the original forests that existed before Reelfoot Lake was created. The existence of these stumps limits the use of a small dredge in most areas due to the damage inflicted on the equipment when striking a stump. A dredge can only be used effectively for removing aquatic vegetation in areas that have been cleared of stumps. For this reason, the implementation of this proposed feature for Reelfoot Lake is not considered feasible for anything other than the current small scale usage in isolated areas that is currently occurring.

Implementation of water level management practices. Water level management is the practice of fluctuating the pool elevations within a lake on a seasonal basis to control vegetation along the water's edge. This is accomplished by the drying action that occurs along the shoreline when the water elevation is lowered. As mentioned previously, in the existing conditions section, the water level in Reelfoot Lake is currently being fluctuated on a seasonal basis. Since 1991, the lake levels may fluctuate up to 282.7 NGVD during the summer months and 283.2 NGVD during the winter months. However, the U.S. Fish and Wildlife Service cannot hold the lake at higher levels because the top of the existing spillway stop logs is at elevation 282.2. The increased lake level allows for additional year-round aquatic habitat and a significant increase in waterfowl habitat during the winter months.

The increased lake level at Reelfoot Lake since 1991 appears to be successful in increasing aquatic habitat, however, it does not fully address the problem of aquatic vegetation in the lake. During the feasibility study, the management practice evaluated for reducing the aquatic vegetation is a periodic drawdown of the water elevation. This drawdown as evaluated in the feasibility study would occur at least once every 10 years but no more often than once every 5 years. Different drawdown elevations were evaluated and benefits and costs computed for each.

The idea of a periodic drawdown is to expose a portion of the lake bottom to the atmosphere for a period of approximately 3 months. This is expected to alleviate the aquatic vegetation within the exposed areas and also consolidate the soft, sediment laden bottom of the lake within the exposed areas. The lake would then be refilled and an increase in open water habitat within the lake would be realized. Due to the potential benefits of implementation of water level management, it has been evaluated in further detail. Specific benefits of different level of implementation are included in later sections of this report.

Construct sediment basin on Reelfoot Creek. Reelfoot Lake is slowly being filled by sediment flowing into the lake. The sediment comes from uplands and agricultural areas which surround the lake. It has been determined that Reelfoot Creek is the largest single contributor of sediment to the lake. As the sediment is deposited within the lake, the depth is reduced and aquatic habitat is lost. This inflow of nutrients and the reduced water depth encourages increased amounts of aquatic vegetation. Water quality is also reduced due to the reduced depth in the lake and higher turbidity levels. The proposal was made during the Reconnaissance Study to construct a sediment basin on Reelfoot Creek and this proposal has been further evaluated during the Feasibility Study. Due to the potential benefits of a sediment basin, the analysis of this feature will be carried forward.

Walnut Log sediment control. This proposed feature consists of diverting drainage from a roadside ditch into a nearby wildlife management area (WMA) to prevent sediment from entering Bayou du Chien and eventually, Reelfoot Lake. An additional measure to prevent sediment deposition into the lake would be to construct sediment basins in the hills east of Walnut Log.

Cleanout of the ditch is anticipated to continue as needed and the diversion of flow into the WMA could be accomplished with minimal effort using a backhoe. Control of sediment in the hills may best be achieved through a small sediment basin or other measures constructed by others. Therefore, no further consideration was given to this feature.

Dredging in critical deposition areas. This feature provides for the removal of sediment from areas expected to be filled by deposition in the next 25 to 50 years. These areas considered for dredging are critical for maintaining flow between basins, for flood control storage and access to the lake. Existing depths in these critical deposition areas are less than 3 feet at a normal pool elevation of 282.2 NGVD.

Potential negative impacts of this feature include water quality problems due to the dredging operation and disposal of the dredged material. Additionally, the tremendous

number of stumps on the lake bottom makes this proposal cost prohibitive. Prevention of additional sediment from entering the lake is a more practical solution. Therefore, this feature was eliminated from further consideration. The circulation channels and sediment basin listed under "Problem 2: Declining Water Quality" better address the problems for which the dredging in critical deposition areas was formulated to address.

Reelfoot Creek and Indian Creek diversion channel. This proposed feature includes a diversion channel which would divert sediment laden flood discharges from Reelfoot Creek and Indian Creek around the lake but would allow continued discharge into the lake during non-flood periods. The diversion channel would begin just downstream of the Tennessee Highway 22 crossing over Reelfoot Creek, parallel the bluff line east of Reelfoot Lake to Tennessee Highway 21, then follow existing field drains to join Running Reelfoot Bayou about 6,000 feet downstream of the existing spillway.

The preliminary analysis indicates that this feature would be effective in diverting sediment loaded flood flows away from the lake. However, negative impacts would also occur. Sediment deposition and flooding in Running Reelfoot Bayou are expected. Also, water quality has been improved in the discharge from Indian Creek due to the construction of a sediment basin by the Natural Resources Conservation Service. The removal of this relatively clean inflow from Reelfoot Lake could have adverse effects on water quality. Therefore, because of the anticipated adverse impacts, the proposed diversion channel is not evaluated in further detail.

Problem 2: Declining Water Quality.

Construct circulation channels. Circulation channels are proposed as a feature to connect the three major basins of the lake (Blue, Buck, and Upper Blue Basin) to each other and the alternative spillway. These channels would provide improved water circulation between major pools during normal stages and minimize isolation of major pools in extremely low stages. The total length of channel considered in this feature is approximately 13 miles at bottom elevation of approximately 274.0 NGVD. Preliminary evaluation of this feature indicates cost effective benefits and therefore it is carried forward for additional evaluation.

Glady Hollow Diversion. Glady Hollow Ditch currently flows out of the hills southeast of the Blue Basin. The stream then crosses to the north of Highway 21 and flows alongside Highway 21 to where it enters Blue Basin at the existing spillway. It is proposed to reroute Glady Hollow Ditch into an existing ditch which flows south of Shelby Lake into Running Reelfoot Bayou and thereby divert the flow from Reelfoot Lake. The purpose of the Proposed diversion was to prevent sediment from Glady Hollow Ditch from entering Blue Basin and thereby improve water quality in the lake.

According to a 1986 report by the Tennessee Department of Health and Environment entitled *Summary of Sedimentation Studies at Reelfoot Lake, 1982 – 1986*, Glady Hollow Ditch delivers 12,342 tons of sediment per year into Reelfoot Lake at the existing spillway. However, at the present time, it appears that most of the sediment "drops

out" somewhere between Glady Hollow and the state park campground. Due to the extensive costs (based on quantity estimates), apparent lack of need, and a lack of potential benefits, this diversion was not pursued.

Reelfoot Creek Reservoirs. This feature proposes to construct reservoirs that would be used to control the erosion from the Reelfoot Creek drainage basin while also providing flood control and water supply capabilities. This feature calls for two reservoirs; one on North Reelfoot Creek and one on South Reelfoot Creek. These reservoirs would be located upstream of the confluence of the two branches of Reelfoot Creek. The proposed reservoir on North Reelfoot Creek would have a maximum pool of 2,000 acres and a permanent pool of 800 acres. The reservoir proposed on South Reelfoot Creek would have a maximum pool of 1,800 acres and a permanent pool of 1,100 acres.

It is estimated that these two basins, if constructed, would capture 70 percent of the sediment runoff from the Reelfoot Creek drainage basin. There is concern, however, that the clean water would pick up additional sediment as it flows through the lower portions of the basin. In addition to their sediment retention capabilities, the reservoirs would also have limited water supply and flood control capabilities. However, the large acreage required for the permanent and maximum pools and the high construction, operation and maintenance costs for the dams and outlet structures make this a very expensive alternative. Based on the high cost and large real estate requirement, this feature was not carried on for further study. Instead, a more efficient and less costly feature was formulated and evaluated.

Walnut Log sediment control. This feature, as discussed in the previous section for the problem of loss of aquatic habitat, would also serve the purpose of improving water quality. This is due to the fact that sediment deposition reduces the depth of the water and increases turbidity. However, as noted earlier, the sediment deposition problem in this area appears to minimal and therefore, no further consideration was given to this feature.

Construct sediment basin on Reelfoot Creek. This feature was also discussed in the previous section. If constructed, this feature would improve water quality by helping to maintain the depth of water in the lake and reducing turbidity due to sediment laden runoff entering the lake. Unlike the Reelfoot Creek Reservoirs feature discussed earlier, this feature would not maintain a permanent pool. This structure would simply detain water for a period of time and allow the sediments to fall out before the water flows into the lake. This appears to be a much more cost efficient way of improving the water quality of the runoff entering the lake from Reelfoot Creek and is carried forward for additional evaluation.

Reelfoot Creek and Indian Creek diversion channel. This feature was also discussed previously as a potential feature for addressing the loss of aquatic habitat problem. However, instead of capturing the sediment to reduce turbidity and improve water quality similar to previous features, this feature would simply divert the sediment laden flows around the lake. While this feature would effectively reduce inflow of sediment laden water into the lake, the anticipated adverse effects are also present and therefore this feature was not evaluated in further detail.

Alternative water supply to Reelfoot Lake. This feature was considered on the basis of providing an additional source of fresh water into Reelfoot Lake in an attempt to compensate for the existing poor water quality. Four different alternative sources of water were considered for this feature.

a. Mississippi River – A key feature of using the Mississippi River as an alternative water supply would be the enlargement of the Bayou du Chien channel form Hickman, Kentucky to the Upper Blue Basin on Reelfoot Lake. A pumping station would also be located just west of Hickman at the Mississippi River levee. The design considered would convey 33,000 acre-feet of supplemental water to the lake in 45 days. This feature, though potentially feasible, was eliminated from further consideration due to high cost and water quality problems.

b. Groundwater – A second alternative water supply feature considered is groundwater. This design would also be sufficient to supply 33,000 acre-feet of supplemental water in 45 days. The source of the supplemental water would be a series of approximately seventy 18-inch diameter wells and pumps placed adjacent to Buck and Blue Basins. Because of potential water quality problems (high iron content) and high pumping costs, this feature was eliminated from further consideration.

c. Reelfoot Creek Reservoirs – This alternative water supply feature is based on the previously proposed feature for North and South Fork Reelfoot Creek reservoirs. If this feature were built, the design and operation of the reservoirs could be such that some of the capacity of the structures would be retained for water supply without adversely affecting the flood control and sediment control capabilities of the reservoirs. An evaluation of the capacity of the reservoirs as previously described indicates that the water supply capabilities of the reservoirs are only sufficient to refill Reelfoot Lake from a normal pool deficit of about 1 foot. Because this feature does not appear to be fully effective and the construction costs would be very high, it was eliminated from further evaluation.

d. Upper Bayou du Chien – The upper Bayou du Chien channel was considered as an alternative source of water supply for Reelfoot Lake. However, based on information gathered in other Corps studies, the upper Bayou du Chien channel has insufficient base flow during the late summer and fall months to be considered a viable source of water. Therefore, this alternative was dropped from consideration in the early stages of the study.

Problem 3: Loss of Waterfowl Habitat.

Implementation of water level management practices. The normal pool elevation at Reelfoot Lake was held constantly near elevation 282.2 NGVD until 1991. The existing condition water level management plan (also known as the Interim Plan) was implemented in 1991 as part of the Record of Decision for the 1989 Reelfoot Lake Water Level Management FEIS prepared by the U.S. Fish and Wildlife Service. This plan fluctuates the water elevation up to 283.2 NGVD in the fall and winter and up to 282.7 in the spring and summer. This fluctuation has improved the waterfowl habitat at Reelfoot Lake by providing shallow flooding of large areas during the proper season for waterfowl use. The predicted future without project condition is that this water level management effort will continue.

Additional water level management activities have been proposed at Reelfoot Lake to increase habitat. A proposal to seasonally increase the elevation of the lake beyond the current 283.2 winter elevation has been evaluated. Because of the potential benefits of this feature, it will be carried forward for further evaluation.

Shelby Lake restoration/waterfowl management units. Shelby Lake is an area just south of Highway 21 and east of Running Reelfoot Bayou. This location was once the site of a significant oxbow shaped lake known as Shelby Lake. Due mainly to agricultural practices, the lake has slowly been filled and drained. Only willows remain of what was once a lake. A proposed feature has been considered to excavate the lake to return it to a more natural state and also construct seasonally flooded waterfowl reservoirs around the perimeter of the lake. Along with this, areas of seasonally flooded hardwood habitat would be restored to provide ideal waterfowl habitat. This feature shows significant potential for waterfowl habitat restoration benefits and is supported by the sponsor. For these reasons, it will be carried forward for additional evaluation.

Lake Isom restoration. Lake Isom is a Federal Wildlife Refuge located approximately 5 miles south of the existing spillway at Reelfoot Lake adjacent to Running Reelfoot Bayou. A proposed feature is to increase the water level management capabilities at Lake Isom to allow for seasonal fluctuations of the water level. This fluctuation would provide increased waterfowl habitat during the winter months. In order to provide the required water level management, the existing levee would need to be raised approximately 2 feet and the water control structure will need to be replaced with a structure capable of raising the water elevation. This feature shows high potential for restoration of waterfowl habitat and therefore will be carried forward for additional evaluation.

Waterfowl units at Reelfoot Creek sediment basin. A sediment detention basin on Reelfoot Creek has been proposed previously to address the problems of loss of aquatic habitat and declining water quality. This structure, if constructed, can also address the problem of reduced waterfowl habitat. Low level levees could be constructed within the sediment basin which would be seasonally flooded to provide shallow water habitat for waterfowl. This could easily be accomplished with simple stoplog structures. Due to the potential benefits of this feature, it will be carried forward for additional evaluation.

Problem 4: Reduced Water Level Management Capability.

Construct alternative spillway. The construction of an alternative spillway would provide a safe and more versatile structure for water level control at Reelfoot Lake in the interest of fish and wildlife habitat restoration, flood control, and allied purposes. The current spillway is not able to effectively manage water levels at Reelfoot Lake. A new spillway with a broader range of water management capabilities is needed to provide seasonal water level fluctuation of the lake. It is particularly needed in order to implement an efficient and effective water level management program as described previously in response to the problem of loss of aquatic habitat. Due to the need and potential benefits of an alternative spillway, it has been carried forward for additional evaluation.

Construct circulation channels. Circulation channels are a feature that has been proposed earlier to address the problem of declining water quality. This feature is also critical to address the water level management problem. In order to provide efficient movement of water between the separate basins in Reelfoot Lake, clear channels of adequate depth are required. These are particularly critical if a periodic drawdown of the lake is implemented. This feature will be carried forward for additional evaluation because of the requirement to have these channels to implement some water level management activities.

Opportunity 1: Protect and Restore Nationally Significant Resources.

As discussed previously, Reelfoot Lake and the surrounding area provide habitat for several nationally significant species including migratory waterfowl and the Bald Eagle. The seasonally flooded bottomland hardwood forests in the Reelfoot Lake area are nationally significant habitat. The features discussed previously and carried on for additional evaluation will help to protect and in some cases restore nationally significant habitat. These evaluations will help to show the level of benefits that can be accomplished by implementation of the proposed features and the positive effect on the nationally significant resources at Reelfoot Lake.

In particular, the "Implementation of water level management practices" feature could create a significant increase in seasonally flooded habitat for waterfowl if the feature includes raising the water elevation in the lake. The "Sediment basin on Reelfoot Creek" feature can be designed so as to create significant waterfowl habitat within the basin. The Shelby Lake and Lake Isom features would also provide nationally significant waterfowl habitat. The alternative spillway feature will provide increased habitat by allowing the implementation of the proposed water level management practices.

Opportunity 2: Improve Recreational Opportunities.

Increase sport fishing opportunities. Reelfoot Lake has been a key destination for sport fishermen for many, many years. The abundance of several sport species including the crappie, bream, catfish and largemouth bass have made the lake well known. Sport fish populations, however, have slowly declined due to loss of aquatic habitat. The loss of habitat is due to the problems previously mentioned including increased aquatic vegetation and sediment deposition within the lake. Construction of the proposed alternative spillway along with implementation of the proposed water level management practices and construction of the proposed sediment basin on Reelfoot Creek should provide significant improvements to the aquatic habitat and therefore improve the sport fishing activities on Reelfoot Lake.

Increase waterfowl hunting opportunities. Reelfoot Lake is also well known for the waterfowl hunting opportunities that exist at and around the lake. The lake's location within the Mississippi Flyway makes it a resting place for millions of waterfowl during their annual migration. Just as the proposed features will improve aquatic habitat, they will also significantly increase waterfowl habitat towards a more historic condition. The increased habitat is expected to improve waterfowl hunting opportunities within the Reelfoot Lake area.

Increase other outdoor recreation. Many non-consumptive recreational activities occur at Reelfoot Lake. These activities include eagle observation tours, sightseeing, general wildlife observation, camping, picnicing and hiking. Implementation of the proposed features will restore, preserve and extend the life of Reelfoot Lake. As such, all recreational opportunities mentioned above will be realized by implementation of the project.

Opportunity 3: Increase Business Opportunities.

Increase commercial fishing opportunities. An opportunity exists to improve commercial fishing at Reelfoot Lake. The commercial fishing industry is dependent on two species – Crappie and Catfish. Reelfoot Lake is the only lake in the state of Tennessee where Crappie is allowed to be taken for commercial fishing. This is due to the abundance of the species in the lake, however the abundance of the species is slowly declining. This is primarily due to the reasons mentioned previously of loss of aquatic habitat. Implementation of the features proposed to restore habitat will benefit the commercial fishing industry at Reelfoot Lake.

Increase visitation to Reelfoot Lake. The opportunity exists to improve visitation by the public to the Reelfoot Lake area. This opportunity is due to the recreational opportunities that will be increased by implementation of the proposed features. Both consumptive and non-consumptive recreational activities are expected to benefit from the proposed project.

TABLE 2
Summary of Preliminary Analysis of Features

Feature	Action
Problem 1: Loss of Aquatic Habitat	
a. Use of herbicides to control vegetation	No Further Evaluation
b. Use of dredge to remove vegetation	No Further Evaluation
c. Implementation of water level management practices	Carry Forward
d. Construct sediment basin on Reelfoot Creek	Carry Forward
e. Walnut Log sediment control	No Further Evaluation
f. Dredging in critical deposition areas	No Further Evaluation
g. Reelfoot & Indian Creek Diversion Channel	No Further Evaluation
Problem 2: Declining Water Quality	
a. Construct dredged circulation channels	Carry Forward
b. Glady Hollow Diversion	No Further Evaluation
c. Reelfoot Creek reservoirs	No Further Evaluation
d. Walnut Log sediment control	No Further Evaluation
e. Construct sediment basin on Reelfoot Creek	Carry Forward
f. Reelfoot & Indian Creek Diversion Channel	No Further Evaluation
g. Alternative water supply to Reelfoot Lake	No Further Evaluation
Problem 3: Loss of Waterfowl Habitat	
a. Implementation of water level management practices	Carry Forward
b. Shelby Lake restoration/waterfowl management units	Carry Forward
c. Lake Isom restoration	Carry Forward
d. Waterfowl units at Reelfoot Creek sediment basin	Carry Forward
Problem 4: Reduced Water Level Management Capability	
a. Construct alternative spillway	Carry Forward
b. Construct dredged circulation channels	Carry Forward
Opportunity 1: Protect and Restore Nationally Significant Resources.	Carry Forward
Opportunity 2: Improve Recreational Opportunities	
a. Increase sport fishing opportunities	Carry Forward
b. Increase waterfowl hunting opportunities	Carry Forward
c. Increase other outdoor recreation	Carry Forward
Opportunity 3: Increase Business Opportunities	
a. Increase commercial fishing opportunities	Carry Forward
b. Increase visitation to Reelfoot Lake	Carry Forward

Environmental Effects of Features

After the preliminary evaluation of features, those which exhibited potentially high levels of benefits, addressed the problems and opportunities identified, appeared to be implementable, and have the sponsor's support were carried forward for additional evaluation. This additional evaluation will optimize and size the features and provide the basis for formulation of alternative plans. Preliminary engineering designs were performed on each feature in order to determine the estimated benefits and costs of the feature. Tables are included with the description of each feature that present the estimated costs and benefits of the feature. Both first costs (construction, real estate, etc.) and average annual costs were calculated for each feature. The average annual cost calculated are the economic costs of the feature which are net costs considering both the first costs and future costs forgone. The economic appendix, appendix D, provides detailed information about the cost calculations.

Implementation of Water Level Management Practices. Water level management is expected to have positive impacts on several of the problems identified. Implementation of the proper water level management will help control the amount of aquatic vegetation within the lake and thereby address the problem of loss of aquatic habitat. Water level management can also impact the problem of loss of waterfowl habitat by providing additional acres of habitat through fluctuation of water elevations during the appropriate seasons of the year. Implementation of water level management will also indirectly impact all opportunities identified in the study by restoring and increasing aquatic and waterfowl habitat in and around Reelfoot Lake.

Twenty-seven different water level management scenarios were initially considered during the study, however most have been eliminated due to a variety of reasons. The Biological and Environmental Appendix lists all alternative management scenarios that were considered and the reasons for or against implementation. One preliminary alternative suggested returning the lake to uncontrolled, natural water fluctuations. While this may appear ideal in some respects, damages to private and public property could be extreme during periods of high water. For this reason, this alternative was not considered further. The following three water level management alternatives have been selected for detailed evaluation.

Alternative 1 – No Action. With this alternative, water level management would continue as described in the existing conditions. The U.S. Fish and Wildlife Service obtained permission in 1991 to operate lake levels under what is known as the "Interim Plan of Operation" as described in the July 1989 "Reelfoot Lake Water Level Management Final Environmental Impact Statement". Under the Interim Plan, water levels may fluctuate annually up to 282.7' m.s.l. during the period of April 16 – November 14 and fluctuate up to 283.2 m.s.l. during the period of November 15 – April 15. This procedure would continue as the No Action alternative.

Alternative 2 – Dynamic Water Level Fluctuation with Major Periodic Drawdown. This alternative is described in the 1989 Environmental Impact Statement prepared by the U.S. Fish and Wildlife Service as "Alternative 6 (Preferred Alternative)". Under this water

level management scenario, the level of Reelfoot Lake would be managed more dynamically than in the past, depending on the natural moisture regime in particular years. The intent would be to manage for a more natural water level regime typical of alluvial lakes. Management would strive for at least a two-foot fluctuation each year. Lake levels would be allowed to fluctuate to at least 283.0' m.s.l. before considering opening any gates of the spillway. Manipulation of the spillway gates could occur between 283.0' - 283.5' m.s.l. depending upon climatic events and runoff in the watershed, seepage impacts of the Mississippi River, and other factors affecting lake hydrology or management needs based on biological indicators of the lake's ecosystem. Additional spillway gates would be opened when the lake level reaches approximately 283.5' m.s.l., except with the occurrence of unusual storm events when opening additional gates at lower elevations would be prudent. As the lake level recedes from elevations above 283.5' m.s.l., the gates would be closed between the same 0.5' intervals until the lake is stabilized at 283.0 m.s.l.

Fluctuations of the lake level of 1 to 2 feet below elevation 282.2 m.s.l. will generally occur dependent upon climatic conditions. However, periodic gate manipulation or artificial lowering of the lake level to approximately 280.0' m.s.l. may be used to accomplish specific practices to improve fisheries and wildlife habitat, control vegetation, or other management needs. Under this operating procedure, the lake could reach levels as high as 284.0' m.s.l. or as low as 280.0' m.s.l. in any given year. High water levels would generally occur in winter and spring; low water levels would generally occur in the summer and early fall. However, unusual climatic events such as natural flooding or drought conditions would occasionally exaggerate the water level extremes or modify their seasonal occurrence. The gate manipulation procedures of this alternative would be modified to accommodate required changes based on experience or biological indicators.

A major periodic drawdown would involve lowering the lake level four feet (from 282.2' m.s.l. to 278.2' m.s.l.) with a new water control structure. The drawdown would start on June 1 and be completed by July 15 or earlier if possible. A minimum of 120 days would be allowed for drying and aeration of the exposed lake bottom. The water control structure would be closed in mid-November. Refilling of the lake would be dependent upon ground water recharge and rainfall. The lake would be refilled to 283.3' m.s.l. and held at that level until June 1 of the following year. Under average climatic conditions, the lake would refill to this elevation by mid to late winter. The major periodic drawdown would be repeated as needed every 5 to 10 years. Specific decisions concerning timing and need of subsequent drawdowns would be made on the basis of monitoring physical and biological conditions resulting from the first or previous drawdown. Dredging of existing circulation channels will be required to facilitate the four foot drawdown. Recreation and commercial fishing benefits are shown based on expected increases due to improved water quality and increased aquatic habitat.

Construction of the proposed Alternative Spillway feature is required in order to implement this water level management plan, however the costs for that feature are calculated separately. Costs for implementing this alternative water level management practice will include appropriate real estate interests in property between elevation 283.2 m.s.l. (existing condition) and elevation 284.0 m.s.l. around Reelfoot Lake. Real estate

interests for this alternative are estimated to include approximately 6,088 acres of agricultural land, woodlands and wetlands and 6 residential structures. Of the 6,088 acres estimated, approximately 755 acres are currently privately owned with the remainder being publicly owned by the state and Federal governments. The real estate plan, appendix C, provides a detailed breakdown of estimated real estate costs. The following table shows the estimated costs and benefits for implementation of this water level management plan.

Table 3
Alternative 2 Water Level Management Practice
Dynamic Water Level Fluctuation w/Major Periodic Drawdown
Benefit and Cost Summary
(1 October 1998 P.L.)

Cost Account	Item		Cost
01	Lands and Damages		$ 2,270,000
		Total First Cost:	$ 2,270,000
		Average Annual Cost:	$ 236,400
	Average Annual Benefits		
	Fish & Wildlife Restoration, terrestrial:		240 AHUV
	Aquatic Habitat Restoration:		4,946 AHUV
	Annual Waterfowl Use Days:		7,125,000
	Recreation and Commercial Fishing:		$ 542,300

Alternative 3 – Interim Plan with Major Periodic Drawdown. This alternative is a combination of Alternative 1 – No Action, as described above, with a major periodic drawdown as described in Alternative 2 above. Lake water levels would be allowed to fluctuate up to 282.7' m.s.l. during the period of April 16 – November 14 and up to 283.2' m.s.l. during the period of November 15 – April 15, the same as the existing condition. A major drawdown to elevation 278.2' m.s.l. would occur every 5 to 10 years as necessary. The drying and refilling times would be as described previously.

Construction of the proposed Alternative Spillway feature is required in order to implement this water level management plan, however the costs for that feature are calculated separately. No additional real estate costs are expected for implementation of this water level management alternative.

Table 4
Alternative 3 Water Level Management Practice
Interim Plan w/Major Periodic Drawdown
Benefit and Cost Summary
(1 October 1998 P.L.)

Cost Account	Item		Cost
		Total First Cost:	$ 0
		Total Average Annual Cost:	$ 0
	Average Annual Benefits		
	Aquatic Habitat Restoration:		3,090 AHUV
	Recreation and Commercial Fishing:		$ 326,500

Construct Alternative Spillway. The alternative spillway feature is proposed to replace the existing outlet structure on Running Reelfoot Bayou built in 1931. As mentioned previously, the existing structure has outlived its design life and is showing signs of deterioration. The radial gate on the structure is rarely used because of structural deterioration. Severe seepage is occurring beneath the structure and the future stability of the structure is unknown.

A new outlet structure is required to implement water level management of the lake as described above. The existing structure does not have the outlet capacity to lower the lake in the required time period, in that the design of the existing structure does not lend itself to a drawdown activity. The existing structure is designed as an overflow weir, therefore, the deteriorated radial gate would have to be used to implement a drawdown. This would not meet the time limitations described and would reduce the overall benefits of a major drawdown.

The alternative spillway feature was designed based on several criteria determined by the study team. They are as follows:

a. The structure must have the flexibility for implementation of various water level management schemes including periodic major drawdown of the lake within the prescribed time periods.
b. The structure must provide flood control equal to the existing structure.
c. Impacts to existing wetlands, parks, and roads must be minimized.

Based on these criteria, the study team formulated alternatives for the construction of the alternative spillway. Seven alternative sites, as shown on Plate 1 were evaluated for the new spillway structure. A comparison matrix, Plate 2, along with other considerations shown on Plate 3, was prepared to help in the evaluation of alternative spillway sites. After extensive review and comparison of the alternatives, Alternative Site 6 was selected as the optimum location for the proposed spillway structure.

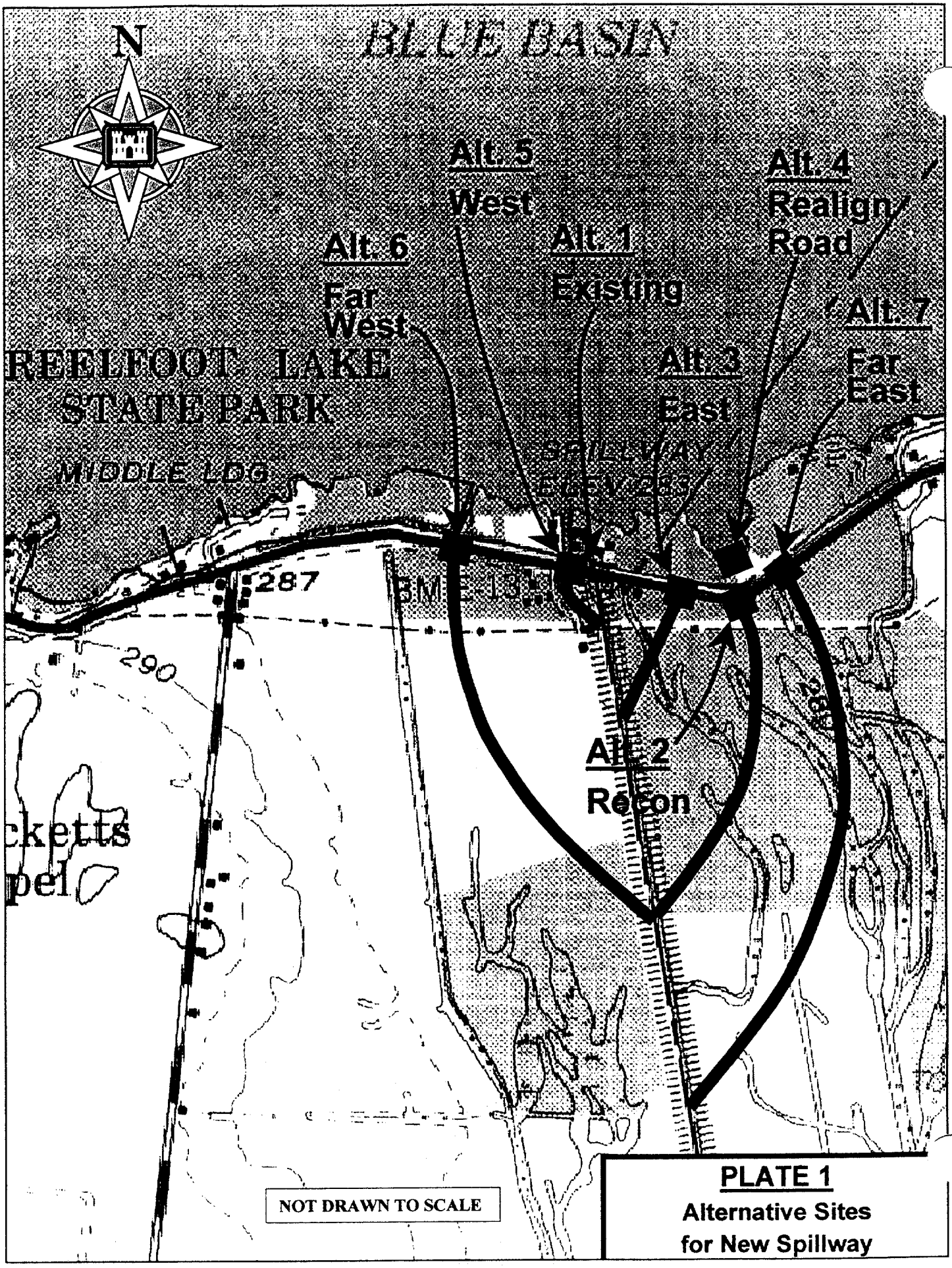


PLATE 1

Alternative Sites for New Spillway

Plate 2
Comparison Matrix for New Spillway Site Selection Criteria

Criteria	Alt. 1 Existing Site	Alt. 2 Recon Site	Alt. 3 East Site At Camp	Alt. 4 Center of Curve	Alt. 5 Just West of Existing	Alt. 6 Far West	Alt. 7 East of Recon
Minimize Negative Environmental Impacts	+	+	0	-	0	0	0
Safe Road Alignment and Grade	0	--	0	+	0	0	0
Minimize Construction Costs	--	-	+	-	-	+	+
Minimize Cost to Maintain Existing Water Management Capability During Construction	--	0	0	0	0	0	0
Minimize Cost to Maintain Road Service During Construction	+	0	0	+	--	0	0
Minimize Real Estate Costs	0	0	--	0	+	0	0
Minimize Negative Impacts to State Park	-	+	+	+	-	+	-

+ Advantage of Site
0 No Advantage or Disadvantage of Site
- Disadvantage of Site
-- Major Disadvantage of Site

Plate 3
Evaluation of New Spillway Site Alternatives

Alternative	Disposition
Alternative Site 1: Existing Site	Eliminated – Cost of construction, complete removal of sill of old structure and fish weirs. Inlet through State Park and difficulty maintaining water level management during construction.
Alternative Site 2: Recon Study Site	Eliminated – Unsafe road alignment
Alternative Site 3: Eastern Site at Private Campground	Eliminated – cost of relocation of trailers and impacts to business could range from $500,000 to $ 2,000,000.
Alternative Site 4: Center of Curve with Road Relocation	Eliminated – Opposed by local sponsor due to potential environmental impacts
Alternative Site 5: Just West of Existing Spillway	Eliminated – High costs of maintaining road service during construction and the inlet through the State Park.
Alternative Site 6: Far West Site	No major drawbacks.
Alternative Site 7: East of Recon Site in State Campground	Eliminated – Opposed by State Park, could have negative impacts on campground

Along with the alternative spillway, a new inlet channel, outlet channel and bridge will be required. The study team determined that separation of the bridge and spillway will be beneficial to the project. If the bridge and spillway were combined, similar to the existing structure, the spillway would be required to support highway traffic. This would require that the deck structure on the spillway be a minimum of 48' wide (2 – 12' lanes and 2 – 12' shoulders). This would greatly increase the depth of the proposed structure and possibly foundation requirements over the design based on separate structures. Separation of the structures also eliminates any potential future problems concerning maintenance responsibilities between state highway and environmental agencies.

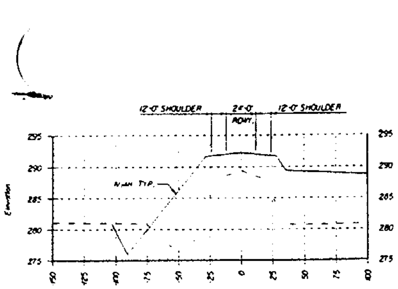
Optimization of the alternative spillway design was performed based on the flow capacities required for the proposed major periodic drawdown of the lake. Designs were considered which incorporated 4, 6, and 8 gated structures. Each gate is a 20'wide vertical lift gate. This type of design allows for flow under the gates that will be beneficial to fish passage through the structure. It was determined through hydraulic analysis, that the proposed 6 gate structure has the capacity to lower the lake to elevation 278.2 m.s.l. in the 45 day time period taking normal precipitation levels into account. Outlet flow rates will be limited to the existing capacity of Running Reelfoot Bayou, therefore no downstream flooding is expected due to the periodic drawdown of the lake.

Plate 4 shows the proposed layout of the 6 gate alternative spillway, the inlet and outlet channels, and the new bridge.

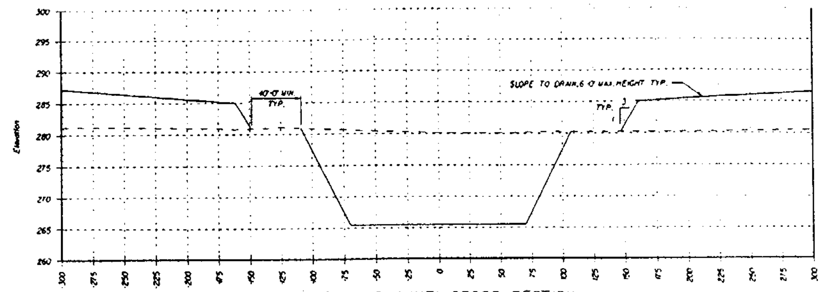
Table 5
Alternative Spillway
Benefit and Cost Summary
(1 October 1998 P.L.)

Cost Account	Item		Cost
01	Lands and Damages	$	545,000
02	Relocations	$	1,825,000
06	Spillway and Outlet Channel	$	5,713,000
30	Planning, Engineering and Design	$	1,141,000
31	Supervision and Administration	$	485,000
	Total First Cost:	$	9,709,000
	Annual Operation and Maintenance	$	18,300
	Average Annual Cost:	$	834,100
	Average Annual Benefits		
	Fish & Wildlife Restoration, terrestrial:		50 AHUV
	Cost Savings and Land Value Enhancement:	$	923,000

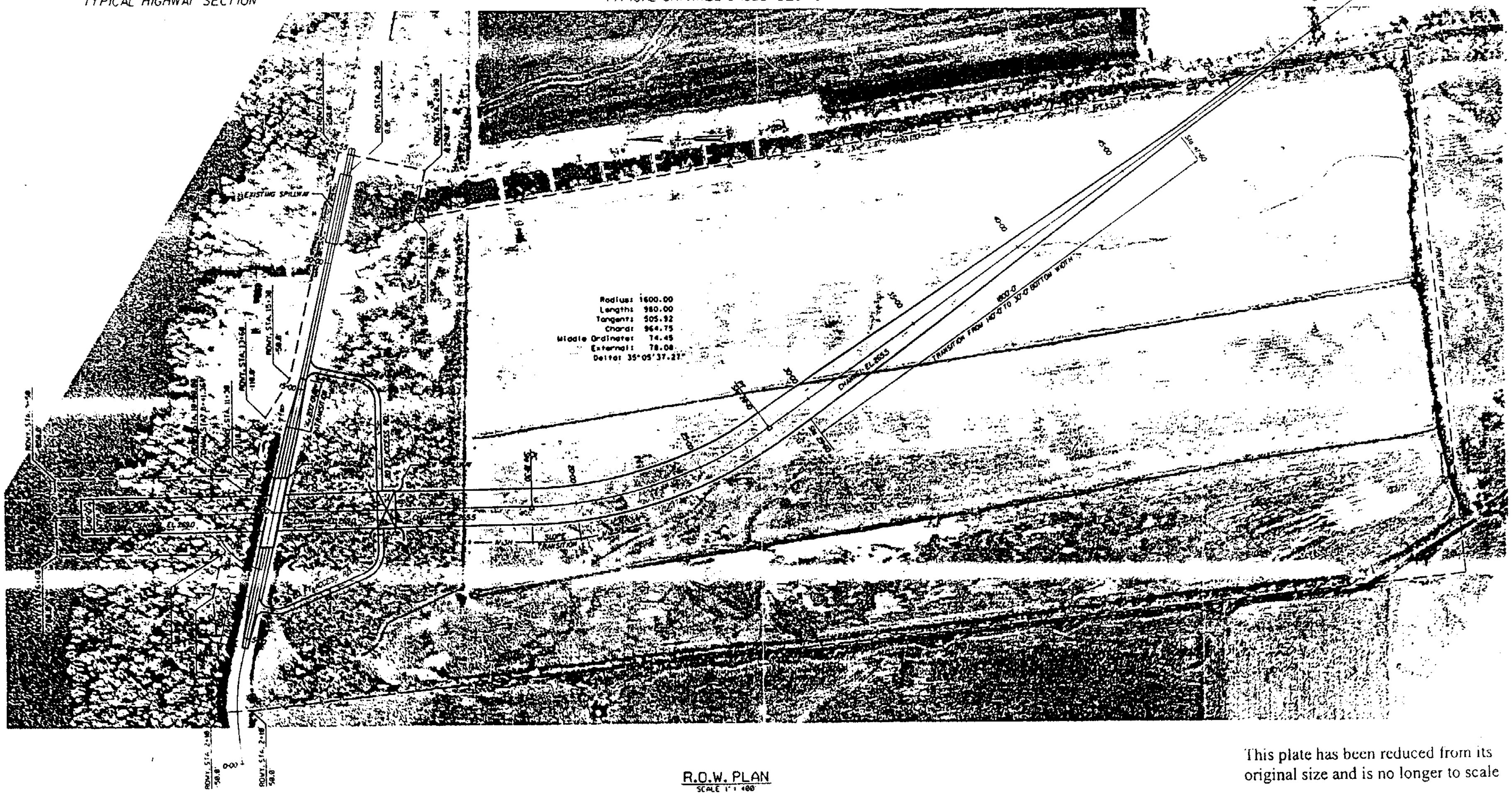
Construct Sediment Basin on Reelfoot Creek. Sediment deposition has been identified as one of the major problems at Reelfoot Lake. It has been determined that approximately 50% of the sediment deposited in the lake is transported by Reelfoot Creek.



TYPICAL HIGHWAY SECTION



TYPICAL CHANNEL CROSS SECTION



R.O.W. PLAN
SCALE 1" = 400'

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REELFOOT LAKE, TENNESSEE & KENTUCKY
REELFOOT LAKE ALTERNATIVE SPILLWAY

PLATE 4

During the Reelfoot Lake, Tennessee and Kentucky, Reconnaissance Study an evaluation was performed which indicated that the construction of a single, large sediment basin on the lower portion of Reelfoot Creek would be beneficial in addressing the problem of sediment deposition in the lake. During the feasibility study, an in-depth sediment study was performed which documents the expected benefits and costs of the construction of a sediment retention basin on Reelfoot Creek.

The sediment basin proposed in the Reconnaissance Study consisted of an earthen levee approximately 16,800 feet in length. This basin would encompass approximately 2,570 acres at the design water elevation of 305.0. During the feasibility study, the size of the proposed sediment detention basin was optimized to provide the most cost efficient structure. Four alternative size basins (including the Reconnaissance design) were evaluated. Plate 5 shows the four alternative levee locations. The design water elevation of 305.0 was maintained for all alternatives. Parametric cost estimates were prepared for the four alternatives along with estimates of benefits for the different size structures. Benefits were estimated for the quantity of silt and sand captured annually, annual habitat unit values (AHUV's), and waterfowl use days (WUD's). After evaluation of the preliminary costs and benefits, Alternative #1 was selected as the optimum design based on the estimated cost per unit of the various benefits.

After the completion of the optimization process, a complete sediment evaluation was performed in accordance with the selected alternative. The following costs and benefits were calculated for the construction of a sediment retention basin on Reelfoot Creek.

Table 6
Sediment Basin on Reelfoot Creek
Benefit and Cost Summary
(1 October 1998 P.L.)

Cost Account	Item		Cost
01	Lands and Damages		$ 5,334,000
02	Relocations		$ 212,000
06	Sediment Retention Basin		$ 4,487,000
18	Cultural Resource Preservation		$ 150,000
30	Planning, Engineering and Design		$ 926,000
31	Supervision and Administration		$ 139,000
		Total First Cost:	$ 11,248,000
	Annual Operation and Maintenance		$ 102,200
		Total Average Annual Cost:	$ 1,000,600

Average Annual Benefits		
Fish & Wildlife Restoration, terrestrial:		324 AHUV
Aquatic Habitat Restoration:		1,186 AHUV
Annual Waterfowl Use Days:		1,590,800
Recreation and Commercial Fishing:	$	135,500
Row Crop Production:	$	82,400

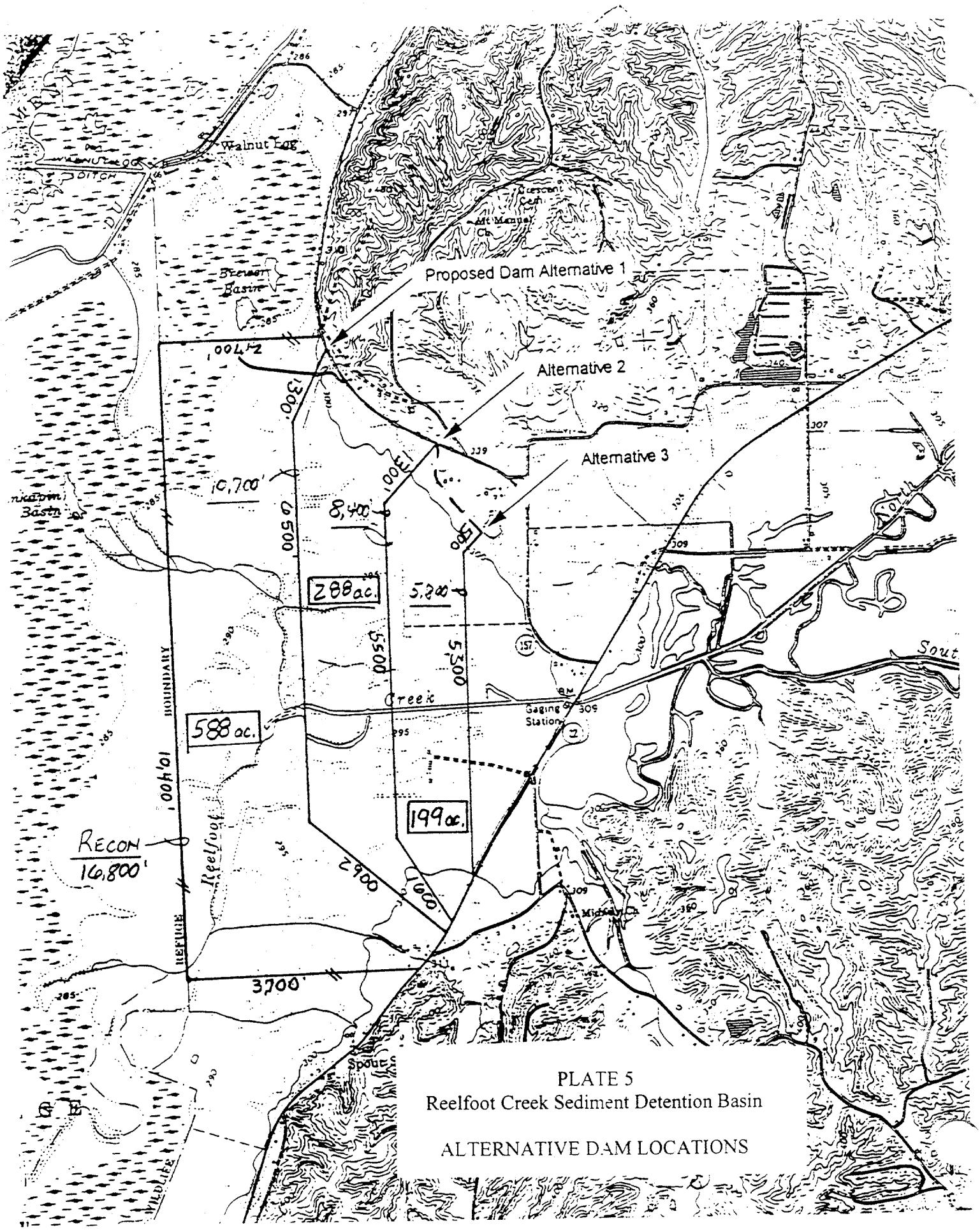


PLATE 5
Reelfoot Creek Sediment Detention Basin

ALTERNATIVE DAM LOCATIONS

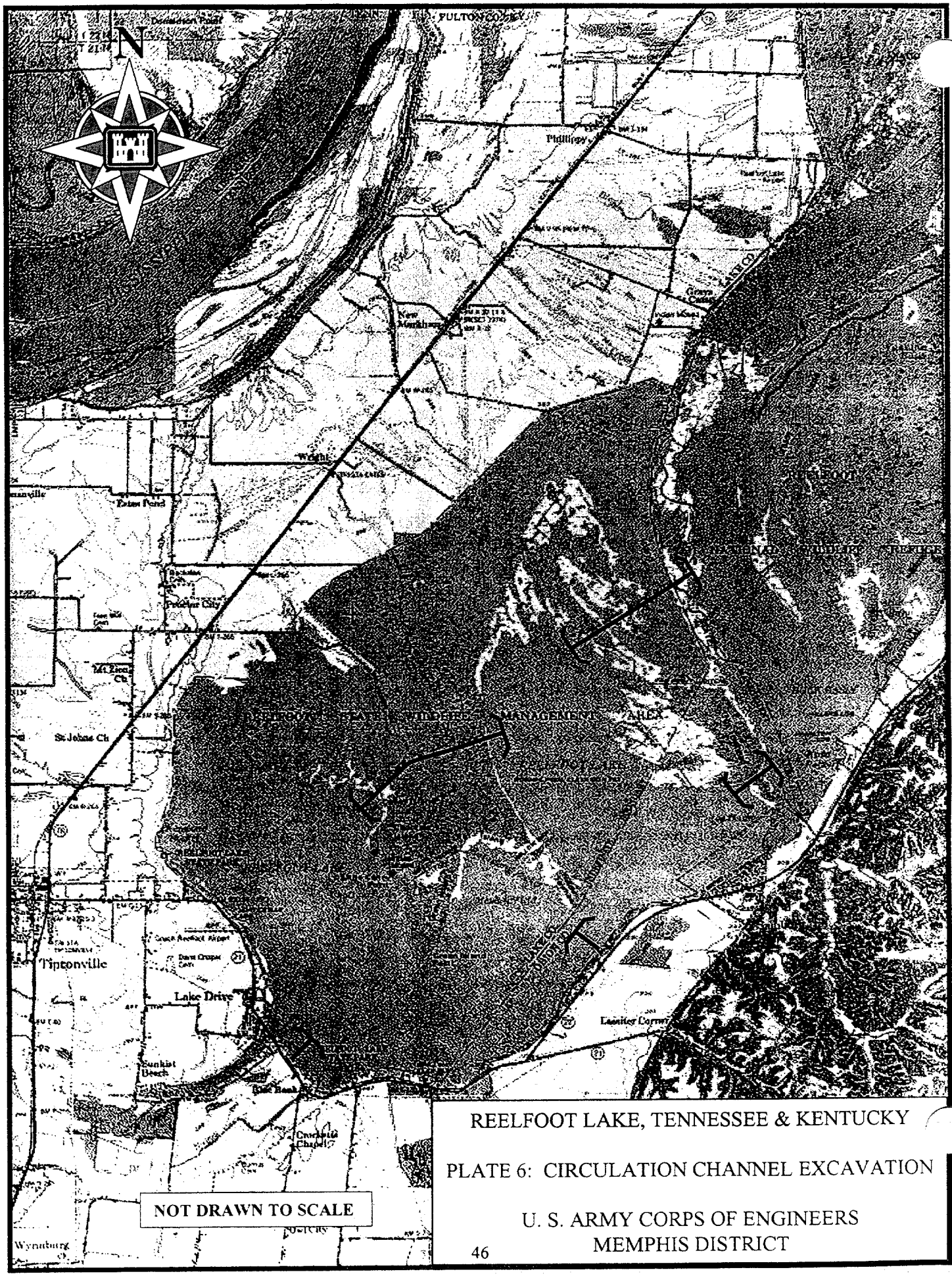
The construction of a sediment retention basin on Reelfoot Creek will address several of the problems identified in the study including 'Loss of Aquatic Habitat', 'Declining Water Quality', and 'Loss of Waterfowl Habitat'. It will also either directly or indirectly address all opportunities listed in the previous section of this report.

Construct Circulation Channels. The circulation channels feature was proposed during the Reconnaissance Study. The purpose of the channels is to provide for better circulation of water between the major basins within the lake. The studies indicate that improved water circulation will improve the problem of 'Declining Water Quality'. Construction of these channels will also provide greater water level management capability within the lake and this feature is considered essential to implementing periodic drawdowns of the lake. This feature will also allow easier boating access to some areas of the lake and therefore will address several of the opportunities identified in this study.

The initial design of this feature during the Reconnaissance Study included approximately 13 miles of channels in the lake. These channels were proposed to have a maximum bottom elevation of 274.0 m.s.l.. This feature was optimized during the feasibility study. Three different bottom elevations for the channels were considered which included 274.0, 276.0 and 278.0. After evaluating construction quantities, impacts on water level management, impacts on existing wetlands, and discussions with the sponsor, it was determined that circulation channels with bottom elevation of 278.0 will address the problems identified in the study.

By increasing the maximum depth of the proposed circulation channels to 278.0, the excavation quantities are reduced to approximately 27,500 cubic yards from approximately 595,000 cubic yards for the 274.0 elevation channels and 254,000 cubic yards for the 276.0 elevation channels. The total length of circulation channels at elevation 278.0 is approximately 3.2 miles compared to approximately 15 miles for the channels at elevation 274.0 and 13 miles for channels at elevation 276.0. Potential negative impacts to the environment from excavation within wetlands and disposal of excavated material are greatly reduced. Circulation channels with a bottom elevation of 278.0 will adequately address the requirements of a major periodic drawdown as described in this report.

The proposed circulation channels are shown on Plate 6. Two boat access channels are included in the proposed feature. These channels are required for access to the lake during major periodic drawdowns for water quality sampling and monitoring. The locations of the proposed channels follow existing channels and ditches within the lake. This design will also help to minimize negative impacts and reduce construction costs.



REELFOOT LAKE, TENNESSEE & KENTUCKY

PLATE 6: CIRCULATION CHANNEL EXCAVATION

U. S. ARMY CORPS OF ENGINEERS
MEMPHIS DISTRICT

Table 7
Circulation Channels
Benefit and Cost Summary
(1 October 1998 P.L.)

Cost Account	Item		Cost
01	Lands and Damages	$	16,000
06	Circulation Channels	$	249,000
30	Planning, Engineering and Design	$	238,000
31	Supervision and Administration	$	36,000
	Total First Cost:	$	539,000
	Annual Operation and Maintenance	$	1,700
	Total Average Annual Cost:	$	48,800
	Average Annual Benefits		
	Aquatic Habitat Restoration:	130 AHUV	
	Recreation and Commercial Fishing:	$	38,400

Shelby Lake Restoration/Waterfowl Management Units. Prior to the construction of the Mississippi River levees, the Reelfoot Lake spillway, and Highway 21, Shelby Lake was a natural oxbow lake surrounded by cypress trees and replenished regularly by flood waters from Reelfoot Lake and the Mississippi River. Since the construction of these items, the site has slowly silted in and has been cleared for agricultural use. A small remnant of the original lake is still too wet for agriculture and has now grown up in willows. This is all that is left of the original natural lake. Plate 7 is a copy of the 1934 U.S.G.S. quad map which clearly shows Shelby Lake just south of Highway 21.

Plates 8 and 9 show the proposed Shelby Lake feature as it has been formulated. The purpose of this feature is to restore the area to the historical wetland condition and to provide waterfowl and wetland habitat. The design of this feature includes shallow excavation of Shelby Lake (0 to 6 feet) and construction of low level terraces for seasonal impoundment of water. The restored Shelby Lake would cover approximately 170 acres at the normal pool elevation of 280.0 m.s.l.. The six seasonally flooded waterfowl areas would cover approximately 483 acres and approximately 312 acres of forest hardwood habitat is included in the feature to provide diversity and cover. Restoration of this area is expected to produce high levels of migratory waterfowl benefits similar to other waterfowl management units already in use in the Reelfoot Lake area.

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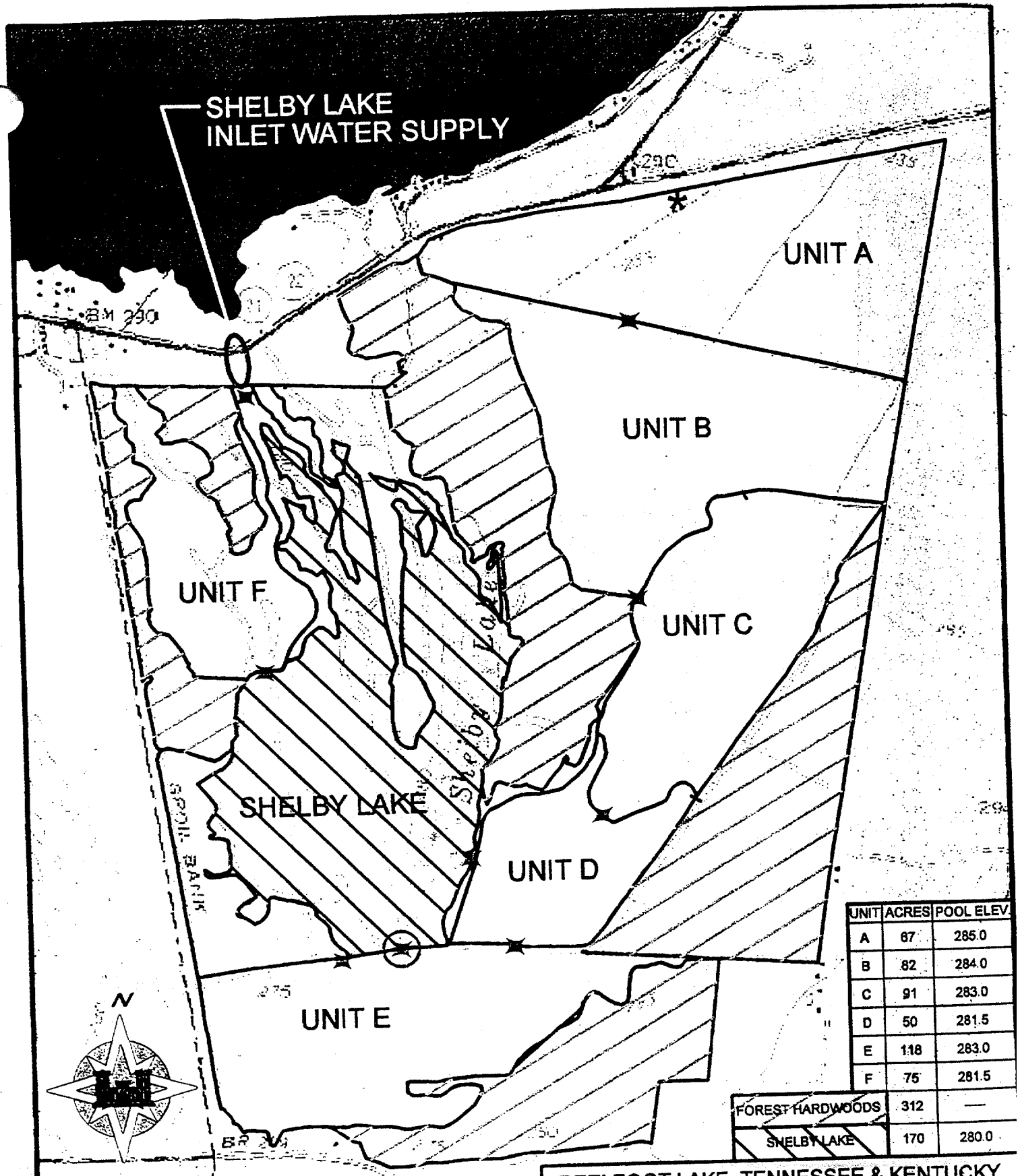
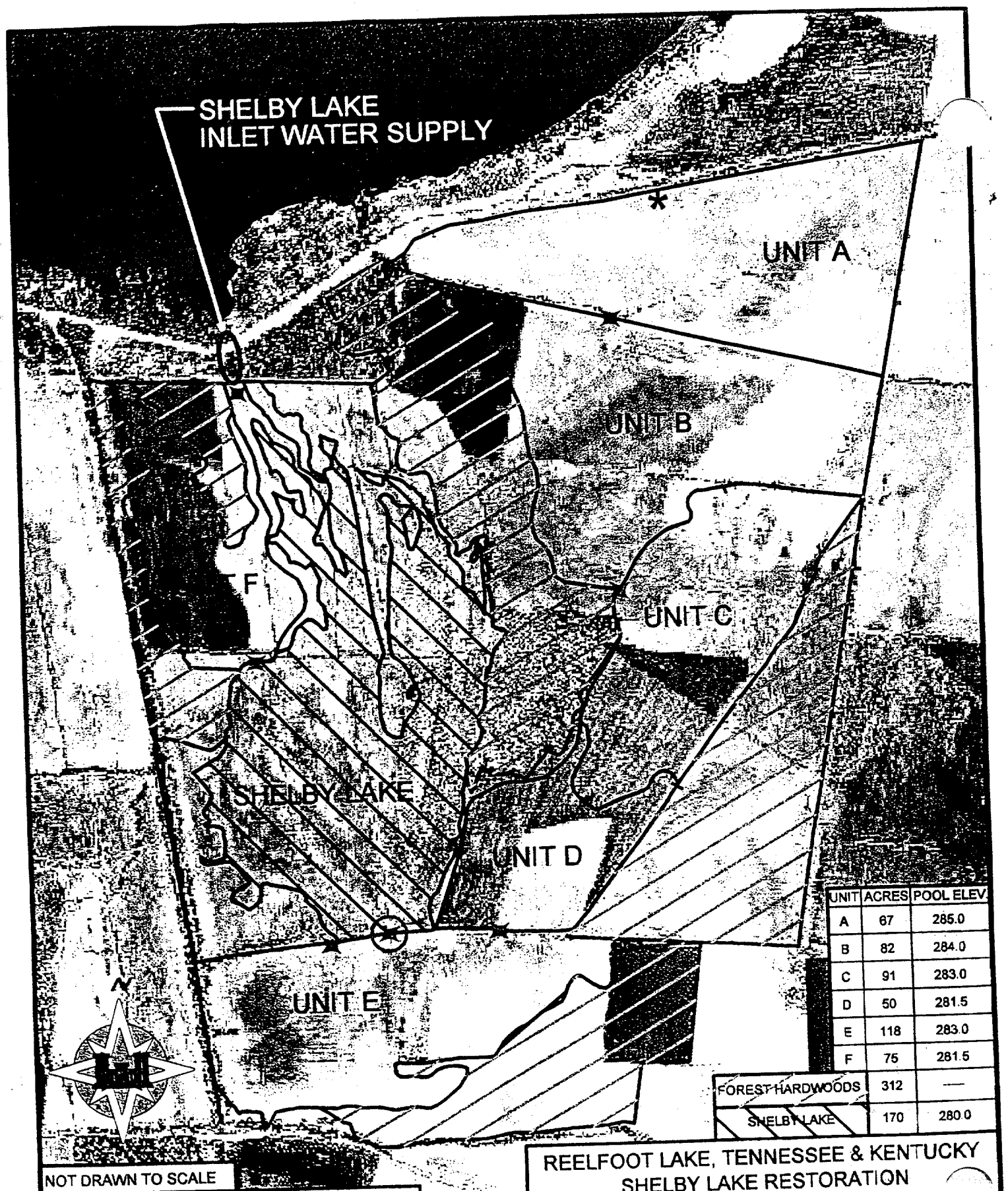
PLATE 7
1934 U.S.G.S QUAD MAP
SHELBY LAKE AREA



UNIT	ACRES	POOL ELEV.
A	67	285.0
B	82	284.0
C	91	283.0
D	50	281.5
E	118	283.0
F	75	281.5
FOREST HARDWOODS	312	—
SHELBY LAKE	170	280.0

REELFOOT LAKE, TENNESSEE & KENTUCKY
SHELBY LAKE RESTORATION
AND
WATERFOWL MANAGEMENT AREA
MEMPHIS DISTRICT
U. S. ARMY CORPS OF ENGINEERS

PLATE 8



UNIT	ACRES	POOL ELEV.
A	67	285.0
B	82	284.0
C	91	283.0
D	50	281.5
E	118	283.0
F	75	281.5
FOREST HARDWOODS	312	—
SHELBY LAKE	170	280.0

PLATE 9

The benefits and costs estimated for the Shelby Lake Restoration/Waterfowl Management Units feature is shown below.

Table 8
Shelby Lake Restoration/Waterfowl Management Units
Benefit and Cost Summary
(1 October 1998 P.L.)

Cost Account	Item		Cost
01	Lands and Damages	$	2,263,000
02	Relocations	$	8,000
06	Waterfowl Management Area/Tree Planting	$	1,906,000
18	Cultural Resource Preservation	$	150,000
30	Planning, Engineering and Design	$	530,000
31	Supervision and Administration	$	106,000
	Total First Cost:	$	4,963,000
	Annual Operation and Maintenance	$	40,700
	Total Average Annual Cost:	$	443,300

Average Annual Benefits		
Fish & Wildlife Restoration, terrestrial:		676 AHUV
Aquatic Habitat Restoration:		28 AHUV
Annual Waterfowl Use Days:		2,455,000
Recreation and Commercial Fishing:	$	100,000
Row Crop Production:	$	38,400

Lake Isom Restoration. The Lake Isom feature is located just south of Shelby Lake and Reelfoot Lake along Running Reelfoot Bayou, the main outlet from Reelfoot Lake. Lake Isom is a Federal Wildlife Refuge which is owned and operated by the U.S. Fish and Wildlife Service. This feature has been formulated to address the problem of loss of waterfowl habitat in the Reelfoot Lake area.

Similar to Shelby Lake, Lake Isom was also recharged frequently by flood waters from Reelfoot Lake and the Mississippi River before the construction of the Mississippi River levees, the Reelfoot Lake spillway and Highway 21. It once existed as a natural wetland complex which provided excellent aquatic and waterfowl habitat. Along with the changes in hydrologic conditions due to the levees and construction around Reelfoot Lake, Lake Isom has also experienced a long term drying effect partly due to alterations in Running Reelfoot Bayou. The bayou was channelized in 1959 and the flowline of the bayou is currently approximately 15 feet lower than the normal water level of Lake Isom.

The proposed feature at Lake Isom is to provide the capability of increased water level management within the lake. The management capability will include the potential for raising the water level in the lake by up to 2 feet. The higher water levels would generally be during the winter months for increased waterfowl habitat. Also, more capability for

fluctuation of the water levels throughout the year would be possible if the plan is implemented. The plan call for annual water level fluctuations between elevation 279.0 and elevation 282.0. The increased annual fluctuation is expected to help control the amount of aquatic vegetation within the lake and therefore improve waterfowl and aquatic habitat.

In order to implement this feature, the elevation of the existing levee at Lake Isom must be raised by 2 feet. A new outlet structure that has the capability to raise the water level to elevation 282.0 will also be required. Six pumps will be constructed to augment natural water supply to Lake Isom for raising the water elevation, particularly during dry years. A borrow area has been selected within the boundaries of Lake Isom as a source of material for raising the elevation of the levee. The selected site will be excavated in a manner to provide aquatic and waterfowl habitat. The following table shows the expected benefits from implementing the Lake Isom feature.

Table 9
Lake Isom Restoration
Benefit and Cost Summary
(1 October 1998 P.L.)

Cost Account	Item		Cost
01	Lands and Damages	$	110,000
06	Lake Isom Improvements	$	813,000
30	Planning, Engineering and Design	$	376,000
31	Supervision and Administration	$	44,000
	Total First Cost:	$	1,343,000
	Annual Operation and Maintenance	$	26,300
	Total Average Annual Cost:	$	139,300
	Average Annual Benefits		
	Fish & Wildlife Restoration, terrestrial:		179 AHUV
	Aquatic Habitat Restoration:		110 AHUV
	Annual Waterfowl Use Days:		2,226,200
	Recreation and Commercial Fishing:	$	22,300

Formulation of Alternative Plans

After the cost and benefit evaluation for the selected features was performed, the features were grouped together into alternative plans for further evaluation. This grouping allows for a cost effectiveness evaluation of the alternative features for selection of the recommended plan. The features included for the formulation of alternative plans include:

- **Implementation of Water Level Management Practices**
  - **Alternative 1 – No Action**
  - **Alternative 2 – Dynamic Water Level Fluctuation with Major Periodic Drawdown**
  - **Alternative 3 – Interim Plan (existing) with Major Periodic Drawdown**
- **Alternative Spillway**
- **Dredged Circulation Channels**
- **Sediment Basin on Reelfoot Creek**
- **Shelby Lake Restoration/Waterfowl Management Units**
- **Lake Isom Restoration**

The Alternative Spillway feature must be constructed in order to implement the Water Level Management Practices Alternative 2 and Alternative 3 features. Because of this, these features are considered to be dependent features and were not evaluated independently. A total of 14 alternative plans (including the no-action plan) were formulated from the features. The plans, costs, benefits, and effects are as follows:

No-Action Plan. This plan is based on the future without project conditions described previously in this report. No Corps of Engineers project would be implemented under this alternative. Environmental resources will continue to degrade and Reelfoot Lake will continue to fill with sediment. The Environmental Appendix and Draft E.I.S. document the expected loss of environmental habitat for the future without project condition. The existing outlet structure will continue to deteriorate and at some time will require replacement. Intermediate steps, such as stabilizing the structure with rock, could be taken to maintain the water level in the lake. A temporary fix of this nature would cause the existing structure to function as a weir and limit the usefulness of the structure.

Eventually, the existing outlet structure must be replaced in order to maintain its function. It is anticipated that the size and location of a replacement structure will be similar to the proposed alternative spillway feature previously discussed in this report whether constructed by the Corps or by some other entity. Therefore, the cost estimate for this structure was used as a basis for the economic analysis of the future without project condition.

Alternative Plan 1a. Alternative plan 1a consists of the Alternative Spillway and Water Level Management Practices Alternative 1. This plan will provide for the replacement of the existing deteriorated control structure and water level management equal to the existing condition. Implementation of this plan would ensure that Reelfoot Lake

continues to exist in a condition equal to the exiting condition without the fear of failure of the existing spillway and bridge structure. This plan will ensure the continuation of existing recreation and commercial fishing activities as well as flood control protection presently provided by Reelfoot Lake.

Table 10
Alternative Plan 1a
Benefit and Cost Summary
(1 October 1998 P.L.)

Total First Cost:		$ 9,709,000
Average Annual Cost:		$ 834,100
Average Annual Benefits:		
		Cost per Benefit
Fish & Wildlife Restoration, Terrestrial:	50 AHUV	$ 16,682
Economic Benefits:	$ 923,000	

Alternative Plan 2a. Alternative plan 2a consists of the Alternative Spillway, Water Level Management Practices Alternative 1, and Circulation Channels. This plan will provide the same benefits as Alternative Plan 1a but will also provide additional water quality benefits within the lake from the addition of the circulation channels. Some additional recreation benefits may be realized due to easier access to the various basins within the lake. The estimated average annual costs and benefits of this plan are listed below.

Table 11
Alternative Plan 2a
Benefit and Cost Summary
(1 October 1998 P.L.)

Total First Cost:		$ 10,248,000
Average Annual Cost:		$ 882,900
Average Annual Benefits:		
		Cost per Benefit
Fish & Wildlife Restoration, Terrestrial:	50 AHUV	$ 17,658
Aquatic Habitat Restoration:	130 AHUV	$ 6,791
Economic Benefits:	$ 961,400	

Alternative Plan 2b. Alternative plan 2b consists of the Alternative Spillway, Water Level Management Practices Alternative 2, and Circulation Channels. This plan will provide the same benefits as Alternative Plan 2a but will also provide substantial waterfowl and aquatic benefits due to the seasonal fluctuation and periodic major drawdowns included

in the Water Level Management Practices Alternative 2. Implementation of this plan will require significant real estate acquisitions due to raising the water level within the lake. Potential negative impacts are due to the effect of a periodic drawdown of the lake on the local economy.

Table 12
Alternative Plan 2b
Benefit and Cost Summary
(1 October 1998 P.L.)

Total First Cost		$ 12,518,000
Average Annual Cost:		$ 1,119,300
Average Annual Benefits:		
		Cost per Benefit
Fish & Wildlife Restoration, Terrestrial:	290 AHUV	$ 3,860
Aquatic Habitat Restoration:	4,946 AHUV	$ 226
Annual Waterfowl Use Days:	7,125,000	$ 0.16
Economic Benefits:	$ 1,465,300	

Alternative Plan 2c. Alternative plan 2c consists of the Alternative spillway, Water Level Management Practices Alternative 3, and the Circulation Channels features. Alternative plan 2c will provide the same benefits as plan 2a plus the additional aquatic benefits provided by the periodic drawdown described previously. Plan 2c does not require the real estate interests needed for implementation of higher water levels within the lake. This plan, however, does not provide the large number of waterfowl benefits estimated for plan 2b due to the increased water levels within Reelfoot Lake.

Table 13
Alternative Plan 2c
Benefit and Cost Summary
(1 October 1998 P.L.)

Total First Cost:		$ 10,248,000
Average Annual Cost:		$ 882,900
Average Annual Benefits:		
		Cost per Benefit
Fish & Wildlife Restoration, Terrestrial:	50 AHUV	$ 17,658
Aquatic Habitat Restoration:	3,090 AHUV	$ 286
Economic Benefits:	$ 1,249,500	

Alternative Plan 3a. This alternative plan consists of the Alternative Spillway feature, the Circulation Channels, Water Level Management Practices Alternative 1, and the Reelfoot Creek Sediment Detention Basin. The inclusion of the sediment detention basin will have a significant impact on the amount of sediment being deposited in Reelfoot Lake from Reelfoot Creek. Other benefits will be similar to Alternative Plan 2a. The estimated costs and benefits of plan 3a are listed below.

Table 14
Alternative Plan 3a
Benefit and Cost Summary
(1 October 1998 P.L.)

Total First Cost:		$ 21,496,000
Average Annual Cost:		$ 1,883,500
Average Annual Benefits:		
		Cost per Benefit
Fish & Wildlife Restoration, Terrestrial:	374 AHUV	$ 5,036
Aquatic Habitat Restoration:	1,316 AHUV	$ 1,431
Annual Waterfowl Use Days:	1,590,800	$ 1.18
Economic Benefits:	$ 1,179,300	

Alternative Plan 3b. Alternative Plan 3b consists of the Alternative Spillway, Circulation Channels, Water Level management Practices Alternative 2, and the Sediment Detention Basin features. This plan provides the maximum level of benefits for this combination of features due to the inclusion of the seasonal water level fluctuations and the periodic major drawdown of Reelfoot Lake. The implementation of this combination of features would provide significant benefits to the lake.

Table 15
Alternative Plan 3b
Benefit and Cost Summary
(1 October 1998 P.L.)

Total First Cost:		$ 23,766,000
Average Annual Cost:		$ 2,119,900
Average Annual Benefits:		
		Cost per Benefit
Fish & Wildlife Restoration, Terrestrial:	614 AHUV	$ 3,453
Aquatic Habitat Restoration:	6,132 AHUV	$ 346
Annual Waterfowl Use Days:	8,715,800	$ 0.24
Economic Benefits:	$ 1,683,200	

Alternative Plan 3c. Alternative Plan 3c is similar to Alternative Plan 3b except that the seasonal water level fluctuation of the lake is not included. This plan consists of the Alternative Spillway, the Circulation Channels, Water Level Management Plan Alternative 3, and the Reelfoot Creek Sediment Detention Basin. The estimated costs and benefits are listed below.

Table 16
Alternative Plan 3c
Benefit and Cost Summary
(1 October 1998 P.L.)

Total First Cost:		$	21,496,000
Average Annual Cost:		$	1,883,500
Average Annual Benefits:			
		Cost per Benefit	
Fish & Wildlife Restoration, Terrestrial:	374 AHUV	$	5,036
Aquatic Habitat Restoration:	4,276 AHUV	$	440
Annual Waterfowl Use Days:	1,590,800	$	1.18
Economic Benefits:	$ 1,467,400		

Alternative Plans 4a, 4b, and 4c. Alternative Plans 4a, 4b, and 4c are similar to Alternative Plans 3a, 3b, and 3c except for the inclusion of the Shelby Lake Restoration/Waterfowl Management Units feature in each of the three plans. The inclusion of this feature is expected to generate both aquatic and waterfowl benefits for the Reelfoot Lake area. Real estate acquisition would be necessary to implement the Shelby Lake feature, however the expected benefits are significant. The construction of this feature will help to return this wetland area to a more historic condition.

Table 17
Alternative Plan 4a
Benefit and Cost Summary
(1 October 1998 P.L.)

Total First Cost:		$	26,459,000
Average Annual Cost:		$	2,326,800
Average Annual Benefits:			
		Cost per Benefit	
Fish & Wildlife Restoration, Terrestrial:	1,050 AHUV	$	2,216
Aquatic Habitat Restoration:	1,344 AHUV	$	1,731
Annual Waterfowl Use Days:	4,045,800	$	0.58
Economic Benefits:	$ 1,317,700		

Table 18
Alternative Plan 4b
Benefit and Cost Summary
(1 October 1998 P.L.)

Total First Cost:		$ 28,729,000
Average Annual Cost:		$ 2,563,200
Average Annual Benefits:		
		Cost per Benefit
Fish & Wildlife Restoration, Terrestrial:	1,290 AHUV	$ 1,987
Aquatic Habitat Restoration:	6,160 AHUV	$ 416
Annual Waterfowl Use Days:	11,170,800	$ 0.23
Economic Benefits:	$ 1,821,600	

Table 19
Alternative Plan 4c
Benefit and Cost Summary
(1 October 1998 P.L.)

Total First Cost:		$ 26,459,000
Average Annual Cost:		$ 2,326,800
Average Annual Benefits:		
		Cost per Benefit
Fish & Wildlife Restoration, Terrestrial:	1,050 AHUV	$ 2,216
Aquatic Habitat Restoration:	4,304 AHUV	$ 541
Annual Waterfowl Use Days:	4,045,800	$ 0.58
Economic Benefits:	$ 1,605,800	

Alternative Plans 5a, 5b, and 5c. These alternative plans are similar to Alternative Plans 4a, 4b, and 4c except for the inclusion of the Lake Isom Restoration feature. Lake Isom is currently a waterfowl refuge operated by the U.S. Fish and Wildlife Service. Implementation of the proposed feature is expected is generate a high level of waterfowl benefits which will help to restore this area closer to the historical wetland condition. The cost estimate for Lake Isom includes a small amount of real estate interests due to the proposed increase of the water level of the lake. The estimated costs and benefits of these proposed alternative plans are as follows.

Table 20
Alternative Plan 5a
Benefit and Cost Summary
(1 October 1998 P.L.)

Total First Cost:		$ 27,802,000
Average Annual Cost:		$ 2,466,100
Average Annual Benefits:		
		Cost per Benefit
Fish & Wildlife Restoration, Terrestrial:	1,229 AHUV	$ 2,007
Aquatic Habitat Restoration:	1,454 AHUV	$ 1,696
Annual Waterfowl Use Days:	6,272,000	$ 0.39
Economic Benefits:	$ 1,340,000	

Table 21
Alternative Plan 5b
Benefit and Cost Summary
(1 October 1998 P.L.)

Total First Cost:		$ 30,072,000
Average Annual Cost:		$ 2,702,500
Average Annual Benefits:		
		Cost per Benefit
Fish & Wildlife Restoration, Terrestrial:	1,469 AHUV	$ 1,840
Aquatic Habitat Restoration:	6,270 AHUV	$ 431
Annual Waterfowl Use Days:	13,397,000	$ 0.20
Economic Benefits:	$ 1,843,900	

Table 22
Alternative Plan 5c
Benefit and Cost Summary
(1 October 1998 P.L.)

Total First Cost:		$ 27,802,000
Average Annual Cost:		$ 2,466,100
Average Annual Benefits:		
		Cost per Benefit
Fish & Wildlife Restoration, Terrestrial:	1,229 AHUV	$ 2,007
Aquatic Habitat Restoration:	4,414 AHUV	$ 559
Annual Waterfowl Use Days:	6,272,000	$ 0.39
Economic Benefits:	$ 1,628,100	

Comparison of Alternative Plans

After completion of the formulation of the alternative plans and estimation of the benefits and costs of each plan, a comparison was performed to evaluate the various plans. Initial screening of all alternatives was performed by evaluating various criteria including acceptability, completeness, efficiency, effectiveness, and partnership context. The comparison includes the cost per benefit evaluation for each category of benefit for each plan. The benefit categories include fish and wildlife terrestrial habitat restoration, aquatic habitat restoration, waterfowl habitat restoration and recreation and commercial fishing benefits. The terrestrial and aquatic habitat benefits are measured in annual habitat unit values (AHUV). This is a measure of the improvement of the environment due to the proposed changes. Waterfowl habitat restoration is measure in waterfowl use days (WUD's). This is a prediction of the number of waterfowl that will use an area due to improved environment. Recreation and commercial fishing benefits are measured in dollars based on environmental and economic evaluations of the effected habitat areas.

Costs were calculated for all proposed features and alternative plans. Both expected first costs and average annual equivalent costs were calculated. The average annual equivalent cost includes not only the annualized first cost, but also considers other economic factors such as future expenses forgone and the predicted impacts on the economy. Cost per benefit comparisons were performed using the expected annual benefits of each alternative plan and the average annual plan cost. Appendix D, the economic appendix, provides a complete breakdown of the annualized costs for the alternative plans. Table 24 provides a summary of the benefits and costs used for the comparison of the alternative plans. Charts 1 through 3 provide a comparison of the alternative plans based on the efficiency of the outputs.

In addition to comparing the costs and benefits of the alternative plans, each plan was evaluated for its effectiveness in addressing the problems and opportunities identified previously in this study. Table 25 provides the results of this evaluation. Ranking of the alternative plans, as shown in Table 23 was performed based on benefit category and cost. This table clearly indicates that the plans which include water level management Alt. 2 (5b, 4b, 3b, 2b) generally have the highest overall benefits.

Table 23
Ranking of Alternative Plans by Benefits and Cost

	1	2	3	4	5	6	7	8	9	10	11	12	13
	Highest Benefits												Lowest Benefits
Terrestrial AHUV	5b	4b	5c	5a	4c	4a	3b	3c	3a	2b	2c	2a	1a
Aquatic AHUV	5b	4b	3b	2b	5c	4c	3c	2c	5a	4a	3a	2a	1a
Waterfowl Use Days	5b	4b	3b	2b	5c	5a	4c	4a	3c	3a	2c	2a	1a
Economic Benefits	5b	4b	3b	5c	4c	3c	2b	5a	4a	2c	3a	2a	1a
	Highest					Average Annual Cost							Lowest
Cost	5b	4b	5c	5a	4c	4a	3b	3c	3a	2b	2c	2a	1a

Table 24
Alternative Plans
Benefits and Cost Summary Table

Alternative Plan	Estimated Average Annual Cost	Fish & Wildlife Rest., Terrestrial AHUV*	Cost Per Unit, Terrestrial AHUV	Aquatic Habitat Restoration, AHUV*	Cost Per Unit, Aquatic AHUV	Annual Waterfowl Use Days*	Cost Per Unit, AWUD	Average Annual Equivalent Economic Benefits*
1a	$ 834,100	50	$ 16,682	0	-	0	$ -	$ 923,000
2a	$ 882,900	50	$ 17,658	130	$ 6,792	0	$ -	$ 961,400
2b	$ 1,119,300	290	$ 3,860	4,946	$ 226	7,125,000	$ 0.16	$ 1,465,300
2c	$ 882,900	50	$ 17,658	3,090	$ 286	0	$ -	$ 1,249,500
3a	$ 1,883,500	374	$ 5,036	1,316	$ 1,431	1,590,800	$ 1.18	$ 1,179,300
3b	$ 2,119,900	614	$ 3,453	6,132	$ 346	8,715,800	$ 0.24	$ 1,683,200
3c	$ 1,883,500	374	$ 5,036	4,276	$ 440	1,590,800	$ 1.18	$ 1,467,400
4a	$ 2,326,800	1,050	$ 2,216	1,344	$ 1,731	4,045,800	$ 0.58	$ 1,317,700
4b	$ 2,563,200	1,290	$ 1,987	6,160	$ 416	11,170,800	$ 0.23	$ 1,821,600
4c	$ 2,326,800	1,050	$ 2,216	4,304	$ 541	4,045,800	$ 0.58	$ 1,605,800
5a	$ 2,466,100	1,229	$ 2,007	1,454	$ 1,696	6,272,000	$ 0.39	$ 1,340,000
5b	$ 2,702,500	1,469	$ 1,840	6,270	$ 431	13,397,000	$ 0.20	$ 1,843,900
5c	$ 2,466,100	1,229	$ 2,007	4,414	$ 559	6,272,000	$ 0.39	$ 1,628,100

*Net Benefits Shown: Future with Project less Future Without Project

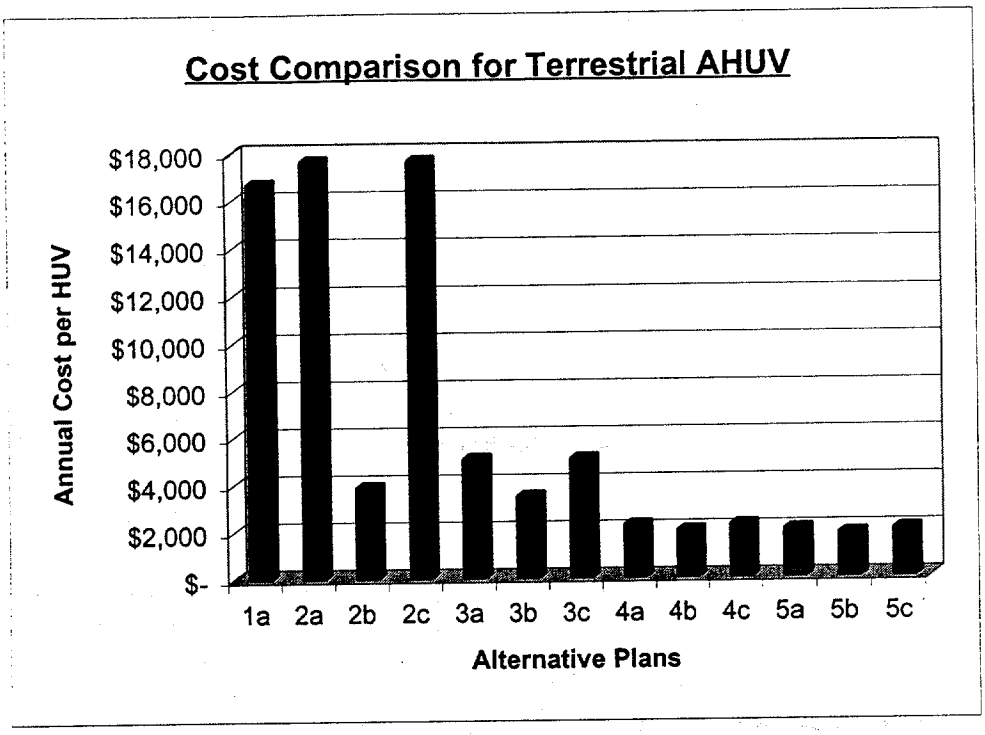


Figure 2

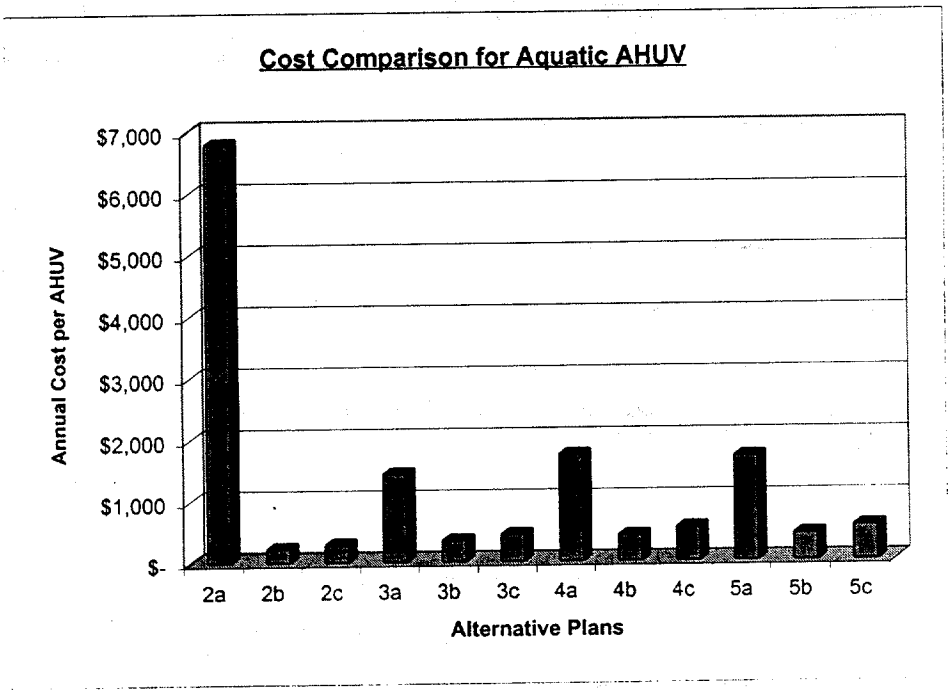


Figure 3

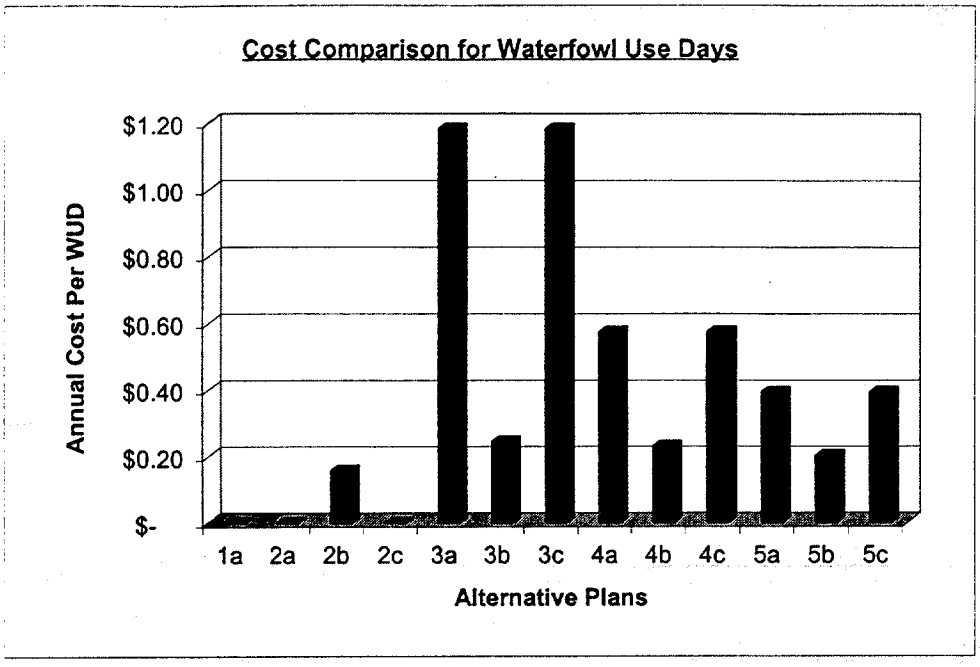


Figure 4

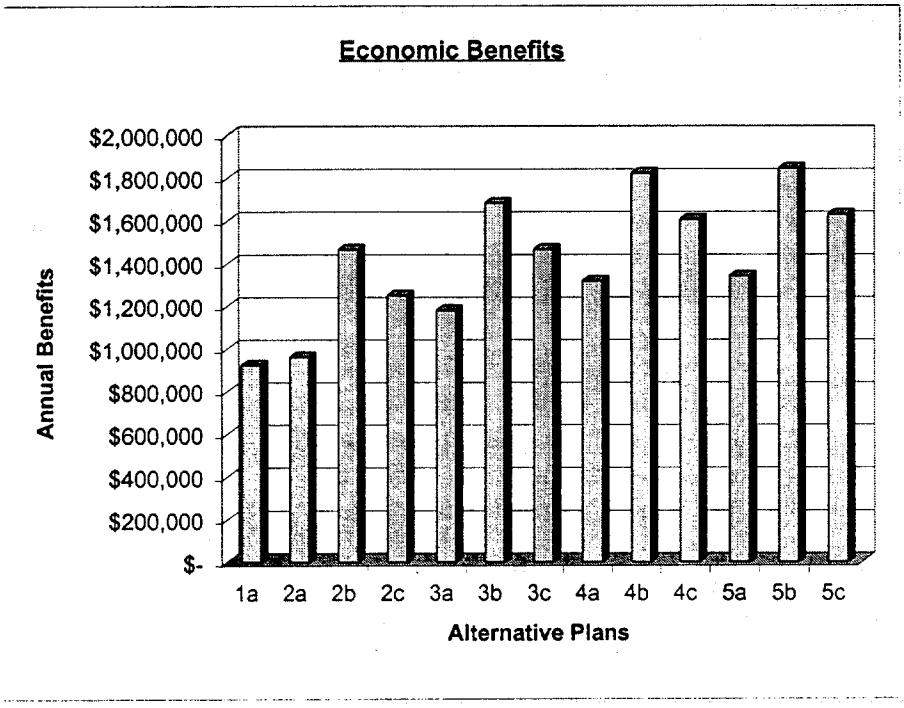


Figure 5

Ranking was also performed on the basis of cost per unit benefit for the various environmental benefits for the 13 alternative plans. This ranking indicates the plans that are most efficient per category of benefit, however this ranking is not fully indicative of the effectiveness of the plan in addressing the problems and opportunities identified in this study.

Table 25
Ranking of Alternative Plans by Cost per Unit Benefit

	1	2	3	4	5	6	7	8	9	10	11	12	13
	Lowest Cost/Benefit												Highest Cost/Benefit
Terrestrial AHUV	5b	4b	5c	5a	4c	4a	3b	2b	3c	3a	1a	2a	2c
Aquatic AHUV	2b	2c	3b	4b	5b	3c	4c	5c	3a	5a	4a	2a	
Waterfowl Use Days	2b	5b	4b	3b	5c	5a	4c	4a	3c	3a			

In summary, the alternative plans which provide the highest levels of environmental and economic benefits are the plans which include the water level management practices alternative 2. These plans also, in general, have the highest costs. The plans which show the least cost per environmental benefit are also, in general, the plans which include the water level management practices alternative 2. This is due to the high levels of benefits expected from the seasonal increase of the water level and the periodic drawdown of the lake as previously described in this report.

Alternative plan 5b provides the highest level of benefits in all environmental and economic benefit categories evaluated in this study. Next, plans 4b, 3b, 5c, and 2b, respectively, provide the highest levels of benefits considering all benefit categories, as shown in Table 23. Efficiency of the alternative plans varies according to the benefit category being examined as shown in Table 25 above. Plans 2b, 5b, 2c, and 4b provide the most efficient output of benefits in at least one of the benefit categories. However, only plans 5b and 4b effectively address all of the problems and opportunities identified. Plan 5b is similar to plan 4b except that it includes the Lake Isom Restoration feature. This feature significantly increases both terrestrial and aquatic habitat benefits along with waterfowl habitat benefits. Because of the relatively low cost of the Lake Isom Restoration feature, plan 5b provides lower cost per unit benefits than plan 4b in all but one of the benefit categories evaluated as shown in Tables 24 and 26. Therefore, plan 5b was found to be both more efficient and more effective than plan 4b.

TABLE 26
REELFOOT LAKE FEASIBILITY STUDY
SYSTEM OF ACCOUNTS

ACCOUNT	WITHOUT PROJECT	PLAN 1A	PLAN 2A	PLAN 2B
A. PLAN DESCRIPTION	NONE	Alternative Spillway and existing water level management plan	Alternative Spillway, Circulation Channels, existing water level management plan	Alternative Spillway, Circulation Channels, dynamic water level fluctuation with drawdown
B. SIGNIFICANT IMPACTS				
1. **National Economic Development**				
a. First Cost (1 Oct 98 P.L.)	---	$9,709,000	$10,248,000	$12,518,000
b. OMRR&R	---	$18,300	$20,000	$20,000
c. Annual Costs (AAE) @ Current Interest Rate (7.125%)	---	$834,100	$ 882,900	$ 1,119,300
d. Annual Benefits (AAE) @ Current Interest Rate (7.125%)	---	$923,000	$ 961,400	$ 1,465,300
2. **Environmental Quality**				
a. Biological Resources				
1. Wildlife Habitat				
a. Terrestrial	Continued Decrease	+ 50 AHUV	+ 50 AHUV	+ 290 AHUV
b. Aquatic	Continued Decrease	No Change	+ 130 AHUV	+ 4,946 AHUV
c. Waterfowl	Continued Decrease	No Change	No Change	+7,125,000 WUD
2. Aquatic Resources	Continued Decrease	Continued Decrease	Increase	Significant Increase
3. Threatened or Endangered Species	Continued Decline	Continued Decline	Improve	Improve
4. Fisheries	Further Degradation	Continued Degradation	Improve	Significant Improvement
b. Air Quality	No Change Expected	No Change Expected	No Change Expected	No Change Expected
c. Water Quality	Further Degradation	Continued Degradation	Improve	Improve
d. Wooded Land	Loss of bottomland hardwoods and forested swamps.	Loss of bottomland hardwoods and forested swamps.	Loss of bottomland hardwoods and forested swamps.	Increase in bottomland hardwoods and forested swamps.
e. Agricultural Land	No Change Expected	No Change Expected	No Change Expected	Acquisition of farmland required.
f. Wetlands	Loss of bottomland hardwoods and forested swamps.	Loss of bottomland hardwoods and forested swamps.	Loss of bottomland hardwoods and forested swamps.	Improved wetlands.
g. Historic Properties	No change expected.	No impacts expected.	No impacts expected.	No impacts expected.

TABLE 26
REELFOOT LAKE FEASIBILITY STUDY
SYSTEM OF ACCOUNTS

ACCOUNT	WITHOUT PROJECT	PLAN 1A	PLAN 2A	PLAN 2B
3. **Regional Economic Development**				
a. Net Income (AAE) @ current interest rate (7.125%)	N/A	$ 88,900	$ 78,500	$ 346,000
b. Employment	Slight Decrease	Temporary increase in construction employment.	Temporary increase in construction employment.	Temporary increase in construction employment.
c. Regional Growth	Slight Decrease	No substantial effect.	No substantial effect.	Increase
d. Local Government Finance	No Effect	No substantial effect.	No substantial effect.	No substantial effect.
4. **Other Social Effects**				
a. Noise	No Effect	Temporary increase during construction.	Temporary increase during construction.	Temporary increase during construction.
b. Esthetics	No Effect	No Effect	No Effect	Reduced during periodic drawdown
c. Health, Safety, and Security of Life	Potential life/safety effect from failure of structure	Increased Effect from new bridge	Increased Effect from new bridge	Increased Effect from new bridge
d. Public Facilities and Services	Decrease	Increase	Increase	Increase
e. Displacement of People	No Effect	Possible	Possible	Possible
f. Community Cohesion	No Effect	No Effect	No Effect	No Effect
g. Community Growth	No Effect	No Effect	No Effect	No Effect
h. Emergency Preparedness	No Effect	No Effect	No Effect	No Effect
C. PLAN EVALUATION				
1. **Relationship to Planning Objectives**				
a. Fish and Wildlife Habitat Restoration	Reduction in fish and wildlife habitat	+ 50 AHUV	+ 180 AHUV	+ 5,236 AHUV
b. Waterfowl Habitat Restoration	Reduction in waterfowl habitat	No Effect	No Effect	+7,125,000 WUD
2. **Net Beneficial and Adverse Effects (AAE)**				
a. Tangible Benefits @ current interest rate (7.125%)	---	$ 923,000	$ 961,400	$ 1,465,300
b. Tangible Costs @ current interest rate (7.125%)	---	$ 834,100	$ 882,900	$ 1,119,300
c. Net Benefits	---	$ 88,900	$ 78,500	$ 346,000

TABLE 26 (Cont'd)
REELFOOT LAKE FEASIBILITY STUDY
SYSTEM OF ACCOUNTS

ACCOUNT	PLAN 2C	PLAN 3A	PLAN 3B	PLAN 3C
A. PLAN DESCRIPTION	Alternative Spillway, Circulation Channels, periodic drawdown	Alternative Spillway, Circulation Channels, sediment basin, existing water level management	Alternative Spillway, Circulation Channels, sediment basin, dynamic water level fluctuation with drawdown	Alternative Spillway, Circulation Channels, sediment basin, periodic drawdown
B. SIGNIFICANT IMPACTS				
1. **National Economic Development**				
a. First Cost (1 Oct 98 P.L.)	$10,248,000	$ 21,496,000	$ 23,766,000	$ 21,496,000
b. OMRR&R	$20,000	$122,200	$122,200	$122,200
c. Annual Costs (AAE) @ Current Interest Rate (7.125%)	$ 882,900	$ 1,883,500	$ 2,119,900	$ 1,883,500
d. Annual Benefits (AAE) @ Current Interest Rate (7.125%)	$ 1,249,500	$ 1,179,300	$ 1,683,200	$ 1,467,400
2. **Environmental Quality**				
a. Biological Resources				
1. Wildlife Habitat				
a. Terrestrial	+ 50 AHUV	+ 374 AHUV	+ 614 AHUV	+374 AHUV
b. Aquatic	+3,090 AHUV	+1,316 AHUV	+ 6,132 AHUV	+4,276 AHUV
c. Waterfowl	No Change	+1,590,800 WUD	+8,715,800 WUD	+1,590,800 WUD
2. Aquatic Resources	Increase	Increase	Significant Increase	Increase
3. Threatened or Endangered Species	Improve	Improve	Improve	Improve
4. Fisheries	Improvement	Increase	Significant Improvement	Significant Improvement
b. Air Quality	No Change expected	No Change expected	No Change expected	No Change expected
c. Water Quality	Increase	Significant Improvement	Significant Improvement	Significant Improvement
d. Wooded Land	Loss of bottomland hardwoods and forested swamps.	Increase in bottomland hardwoods and forested swamps.	Increase in bottomland hardwoods and forested swamps.	Increase in bottomland hardwoods and forested swamps.
e. Agricultural Land	No Change Expected	Acquisition of farmland required.	Acquisition of farmland required.	Acquisition of farmland required.
f. Wetlands	Loss of bottomland hardwoods and forested swamps.	Increase in bottomland hardwoods and forested swamps.	Increase in bottomland hardwoods and forested swamps.	Increase in bottomland hardwoods and forested swamps.
g. Historic Properties	No impacts expected.	No impacts expected.	No impacts expected.	No impacts expected.

TABLE 26 (Cont'd)
REELFOOT LAKE FEASIBILITY STUDY
SYSTEM OF ACCOUNTS

ACCOUNT	PLAN 2C	PLAN 3A	PLAN 3B	PLAN 3C
3. **Regional Economic Development**				
a. Net Income (AAE) @ current interest rate (7.125%)	$ 366,600	$ (704,200)	$ (436,700)	$ (416,100)
b. Employment	Temporary increase in construction employment.	Temporary increase in construction employment.	Temporary increase in construction employment.	Temporary increase in construction employment.
c. Regional Growth	Increase	Increase	Increase	Increase
d. Local Government Finance	No substantial effect.	No substantial effect.	No substantial effect.	No substantial effect.
4. **Other Social Effects**				
a. Noise	Temporary increase during construction.	Temporary increase during construction.	Temporary increase during construction.	Temporary increase during construction.
b. Esthetics	Reduced during periodic drawdown	No Effect	Reduced during periodic drawdown	Reduced during periodic drawdown
c. Health, Safety, and Security of Life	Increased Effect from new bridge	Increased Effect from new bridge	Increased Effect from new bridge	Increased Effect from new bridge
d. Public Facilities and Services	Increase	Increase	Increase	Increase
e. Displacement of People	Possible	Possible	Possible	Possible
f. Community Cohesion	No Effect	No Effect	No Effect	No Effect
g. Community Growth	No Effect	No Effect	No Effect	No Effect
h. Emergency Preparedness	No Effect	No Effect	No Effect	No Effect
C. PLAN EVALUATION				
1. **Relationship to Planning Objectives**				
a. Fish and Wildlife Habitat Restoration	Increase 3,140 AHUV	Increase by 1,690 AHUV	Increase by 6,746 AHUV	Increase by 4,650 AHUV
b. Waterfowl Habitat Restoration	No Effect	Increase by 1,590,800 WUD	Increase by 8,715,800 WUD	Increase by 1,590,800 WUD
2. **Net Beneficial and Adverse Effects (AAE)**				
a. Tangible Benefits @ current interest rate (7.125%)	$ 1,249,500	$ 1,179,300	$ 1,683,200	$ 1,467,400
b. Tangible Costs @ current interest rate (7.125%)	$ 882,900	$ 1,883,500	$ 2,119,900	$ 1,883,500
c. Net Benefits	$ 366,600	$ (704,200)	$ (436,700)	$ (416,100)

TABLE 26 (Cont'd)
REELFOOT LAKE FEASIBILITY STUDY
SYSTEM OF ACCOUNTS

ACCOUNT	PLAN 4A	PLAN 4B	PLAN 4C
A. PLAN DESCRIPTION	Alternative Spillway, Circulation Channels, sediment basin, Shelby Lake, existing water level management	Alternative Spillway, Circulation Channels, sediment basin, Shelby Lake, dynamic water level fluctuation with drawdown	Alternative Spillway, Circulation Channels, sediment basin, Shelby Lake, periodic drawdown
B. SIGNIFICANT IMPACTS			
1. **National Economic Development**			
a. First Cost (1 Oct 98 P.L.)	$ 26,459,000	$ 28,729,000	$ 26,459,000
b. OMRR&R	$ 162,900	$ 162,900	$ 162,900
c. Annual Costs (AAE) @ Current Interest Rate (7.125%)	$ 2,326,800	$ 2,563,200	$ 2,326,800
d. Annual Benefits (AAE) @ Current Interest Rate (7.125%)	$ 1,317,700	$ 1,821,600	$ 1,605,800
2. **Environmental Quality**			
a. Biological Resources			
1. Wildlife Habitat a. Terrestrial b. Aquatic c. Waterfowl	Increase 1,050 AHUV Increase 1,344 AHUV Increase 4,045,800 WUD	Increase 1,290 AHUV Increase 6,160 AHUV Increase 11,170,800 WUD	Increase 1,050 AHUV Increase 4,304 AHUV Increase 4,045,800 WUD
2. Aquatic Resources	Increase	Significant Increase	Significant Increase
3. Threatened or Endangered Species	Improve	Improve	Improve
4. Fisheries	Increase	Significant Improvement	Significant Improvement
b. Air Quality	No Change expected	No Change expected	No Change expected
c. Water Quality	Significant Improvement	Significant Improvement	Significant Improvement
d. Wooded Land	Increase in bottomland hardwoods and forested swamps.	Increase in bottomland hardwoods and forested swamps.	Increase in bottomland hardwoods and forested swamps.
e. Agricultural Land	Acquisition of farmland required.	Acquisition of farmland required.	Acquisition of farmland required.
f. Wetlands	Increase in bottomland hardwoods and forested swamps.	Increase in bottomland hardwoods and forested swamps.	Increase in bottomland hardwoods and forested swamps.
g. Historic Properties	No impacts expected.	No impacts expected.	No impacts expected.
3. **Regional Economic Development**			
a. Net Income (AAE) @ current interest rate (7.125%)	$ (1,009,100)	$ (741,600)	$ (721,000)

TABLE 26 (Cont'd)
REELFOOT LAKE FEASIBILITY STUDY
SYSTEM OF ACCOUNTS

ACCOUNT	PLAN 4A	PLAN 4B	PLAN 4C
b. Employment	Temporary increase in construction employment.	Temporary increase in construction employment.	Temporary increase in construction employment.
c. Regional Growth	Increase	Increase	Increase
d. Local Government Finance	No substantial effect.	No substantial effect.	No substantial effect.
4. **Other Social Effects**			
a. Noise	Temporary increase during construction.	Temporary increase during construction.	Temporary increase during construction.
b. Esthetics	No Effect	Reduced during periodic drawdown	Reduced during periodic drawdown
c. Health, Safety, and Security of Life	Increased Effect from new bridge	Increased Effect from new bridge	Increased Effect from new bridge
d. Public Facilities and Services	Increase	Increase	Increase
e. Displacement of People	Possible	Possible	Possible
f. Community Cohesion	No Effect	No Effect	No Effect
g. Community Growth	No Effect	No Effect	No Effect
h. Emergency Preparedness	No Effect	No Effect	No Effect
C. PLAN EVALUATION			
1. **Relationship to Planning Objectives**			
a. Fish and Wildlife Habitat Restoration	Increase by 2,394 AHUV	Increase by 7,450 AHUV	Increase by 5,354 AHUV
b. Waterfowl Habitat Restoration	Increase by 4,045,800 WUD	Increase by 11,170,800 WUD	Increase by 4,045,800 WUD
2. **Net Beneficial and Adverse Effects (AAE)**			
a. Tangible Benefits @ current interest rate (7.125%)	$ 1,317,700	$ 1,821,600	$ 1,605,800
b. Tangible Costs @ current interest rate (7.125%)	$ 2,326,800	$ 2,563,200	$ 2,326,800
c. Net Benefits	$ (1,009,100)	$ (741,600)	$ (721,000)

TABLE 26 (Cont'd)
REELFOOT LAKE FEASIBILITY STUDY
SYSTEM OF ACCOUNTS

ACCOUNT	PLAN 5A	PLAN 5B	PLAN 5C
A. PLAN DESCRIPTION	Alternative Spillway, Circulation Channels, sediment basin, Shelby Lake, Lake Isom, existing water level management	Alternative Spillway, Circulation Channels, sediment basin, Shelby Lake, Lake Isom, dynamic water level fluctuation with drawdown	Alternative Spillway, Circulation Channels, sediment basin, Shelby Lake, Lake Isom, periodic drawdown
B. SIGNIFICANT IMPACTS			
1. **National Economic Development**			
a. First Cost (1 Oct 98 P.L.)	$ 27,802,000	$ 30,072,000	$ 27,802,000
b. OMRR&R	$ 189,200	$ 189,200	$ 189,200
c. Annual Costs (AAE) @ Current Interest Rate (7.125%)	$ 2,466,100	$ 2,702,500	$ 2,466,100
d. Annual Benefits (AAE) @ Current Interest Rate (7.125%)	$ 1,340,000	$ 1,843,900	$ 1,628,100
2. **Environmental Quality**			
a. Biological Resources			
1. Wildlife Habitat			
a. Terrestrial	Increase 1,229 AHUV	Increase 1,469 AHUV	Increase 1,229 AHUV
b. Aquatic	Increase 1,454 AHUV	Increase 6,270 AHUV	Increase 4,414 AHUV
c. Waterfowl	Increase 6,272,000 WUD	Increase 13,397,000 WUD	Increase 6,272,000 WUD
2. Aquatic Resources	Increase	Significant Increase	Significant Increase
3. Threatened or Endangered Species	Improve	Improve	Improve
4. Fisheries	Increase	Significant Improvement	Significant Improvement
b. Air Quality	No Change expected	No Change expected	No Change expected
c. Water Quality	Significant Improvement	Significant Improvement	Significant Improvement
d. Wooded Land	Increase in bottomland hardwoods and forested swamps.	Increase in bottomland hardwoods and forested swamps.	Increase in bottomland hardwoods and forested swamps.
e. Agricultural Land	Acquisition of farmland required.	Acquisition of farmland required.	Acquisition of farmland required.
f. Wetlands	Increase in bottomland hardwoods and forested swamps.	Increase in bottomland hardwoods and forested swamps.	Increase in bottomland hardwoods and forested swamps.
g. Historic Properties	No impacts expected.	No impacts expected.	No impacts expected.
3. **Regional Economic Development**			
a. Net Income (AAE) @ current interest rate (7.125%)	$ (1,126,100)	$ (858,600)	$ (838,000)

TABLE 26 (Cont'd)
REELFOOT LAKE FEASIBILITY STUDY
SYSTEM OF ACCOUNTS

ACCOUNT	PLAN 5A	PLAN 5B	PLAN 5C
b. Employment	Temporary increase in construction employment.	Temporary increase in construction employment.	Temporary increase in construction employment.
c. Regional Growth	Increase	Increase	Increase
d. Local Government Finance	No substantial effect.	No substantial effect.	No substantial effect.
4. **Other Social Effects**			
a. Noise	Temporary increase during construction.	Temporary increase during construction.	Temporary increase during construction.
b. Esthetics	No Effect	Reduced during periodic drawdown	Reduced during periodic drawdown
c. Health, Safety, and Security of Life	Increased Effect from new bridge	Increased Effect from new bridge	Increased Effect from new bridge
d. Public Facilities and Services	Increase	Increase	Increase
e. Displacement of People	Possible	Possible	Possible
f. Community Cohesion	No Effect	No Effect	No Effect
g. Community Growth	No Effect	No Effect	No Effect
h. Emergency Preparedness	No Effect	No Effect	No Effect
C. PLAN EVALUATION			
1. **Relationship to Planning Objectives**			
a. Fish and Wildlife Habitat Restoration	Increase by 2,683 AHUV	Increase by 7,739 AHUV	Increase by 5,643 AHUV
b. Waterfowl Habitat Restoration	Increase by 6,272,000 WUD	Increase by 13,397,000 WUD	Increase by 6,272,000 WUD
2. **Net Beneficial and Adverse Effects (AAE)**			
a. Tangible Benefits @ current interest rate (7.125%)	$ 1,340,000	$ 1,843,900	$ 1,628,100
b. Tangible Costs @ current interest rate (7.125%)	$ 2,466,100	$ 2,702,500	$ 2,466,100
c. Net Benefits	$ (1,126,100)	$ (858,600)	$ (838,000)

Table 27 Alternative Plans Comparison Matrix							
Plan	Problem 1: Loss of Aquatic Habitat	Problem 2: Declining Water Quality	Problem 3: Loss of Waterfowl Habitat	Problem 4: Reduced Water Level Management Capability	Opportunity 1: Protect and Restore Nationally Significant Resources	Opportunity 2: Improve Recreational Opportunities	Opportunity 3: Increase Business Opportunities
FWOP	NO	NO	NO	NO	NO	NO	NO
1a	YES	NO	NO	NO	NO	NO	NO
2a	YES	YES	NO	NO	NO	NO	NO
2b	YES	YES	YES	YES	NO	YES	YES
2c	YES	YES	NO	YES	NO	NO	NO
3a	YES	YES	YES	NO	NO	NO	NO
3b	YES	YES	YES	YES	NO	YES	YES
3c	YES	YES	YES	YES	NO	NO	NO
4a	YES	YES	YES	NO	YES	NO	NO
4b	YES	YES	YES	YES	YES	YES	YES
4c	YES	YES	YES	YES	YES	NO	NO
5a	YES	YES	YES	YES	YES	NO	NO
5b	YES	YES	YES	YES	YES	YES	YES
5c	YES	YES	YES	YES	YES	NO	NO

Selection of Initially Recommended Plan

Selection of the initially recommended plan was based on the analysis of the alternative plans to determine which plan most effectively and efficiently addressed the problems and opportunities identified in the study (Table 27). The primary benefits considered in selecting the initially recommended plan were the net environmental benefits generated by implementation of the various features included in the plans. The economic benefits calculated are secondary to the environmental outputs, in that, the primary purpose of the project is environmental restoration. For that reason, the benefit to cost ratio calculated for the economic benefits was not used as a primary determining factor for selecting the recommended plan. Another important factor considered in the initial selection was real estate requirements. All alternative plans which include seasonally raising the water elevation in Reelfoot Lake required acquisition of real estate interests in both Tennessee and Kentucky. Other features evaluated including the Alternative Spillway, Reelfoot Creek Sediment Basin and Shelby Lake Restoration require acquisition of significant real estate interests.

After a complete evaluation of the completeness, effectiveness, and efficiency of the alternative plans along with the evaluation of the environmental and economic impacts, both positive and negative, plan 5b was initially selected as the best plan. This plan provides the highest levels of environmental benefits which would help restore, enhance and preserve the Nationally Significant environment in the Reelfoot Lake area. Negative environmental impacts of this plan, expected from construction activities, were minimal and greatly offset by the positive environmental effects of the project.

Refinement of Recommended Plan

During the public review of the draft feasibility report and draft environmental impact statement (DEIS), strong opposition to the water level management aspects of the initially recommended plan were presented. Through additional coordination with the various local, state, and Federal interests, the plan proposed in the draft feasibility report and DEIS was refined. The refined recommended plan addresses the primary concerns expressed (concerns about water level management of Reelfoot Lake) while providing environmental benefits. The initially recommended plan had a higher cost (due to the requirement for flowage easements around Reelfoot Lake in both Tennessee and Kentucky) and greater aquatic and waterfowl benefits. However, the initially recommended plan was deemed unimplementable due to the nature and extent of opposition to the proposed water level management of Reelfoot Lake. While the refined recommended plan has a reduced cost and reduced environmental benefits, it provides additional benefits to agriculture through lowering the lake in the spring to elevation 282.7 by March 15. The refined plan addresses the wide range of concerns to a drawdown of Reelfoot Lake by phasing in the drawdown. Initially, a three foot drawdown will be conducted. This would lower the lake to a level similar to that experienced in 1985. Likewise, the lake level has historically dropped by three feet. Following the initial drawdown, additional drawdowns will be scheduled on an as needed basis every five to ten years and may be extended up to a 4 foot drawdown.

Table 28 presents a comparison of the initially recommended plan from the draft feasibility report and DEIS and the current, refined recommended plan. Both plans call for construction of five features previously presented: (1) Alternative spillway and associated bridge, inlet and outlet channel, and closure of the existing spillway; (2) Circulation channels within Reelfoot Lake; (3) A sediment retention basin on Reelfoot Creek; (4) Construction of Shelby Lake and waterfowl management areas around Shelby Lake; and (5) Improvements at the Lake Isom National Wildlife Refuge (NWR), including raising the earthen dam embankment and emergency spillway and replacing the existing outlet structure. Likewise, both plans include changes in water level management at the Lake Isom NWR. The current and proposed water level management of Lake Isom is outlined in Table 29. Differences in the two plans include the benefits realized, the costs involved, and the proposed water level management changes for Reelfoot Lake. Table 30 presents a comparison of the existing operation schedule for water level management of Reelfoot Lake, the draft recommended operation schedule, and the final recommended operation schedule for water level management of Reelfoot Lake.

Table 28
Comparison of Initial and Refined Recommended Plans

Features	Initial Plan (Draft Report)	Refined Plan (Current)
New spillway	Included	Included
Circulation Channels	Included	Included
Sediment Retention Basin	Included	Included
Shelby Lake and waterfowl areas	Included	Included
Lake Isom improvements	Included	Included
Changes in water level management at Lake Isom NWR	Included (see Table 29)	Included (see Table 29)
Seasonal flowage easements in vicinity of Lake Isom	104.7 acres	104.7 acres
Changes in water level management of Reelfoot Lake	Included (see Table 30)	Included (see Table 30)
Seasonal flowage easements around Reelfoot Lake in TN and KY	Included	None
First Cost (1 Oct 98 P.L.)	$30.0 million	$27.8 million
Fully Funded Cost	$35.3 million	$32.6 million
OMRR&R	$189,200	$189,200
Annual Costs (AAE) @ Current Interest Rate (7.125%)	$2.7 million	$2.5 million
Terrestrial Benefits	1,469 AHUV	1,469 AHUV
Aquatic Benefits	6,270 AHUV	4,414 AHUV
Waterfowl Benefits	13,397,000 WUD	6,272,000 WUD

Table 29 Lake Isom Water Level Management	
Existing Yearly Schedule	**Proposed Yearly Schedule (Initially and Refined)**
Oct 15 - Nov 1 Raise Lake Isom from elevation 279.0 to 280.5	Oct 15 - Nov 1 Raise Lake Isom from elevation 279.0 to 282.0
Nov 1 - Mar 1 Maintain elevation 280.5	Nov 1 - Mar 1 Maintain elevation 282.0
Mar 1 - Mar 15 Lower Lake Isom from elevation 280.5 to 279.0	Mar 1 - Mar 15 Lower Lake Isom from elevation 282.0 to 279.0
Mar 15 - Oct 15 Maintain elevation 279.0	Mar 15 - Oct 15 Maintain elevation 279.0

Table 30
Reelfoot Lake
Water Level Management

Existing Operation Schedule	Draft Recommended Operation Schedule	Final Recommended Operation Schedule
Yearly:	Yearly:	Yearly:
Nov 15 - Apr 15	Nov 15 - Apr 15	Nov 15 - Mar 1
Fluctuate up to elevation 283.2	Fluctuate between elevations 282.2 and 283.5	Fluctuate up to elevation 283.2
Apr 16 - Nov 14	Apr 16 - Nov 14	Mar 1 - Mar 15
Fluctuate up to elevation 282.7	Fluctuate between elevations 282.2 and 283.0	Lower lake to elevation 282.7
		Mar 15 - Jul 1
		Hold lake at elevation 282.7
		Jul 1 - Nov 15
		Fluctuate up to elevation 282.7
	Every 5 to 10 years:	Every 5 to 10 years:
	Lower lake to elevation 278.2 from Jun 1 - Jul 15	Lower lake to drawdown elevation from Jun 1 - Jul 15
	Hold lake at elevation 278.2 from Jul 15 - Nov 15	Hold lake at drawdown elevation from Jul 15 - Nov 15
	Refill lake to elevation 283.3 from Nov 16 - Jun 1	Refill lake up to elevation 283.2 from Nov 16 - Mar 1
	Drop back to yearly schedule on Jun 2	Drop back to yearly schedule on Mar 1
		Initial drawdown of 3'. Future drawdowns at up to 4' as needed

Partnering Opportunities

Future Operation and Maintenance (O & M) responsibilities in most cases will rest with the official project sponsor, TWRA with the exception of the Lake Isom improvements. However, due to the close interrelationship between TWRA, USFWS, NRCS, COE, TDOT, and TDEC; shared responsibilities must be described in detail as the PCA, operating manuals, and specific management plans are developed. The two features that will require complex interagency agreements are the alternative spillway (with inlet and outlet channels) and the sediment basin. In addition to the PCA and other documents described above; O & M responsibilities must be clearly addressed in the TWRA *Fifty Year Management Plan* and their annual management plans, the refuge management plans (FWS), and the state park plan of operation. Also, the lease agreement between the USFWS and the TWRA will expire in the year 2016 and all parties agree that the lease must be amended to include the new spillway and the new sediment basin.

FINANCIAL ANALYSIS

The State of Tennessee, acting through the Tennessee Wildlife Resources Agency, is willing and financially capable to share in the construction and operation and maintenance of the project according to the terms of the draft Project Cooperation Agreement. A letter of intent from the non-Federal sponsor is included after the "Recommendations" section of this report.

LOCAL COOPERATION AND COST SHARING

In accordance with the Water Resources Development Act of 1996 (WRDA 1996), ecosystem restoration projects are cost shared 65 percent Federal and 35 percent non-Federal. Included in the 35 percent non-Federal cost are all lands, easements, rights of way, relocations, and dredged material disposal areas (LERRDs). No minimum cash requirement from the non-Federal cost sharing partner is required. However, if the LERRDs do not equal 35 percent of the total project costs, the non-Federal cost sharing partner is required to pay an amount in cash that will bring the non-Federal contributions to 35 percent of the total project costs. Upon completion of construction, the non-Federal cost sharing partner assumes 100 percent of the costs associated with operation and maintenance, repair, replacement, and rehabilitation (OMRR&R) of the project.

Cultural resources mitigation costs are a 100 percent Federal cost up to an amount equal to one percent of the total project cost. If cultural resources mitigation costs are estimated to exceed one percent of the total project cost, that amount above one percent of total project costs must be approved by Congress and is cost shared with the non-

Federal cost sharing partner at the rate of the remainder of the project (35 percent non-Federal).

Improvements on Federal refuges, such as those presented in this report for the Lake Isom National Wildlife Refuge, have a 100 percent Federal first cost. In the event that improvements were to result in operation and maintenance (O&M) costs beyond that currently experienced, then such incremental increase would be at 75% Federal cost / 25% non-Federal cost. In this case, there is no such incremental increase because the improvements will necessitate no O&M over that currently borne by the U.S. Fish and Wildlife Service.

The non-Federal local cooperation requirements are further outlined as follows:

(1) Provide 35 percent of the separable project costs allocated to environmental restoration as further specified below:

(a) Enter into an agreement which provides, prior to execution of a project cooperation agreement, 25 percent of project design costs;

(b) Provide, during construction, any additional funds needed to cover the non-federal share of project design costs;

(c) Provide all lands, easements, and rights-of-way, including suitable borrow and dredged or excavated material disposal areas, and perform or assure the performance of all relocations determined by the Government to be necessary for the construction, operation, and maintenance of the project;

(d) Provide or pay to the Government the cost of providing all retaining dikes, wasteweirs, bulkheads, and embankments, including all monitoring features and stilling basins, that may be required at any dredged or excavated material disposal areas required for the construction, operation, and maintenance of the project; and

(e) Provide, during construction, any additional funds as necessary to make its total contribution equal to 35 percent of the separable project costs allocated to environmental restoration.

(2) For so long as the project remains authorized, operate, maintain, repair, replace, and rehabilitate the completed project, or functional portion of the project, at no cost to the Government, in accordance with applicable Federal and State laws and any specific directions prescribed by the Government.

(3) Give the Government a right to enter, at reasonable times and in a reasonable manner, upon land which the local sponsor owns or controls for access to the project for the purpose of inspection, and, if necessary, for the purpose of completing, operating, maintaining, repairing, replacing, or rehabilitating the project.

(4) Assume responsibility for operating, maintaining, replacing, repairing, and rehabilitating (OMRR&R) the project or completed functional portions of the project, including mitigation features without cost to the Government, in a manner compatible with the project's authorized purpose and in accordance with applicable Federal and State laws and specific directions prescribed by the Government in the OMRR&R manual and any subsequent amendments thereto.

(5) Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended, and Section 103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended, which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the non-Federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element.

(6) Hold and save the Government free from all damages arising from the construction or operation and maintenance of the Project and any Project-related betterments, except for damages due to the fault or negligence of the Government or the Government's contractors. The phrase "operations and maintenance" includes repair, replacement and rehabilitation.

(7) Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project to the extent and in such detail as will properly reflect total project costs.

(8) Perform, or cause to be performed, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. 9601-9675, that may exist in, on, or under lands, easements or rights-of-way necessary for the construction, operation, and maintenance of the project; except that the non-Federal sponsor shall not perform such investigations on lands, easements, or rights-of-way that the Government determines to be subject to the navigation servitude without prior specific written direction by the Government.

(9) Assume complete financial responsibility for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the Government determines necessary for the construction, operation, or maintenance of the project.

(10) To the maximum extent practicable, operate, maintain, repair, replace, and rehabilitate the project in a manner that will not cause liability to arise under CERCLA.

(11) Prevent future encroachments on project lands, easements, and rights-of-way which might interfere with the proper functioning of the project.

(12) Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public law 91-646, as amended by title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17), and the Uniform Regulations contained in 49 CFR part 24, in acquiring lands, easements, and rights-of-way, and performing relocations for construction, operation, and maintenance of the project, and inform all affected persons of applicable benefits, policies, and procedures in connection with said act.

(13) Comply with all applicable Federal and State laws and regulations, including Section 601 of the Civil Rights Act of 1964, Public Law 88-352, and Department of Defense Directive 5500.11 issued pursuant thereto, as well as Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army".

(14) Provide 35 percent of that portion of total cultural resource preservation mitigation and data recovery costs attributable to environmental restoration that are in excess of one percent of the total amount authorized to be appropriated for environmental restoration.

(15) Do not use Federal funds to meet the non-Federal sponsor's share of total project costs unless the Federal granting agency verifies in writing that the expenditure of such funds is authorized.

Nothing herein shall constitute, or be deemed to constitute, an obligation of future appropriations by the General Assembly of the State of Tennessee when such obligation would be inconsistent with the State's constitutional or statutory limitations.

Cost Apportionment

A summary of fully funded non-Federal and Federal costs, by year, is presented in Tables 31 through 35. Table 31presents the cost summary for full implementation of the recommended plan. The total fully funded cost for construction is estimated to be $32,597,000. Non-Federal costs are estimated to be $10,744,000, including $260,000 for Planning, Engineering and Design (PED) and $10,484,000 for lands, easements, rights of way, relocations, and dredged material disposal areas (LERR&Ds). Federal costs are estimated to be $21,853,000 of which $1,434,000 is for LERR&Ds (due to the cost of LERR&Ds exceeding the non-Federal share of Project costs), $357,000 is for cultural resources mitigation, and $20,062,000 is for PED and construction costs. The non-Federal cost sharing partner (State of Tennessee) will be required to assume the total annual operation, maintenance, repair, replacement, and rehabilitation costs (estimated at $162,900) for all features except for the improvements at Lake Isom National Wildlife Refuge, which will be borne by the U.S. Fish and Wildlife Service.

Implementation of this project is currently estimated to be completed in phases. Tables 32 through 34 break out the associated cost sharing taking into account the phased implementation. The first phase consists of the alternative spillway and circulation

channels (Table 32). Phase two is the sediment retention basin on Reelfoot Creek (Table 33). Phase three consists of construction of Shelby Lake and the waterfowl management units around Shelby Lake (Table 34). Implementation of the improvements at Lake Isom National Wildlife Refuge (NWR) are listed in Table 35. Improvements on Federal refuges, such as those presented in this report for the Lake Isom National Wildlife Refuge, have a 100 percent Federal first cost. In the event that improvements were to result in operation and maintenance (O&M) costs beyond that currently experienced, then such incremental increase would be at 75% Federal cost / 25% non-Federal cost. In this case, there is no such incremental increase because the improvements will necessitate no O&M over that currently borne by the U.S. Fish and Wildlife Service.

CONCLUSIONS

This Feasibility Report is a summary of the results of the study performed by the Memphis District, U.S. Army Corps of Engineers for the Reelfoot Lake, Tennessee and Kentucky project. The documentation in the report includes data, analyses, and engineering designs produced by the multi-disciplinary study team to address the problems and opportunities identified in the Reelfoot Lake study area. The studies and evaluations were performed in coordination with the sponsor and other State and Federal agencies in accord with current guidance for environmental restoration projects.

The findings of this study, along with those of the previously certified Reconnaissance Report, clearly indicate that the ecosystem complex that existed at and around Reelfoot Lake has changed significantly since the construction of the Mississippi River levees by the Corps of Engineers. The construction of these levees, while enormously benefiting the public in many ways, has effected the natural hydraulic regime of the lake. Seasonal flooding on the Mississippi River, which occurred frequently, no longer reaches Reelfoot Lake. This change has cut off Reelfoot Lake's natural source for periodic recharge and replenishment.

Implementation of the recommended plan will improve both terrestrial and aquatic habitat in and around Reelfoot Lake, provide additional habitat for waterfowl, and create economic benefits in the Reelfoot Lake area. This project will help to return the lake to a more natural and historic condition. Possibly, the most important factor, however, is that this project will help to preserve and protect this nationally significant environmental resource for future generations.

Table 31

Reelfoot Lake, Tennessee and Kentucky

Cost Sharing Summary

Implementation of All Features

(All Costs are in Thousands of Dollars and are Fully Funded)

Year	Total Project Cost [1]			LERR&D [8]			Construction				Total Project Cost [2]
	Non-Fed Subtotal [7]	Federal Subtotal	Total [1]	Non-Fed	Federal	Total	Non-Fed Cash [4]	Federal	Total	% [3,5]	(Total Federal Includes CR Mitigation)
PRIOR	260	780	1,040				260	780	1,040		1,040
1	1,766	710	2,476	1,766	0	1,766	0	710	710	8.6	2,476
2	3,144	5,124	8,268	3,144	0	3,144	0	5,124	5,124	25.2	8,268
3	5,222	3,572	8,794	5,222	163	5,385	0	3,409	3,409	16.8	8,794
4	352	5,089	5,441	352	1,271	1,623	0	3,818	3,818	18.8	5,798
5	0	5,950	5,950	0	0	0	0	5,950	5,950	29.3	5,950
6	0	92	92	0	0	0	0	92	92	0.5	92
7	0	179	179	0	0	0	0	179	179	0.9	179
TOTAL [6]	10,744	21,496	32,240	10,484	1,434	11,918	260	20,062	20,322	100	32,597

1 Total project cost (TPC) excludes cultural resources mitigation up to 1% of TPC.

2. TPC includes 1% of TPC for cultural resources mitigation costs. The 1% of TPC for cultural resources mitigation is not cost shared.

3 Construction obligations scheduled for each FY, expressed as a percent of total construction obligations.

4 The non-Federal cash amount made available and obligated each fiscal year is based on total sponsor cash x percentage.

5 Construction percent listed under FY 1 based on construction obligations scheduled for FY PRIOR and FY 1, expressed as a percent of total construction obligations.

6 All totals rounded to nearest $1,000.

7 Sponsor's cost share is $10,744,000 (35 percent of (TPC-1% of TPC for Cultural Resources - Lake Isom Improvements [$1,544,000])). Sponsor's LERRD contributions are $10,484,000 and cash share is $260,000 PED.

All Lake Isom Improvements are assumed to be 100% Federal cost.

8. Federal Government assumes financial responsibility for LERRDs after non-Federal Sponsor fulfills 35% cost share requirements. Assumption of financial responsibility will be via reimbursement of sponsor for LERRDs when necessary for project construction.

Table 32

Reelfoot Lake, Tennessee and Kentucky

Cost Sharing Summary

Implementation of Item 1: Alternative Spillway, Bridge, Inlet and Outlet Channel, and Closure of Existing Spillway and Item 3: Circulation / Drawdown Channels

(All Costs are in Thousands of Dollars and are Fully Funded)

Year	Total Project Cost [1]			LERR&D			Construction				Total Project Cost [2]
	Non-Fed Subtotal [7]	Federal Subtotal	Total [1]	Non-Fed	Federal	Total	Non-Fed Cash [4]	Federal	Total	% [3,5]	(Total Federal Includes CR Mitigation)
PRIOR	260	780	1,040				260	780	1,040		1,040
1	1,464	281	1,745	1,464	0	1,464	0	281	281	14.6	1,745
2	1,047	1,306	2,353	850	0	850	197	1,306	1,503	16.6	2,353
3	910	3,162	4,072	300	0	300	610	3,162	3,772	41.8	4,072
4	393	2,037	2,430	0	0	0	393	2,037	2,430	26.9	2,430
5	0	0	0	0	0	0	0	0	0	0.0	0
6	0	0	0	0	0	0	0	0	0	0.0	0
7	0	0	0	0	0	0	0	0	0	0.0	0
TOTAL [6]	4,074	7,565	11,639	2,614	0	2,614	1,459	7,565	9,025	100	11,639

1 Total project cost (TPC) excludes cultural resources mitigation up to 1% of TPC.

2. TPC includes 1% of TPC for cultural resources mitigation costs. The 1% of TPC for cultural resources mitigation is not cost shared.

3 Construction obligations scheduled for each FY, expressed as a percent of total construction obligations.

4 The non-Federal cash amount made available and obligated each fiscal year is based on total sponsor cash x percentage.

5 Construction percent listed under FY 1 based on construction obligations scheduled for FY PRIOR and FY 1, expressed as a percent of total construction obligations.

6 All totals rounded to nearest $1,000.

7 Sponsor's cost share is $4,074,000 (35 percent of (TPC-1% of TPC for Cultural Resources)).
Cash share is $1,459,000 and LERRDs are $2,614,000.

Table 33

Reelfoot Lake, Tennessee and Kentucky

Cost Sharing Summary

Implementation of Item 2: Sediment Retention Basin

(All Costs are in Thousands of Dollars and are Fully Funded)

Year	Total Project Cost [1]			LERR&D			Construction				Total Project Cost [2]
	Non-Fed Subtotal [7]	Federal Subtotal	Total [1]	Non-Fed	Federal	Total	Non-Fed Cash [4]	Federal	Total	% [3,5]	(Total Federal Includes CR Mitigation)
PRIOR	0	0	0				0		0		0
1	1,772	250	2,022	1,772	0	1,772	0	250	250	3.7	2,022
2	2,917	941	3,858	2,917	691	3,608	0	250	250	3.7	3,858
3	0	1,430	1,430	0	1,180	1,180	0	250	250	3.7	1,530
4	0	3,419	3,419	0	0	0	0	3,419	3,419	50.0	3,498
5	0	2,667	2,667	0	0	0	0	2,667	2,667	39.0	2,667
6	0	0	0	0	0	0	0	0	0	0.0	0
7	0	0	0	0	0	0	0	0	0	0.0	0
TOTAL [6]	4,689	8,707	13,396	4,689	1,871	6,560	0	6,836	6,836	100	13,575

1 Total project cost (TPC) excludes cultural resources mitigation up to 1% of TPC.

2. TPC includes 1% of TPC for cultural resources mitigation costs. The 1% of TPC for cultural resources mitigation is not cost shared.

3 Construction obligations scheduled for each FY, expressed as a percent of total construction obligations.

4 The non-Federal cash amount made available and obligated each fiscal year is based on total sponsor cash x percentage.

5 Construction percent listed under FY 1 based on construction obligations scheduled for FY PRIOR and FY 1, expressed as a percent of total construction obligations.

6 All totals rounded to nearest $1,000.

7 Sponsor's cost share is $4,689,000 (35 percent of (TPC-1% of TPC for Cultural Resources)).
Cash share is $0 and LERRDs are $4,689,000.

Table 34

Reelfoot Lake, Tennessee and Kentucky

Cost Sharing Summary

Implementation of Item 4: Shelby Lake and Waterfowl Management Units

(All Costs are in Thousands of Dollars and are Fully Funded)

Year	Total Project Cost [1]			LERR&D			Construction				Total Project Cost [2]
	Non-Fed Subtotal [7]	Federal Subtotal	Total [1]	Non-Fed	Federal	Total	Non-Fed Cash [4]	Federal	Total	% [3,5]	(Total Federal Includes CR Mitigation)
PRIOR	0	0	0				0		0		0
1	1,100	200	1,300	1,100	0	1,100	0	200	200	6.6	1,300
2	881	828	1,709	881	628	1,509	0	200	200	6.6	1,709
3	0	2,535	2,535	0	6	6	0	2,529	2,529	83.0	2,713
4	0	117	117	0	0	0	0	117	117	3.8	117
5	0	0	0	0	0	0	0	0	0	0.0	0
6	0	0	0	0	0	0	0	0	0	0.0	0
7	0	0	0	0	0	0	0	0	0	0.0	0
TOTAL [6]	1,981	3,680	5,661	1,981	634	2,615	0	3,046	3,046	100	5,839

1 Total project cost (TPC) excludes cultural resources mitigation up to 1% of TPC.

2. TPC includes 1% of TPC for cultural resources mitigation costs. The 1% of TPC for cultural resources mitigation is not cost shared.

3 Construction obligations scheduled for each FY, expressed as a percent of total construction obligations.

4 The non-Federal cash amount made available and obligated each fiscal year is based on total sponsor cash x percentage.

5 Construction percent listed under FY 1 based on construction obligations scheduled for FY PRIOR and FY 1, expressed as a percent of total construction obligations.

6 All totals rounded to nearest $1,000.

7 Sponsor's cost share is $1,981,000 (35 percent of (TPC-1% of TPC for Cultural Resources)). Cash share is $0 and LERRDs are $1,981,000.

Table 35

Reelfoot Lake, Tennessee and Kentucky

Cost Sharing Summary

Implementation of Item 5: Lake Isom Improvements

(All Costs are in Thousands of Dollars and are Fully Funded)

Year	Total Project Cost [1]			LERR&D			Construction				Total Project Cost [2]
	Non-Fed Subtotal [7]	Federal Subtotal	Total [1]	Non-Fed	Federal	Total	Non-Fed Cash [4]	Federal	Total	% [3,5]	(Total Federal Includes CR Mitigation)
PRIOR	0	0	0				0		0		0
1	0	350	350	0	0	0	0	350	350	24.6	350
2	0	1,194	1,194	0	124	124	0	1,070	1,070	75.4	1,194
3	0	0	0	0	0	0	0	0	0	0.0	0
4	0	0	0	0	0	0	0	0	0	0.0	0
5	0	0	0	0	0	0	0	0	0	0.0	0
6	0	0	0	0	0	0	0	0	0	0.0	0
7	0	0	0	0	0	0	0	0	0	0.0	0
TOTAL [6]	0	1,544	1,544	0	124	124	0	1,420	1,420	100	1,544

1 Total project cost (TPC) excludes cultural resources mitigation up to 1% of TPC.

2. TPC includes 1% of TPC for cultural resources mitigation costs. The 1% of TPC for cultural resources mitigation is not cost shared.

3 Construction obligations scheduled for each FY, expressed as a percent of total construction obligations.

4 The non-Federal cash amount made available and obligated each fiscal year is based on total sponsor cash x percentage.

5 Construction percent listed under FY 1 based on construction obligations scheduled for FY PRIOR and FY 1, expressed as a percent of total construction obligations.

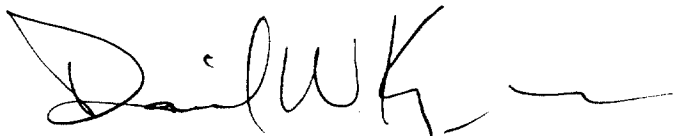
6 All totals rounded to nearest $1,000.

7 Sponsor's cost share is zero.

RECOMMENDATIONS

I recommend that the selected plan for environmental restoration at Reelfoot Lake, Tennessee and Kentucky, described herein, be authorized for implementation as a Federal project, with such modifications thereof as in the discretion of the Commander, HQUSACE may be advisable, in accordance with cost-sharing and financing arrangements satisfactory to the President and the Congress. Included in the selected plan is an operation schedule for water level management of Reelfoot Lake presented in Table 30 under the column "final recommended operation schedule". The plan's first cost (1 October 1998 P.L.) is presently estimated to be $27,802,000, and the annual operation, maintenance, and replacement costs are estimated to be $189,200. The fully funded cost, and a breakout of Federal and non-Federal costs are presented in Table 31. This recommendation is made with the provision that, the exact amount of non-Federal contributions shall be in accordance with the current cost sharing policies for environmental restoration projects. Furthermore, prior to implementation, the non-Federal sponsor shall agree to perform the required items of cooperation outlined under the heading "Local Cooperation and Cost Sharing".

These recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for implementation funding. However, prior to transmittal to the Congress, the sponsor, the States, interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.



Daniel W. Krueger
Colonel, Corps of Engineers
District Engineer

Non-Federal Sponsor's Letter of Intent

TENNESSEE WILDLIFE RESOURCES AGENCY

ELLINGTON AGRICULTURAL CENTER
P. O. BOX 40747
NASHVILLE, TENNESSEE 37204

(615)781-6610 FAX: (615)781-6654

September 30, 1999

Colonel Daniel W. Krueger
District Engineer
U. S. Army Engineer District, Memphis
167 North Main Street, B-202
Memphis, TN 38103-1894

Dear Colonel Krueger:

The State of Tennessee, acting through the Tennessee Wildlife Resources Agency (TWRA), will act as the non-Federal sponsor of the Reelfoot Lake, Tennessee & Kentucky Project, and will be capable of meeting the cost-sharing obligations required, if appropriate legislative appropriations are made, proper approvals the Tennessee Wildlife Resources Commission (TWRC) are forthcoming, and any other governmental constraints are overcome. We are prepared to negotiate and sign a PED cost sharing agreement for the preparation of designs, plans and specifications for the first item of construction (a new spillway, inlet and outlet channel, and closure of the existing spillway at Reelfoot Lake).

With regard to our financial capability, the State of Tennessee would be the cost sharing partner for a project at Reelfoot Lake, and would provide a significant portion of the estimated $10.744 million non-Federal share of project costs. All State of Tennessee funding for this project would be subject to the availability of funds, and to the appropriate and necessary approval(s) of the governing bodies. Potential funding sources may include any or all of the following:

1. The $6 million annual wetland acquisition fund, provided there are willing sellers of land required for the project, and subject to TWRC approval;

2. Use of state highway funds;

3. General appropriations, pending approval by the Tennessee General Assembly

4. TWRA funds, pending TWRC approval.

The funds if available and approved should be more than sufficient to fund the non-Federal obligations presented in Table 1 (provided by the Memphis District Corps of Engineers and taken from the Feasibility Report).

Table 1
Summary of Non-Federal Construction Costs
Reelfoot Lake, TN & KY Project
(Fully Funded Costs, Including Estimates for Inflation)
Costs in Thousands of Dollars

Fiscal Year	Cash Required	LERRD	Total
2000	$260	$0	$260
2001	$0	$1,766	$1,766
2002	$0	$3,144	$3,144
2003	$0	$5,222	$5,222
2004	$0	$352	$352
Total	$260	$10,484	$10,744

The TWRA understands its obligation to operate and maintain this project after its completion. The TWRA anticipates operating and maintaining the project using TWRA personnel and equipment. Revenues to meet this obligation should come from the Wetlands Acquisition fund and general operating funds, again subject to governmental constraints and approval. An estimate of the project's operation, maintenance, and replacement costs has been furnished by the Memphis District (Table 2). It is understood that these costs are based on October 1998 price levels and that they will escalate over the life of the project due to inflation. The annual operation and maintenance costs will be covered by the above annual revenues.

Table 2
Operation, Maintenance, and Replacement Costs
Reelfoot Lake, TN & KY Project
(October 1998 Price Levels)
Costs in Thousands of Dollars

Item	Average Annual Cost
Spillway	18.3
Sediment Basin	102.2
Circulation Channels	1.7
Shelby Lake Feature	40.7

September 30, 1999

In agreeing to move forward with this project, we are re-affirming our support for the completion of the full project. However, we also need to stress that TWRC support for the project is subject to a timely drawdown of Reelfoot Lake.

If you have any questions, please don't hesitate to contact Greg Wathen, Special Assistant to the Director, at (615)781-6610.

Sincerely,

Tennessee Wildlife Resources Agency

Gary T. Myers
Executive Director

GTM/vc:

FINAL ENVIRONMENTAL IMPACT STATEMENT

REELFOOT LAKE, TENNESSEE AND KENTUCKY

The responsible lead agency is the Memphis District Corps of Engineers. The project sponsor is the Tennessee Wildlife Resources Agency (TWRA).

ABSTRACT:

The Reelfoot Lake project area is located in northwestern Tennessee and southwestern Kentucky and includes significant portions of Lake and Obion counties in Tennessee and a small portion of Fulton County, Kentucky. The Memphis District, the U. S. Fish and Wildlife Service, the Tennessee Department of Environment and Conservation, and the Natural Resources Conservation Service, as cooperating agencies, have investigated fish and wildlife resources, recreation, and environmental protection/restoration measures that could potentially be implemented within the project area. Thirteen alternative plans were investigated in detail and are presented as the final array of alternatives. The water level management alternatives (except the No Action alternative) will provide terrestrial and aquatic restoration benefits associated with the dynamic water level fluctuation and a major periodic drawdown. In addition, the proposed features (Alternate Spillway, Sediment Dam, Lake Isom and Shelby Lake Restoration, the Waterfowl Management Area) will reduce sediment inflow, restore wetlands, and provide additional waterfowl habitat. Direct construction impacts to woodlands and wetlands will be minor (approximately 40 ~~acres) and will be more than offset by~~ habitat gained by each feature. This final environmental impact statement evaluates the effects each plan has on the study areas significant resources. The recommended plan provides water level management, a periodic drawdown, a sediment dam, new spillway, circulation channels, Lake Isom and Shelby Lake Restoration, and waterfowl management areas. The estimated first cost (1 October 1998 P.L.) of the recommended plan is $27,802,000.

NOTE: Information, displays, maps, etc., discussed in the Main Report and appendices are incorporated by reference in the Final Environmental Impact Statement.

SUMMARY

Major Conclusions and Findings

The study area is located east of the Mississippi River about 120 miles north of Memphis, Tennessee and 6 miles east of Tiptonville, Tennessee, in Lake and Obion Counties, Tennessee and Fulton County, Kentucky. Reelfoot Lake, formed by the earthquakes of 1811–1812, covers approximately 15,500 acres at the normal pool elevation of 282.2 NGVD in Tennessee and Kentucky. Reelfoot Lake is a nationally significant and unique natural resource. It is the largest natural freshwater lake in Tennessee and one of the largest in the country. The lake provides nesting and feeding habitat for the Bald Eagle, a threatened species, while providing one of the most highly productive fisheries in the area. Also, Reelfoot Lake is located within the Mississippi Flyway and is widely used by waterfowl. The North American Waterfowl Management Plan (NAWMP), an international treaty between the U.S., Canada, and Mexico, has identified the Lower Mississippi River Delta as a "priority habitat range." Reelfoot Lake was also identified as a "key area" for waterfowl in the Lower Mississippi Valley Joint Venture, which is under the auspices of the NAWMP.

Flood control and drainage improvements in the basin have dramatically impacted the quality of fish and wildlife habitat. Construction of the Mississippi River levees stopped the almost annual recharge of the lake by overflow from the Mississippi River. Construction of a spillway and Running Reelfoot Bayou stabilized water level fluctuations of Reelfoot Lake and provided drainage for surrounding areas. The resulting land clearing and conversion to agriculture practices on lands surrounding the lake contributed to an unusually high rate of sediment deposition in the lake, which is reducing the value of the lake's aquatic habitat and the lake's value as a flood attenuation system.

The Feasibility Study examined the potential benefits and costs of various features designed to restore and protect the environment (both terrestrial and aquatic) in the Reelfoot Lake area. The selected features, which exhibit the highest levels of environmental benefits, were combined into a recommended plan. The recommended plan includes construction of an alternative spillway, bridge, inlet and outlet channels, circulation channels within Reelfoot Lake, a sediment basin on Reelfoot Creek, restoration of Shelby Lake area and improvements at Lake Isom. The recommended plan also includes implementation of a water level management plan for Reelfoot Lake which is expected to improve aquatic habitat value within the lake. Full implementation of the recommended plan is expected to produce net environmental benefits of 1,469 terrestrial annual habitat unit values (AHUV's), 4,414 aquatic AHUV's, and 6,272,000 waterfowl use days. The estimated first cost of the recommended plan is $27,802,000 and the estimated average annual cost is $2,466,100.

Corps Civil Works Ecosystem Restoration Guidance, Chapter 4, Section VIII, ER 1105-2-100 dated 2 October 1997 identifies the restoration of ecosystems or parts thereof, and their associated ecological resources as a priority project purpose. Priority will be given to restoration

where a Corps project contributed to the degradation of the ecosystem. The fish and wildlife habitat resources at Reelfoot Lake are nationally significant and they have greatly declined from modern historic conditions. Construction of Corps projects (the Mississippi River levees and improvements to Running Reelfoot Bayou) contributed in part to the degradation. The degraded resources will not be restored to a greater level than modern historic conditions. Construction of the features identified, along with implementation of the recommended water level management plan, is necessary to prevent the continuing decline of these natural resources and to protect the public's investment in over 33,000 acres in the Reelfoot Lake area including two national wildlife refuges, a state wildlife management area, and a state park. Construction of these features would utilize the Corps interdisciplinary planning, engineering, design, and construction expertise to restore and protect nationally significant fish and wildlife habitat.

The State of Tennessee, acting through the Tennessee Wildlife Resources Agency, has indicated a willingness to participate, on a cost shared basis, in implementation of the recommended plan. It has been concluded that the predicted environmental benefits of the recommended plan outweigh the estimated costs and therefore, the project is feasible and has Federal interest.

RATIONALE FOR DESIGNATION OF THE RECOMMENDED PLAN

Alternative Plan 5b was originally chosen as the recommended plan because it maximizes net environmental benefits. Plan 5b is the same as the "Preferred Alternative" in the 1989 FEIS prepared by the FWS. Alternative 5b, which is the most environmentally beneficial plan, would provide annual net environmental benefits of 7,739 AHUVs and approximately 13,397,000 Waterfowl Use Days (WUDs). Furthermore, this alternative meets the study objectives and satisfies many of the project areas problems and needs. Plan 5b also provides additional waterfowl habitat, benefits to lake and stream fisheries, and a variety of wetland restoration benefits. The estimated first cost of plan 5b is $30,072,000 and the estimated average annual cost is $2,702,500.

During the public review period of the DEIS, strong opposition to the Reelfoot Lake water level management aspect of plan 5b was presented. After supplemental meetings and discussions, a revised recommended water level management plan for Reelfoot Lake was developed. This plan addresses the major concerns of impacts to farming and tourism while providing a stable lake level during times of fish spawning. The net environmental benefits of the recommended plan are reduced to 5,883 AHUVs and approximately 6,272,000 WUDs, but is a more implementable plan.

SECTION 404 FINDINGS

The project features of the tentative selected plans have been evaluated with respect to Section 404(b)(1) Guidelines for Specifications of Disposal Sites for Dredged or Fill Material, published by the U. S. Environmental Protection Agency. These evaluations are included in Appendix A, Section IV. The potential for environmental impact of each disposal activity was estimated on the basis of currently available engineering design data and the pertinent physical, chemical, and biological information that have been compiled as a result of this and other studies.

Efforts were made to identify the least environmentally damaging practical alternative for each disposal site, wherever such alternatives were available.

No particular violations of applicable State of Tennessee water quality standards, other than for turbidity during construction operations were found. Construction methods would be employed to minimize the possibility of violating the Toxic Effluent Standards of Section 307 of the Clean Water Act. None of the proposed plans would harm any threatened or endangered species or their critical habitat.

It was found that the proposed material discharges would not cause or contribute to significant adverse effects on human health; the life stages of organisms within the aquatic ecosystem; or ecosystem diversity, productivity, and stability. Also, no significant impacts were identified on recreational, aesthetic, or economic values. When authorized by congress, this project will be exempt of any state water quality certification requirements based on Section 404 (b) of the Water Quality Act. The proposed dredged material disposal sites are found to be in compliance with the current Section 404 guidelines.

FINDINGS ON EXECUTIVE ORDER 11988, FLOODPLAIN MANAGEMENT

Portions of the proposed project would be constructed in floodplains. All non-floodplain alternatives were dropped during screening because they were not economically justified. Section 6 describes the beneficial and adverse impacts of each alternative in the final array and describes any expected losses of natural floodplain benefits. Views of the general public have been obtained at numerous meetings. All alternatives were designed to minimize, to the extent practical, adverse impacts to floodplains. The tentative selected plans are responsive to the planning objectives and consistent with the requirements of Executive Order 11988.

FINDINGS ON EXECUTIVE ORDER 11990, PROTECTION OF WETLANDS

One of the major project planning objectives was to maintain the long range productivity of wetlands and forests. Although efforts were made to minimize impacts to wetlands, there were no practical alternatives to locating some project features in wetlands. Adverse impacts to wetlands are discussed in Section 6.The tentative selected plans are responsive to the planning objectives established for the study; and are also consistent with the requirements of Executive Order 11990.

FINDINGS ON ER 1165-2-132, HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE

Engineering Regulation 1165-2-132, Water Resources Policies and Authorities for Hazardous, Toxic, and Radioactive Waste for Civil Works Projects, requires the performance of a hazardous, toxic, and radioactive waste (HTRW) assessment(s) to determine the potential for encountering any HTRW at or near Corps civil works projects.

A Phase 1 Assessment was conducted to determine the potential for HTRW occurring within the project-affected area. Site inspections (ground and air), aerial photography review, landowner contact, document research, and coordination with appropriate agencies were performed in conducting this assessment. Based on these investigations, it was concluded that it was improbable that any known HTRW or potential HTRW exists within the project impact zone and that it was unlikely that any known or potential HTRW would be impacted by project construction or operation.

No additional HTRW investigations are required unless new information is revealed to indicate otherwise. The complete HTRW Phase 1 Assessment is contained in Appendix A, Section IX.

Areas of Controversy

The major concerns raised during this study were related to potential economic impacts on (1) agricultural land, particularly in Kentucky, due to flooding associated with higher lake levels and (2) recreation businesses that may be affected by a periodic drawdown. Public and private interests expressed their concerns regarding these matters at numerous meetings. Therefore, it was extremely important to adequately evaluate and document the environmental and economic impacts associated with the project.

Unresolved Issues

The areas of controversy listed above still remain as unresolved issues. However, efforts have been and are currently underway toward seeking resolution. ~~Both areas of impact are directly related~~ to implementation of proposed water level management of Reelfoot Lake. Recreational business owners are concerned that a periodic major drawdown, once every five to ten years, will result in severe revenue losses during the drawdown year. This is particularly related to those businesses that are directly associated with recreational fishing. It is reasonable to expect that there will be some adverse impacts to recreational fishing. However, it is important to note that a proposed drawdown would not start until June 1 and the lake would slowly fall until July 15 and the traditional peak fishing season at Reelfoot Lake is March through May. There is also the theory that a periodic drawdown will bring supplemental business to the area as sight-seers are drawn to the area. This issue is addressed in detail in the economic section of the feasibility report and the Economic Appendix.

The other major area of concern is that agricultural land, particularly in Kentucky, may experience occasional flooding associated with slightly higher managed water levels as identified in Water Management Alternative 2. Actual ground surveys and GIS mapping prepared as a part of this feasibility study have identified approximately 600 acres of land that may experience flooding at a 284.0 foot (M.S.L.) lake level. Actual susceptibility to inundation will depend upon bottom elevations of connecting ditches, the condition of existing culverts, and other on sight conditions. It is important to note that the current plan of operation (FWS Interim Plan) allows the lake level to fluctuate up to 282.7' M.S.L. during the crop season (April 16 - November 14) and the proposed Alternative 2 would allow the lake level to fluctuate up to 283.0' M.S.L. during the same crop

season. This is only an increase of 0.3 foot. This issue is addressed in detail in the economic and real estate sections of the feasibility report and the appendix for each. Restoration benefits derived from a plan that does not include additional land acquisition or easements from willing sellers will be the same as those benefits attributed to Alternative Plan 5c (see Table 24, page 61 of the Feasibility Report). These benefits also justify federal interest.

Relationship of Plans to Environmental Requirements

Table 1 indicates the relationship and compliance status of each plan alternative with federal environmental protection statutes and appropriate executive orders and memoranda.

TABLE 1-1
RELATIONSHIP OF PLANS TO ENVIRONMENTAL PROTECTION
STATUTES OR OTHER ENVIRONMENTAL REQUIREMENTS
REELFOOT LAKE, TENNESSEE AND KENTUCKY

FEDERAL STATUTES	ALL PLANS
1. Archaeological and Historic Preservation Act of 1974.	PC
2. Clean Air Act, as Amended.	FC
3. Clean Water Act of 1977. See Appendix A, Section IV, for the 404(b)(1) evaluation.	PC
4. Endangered Species Act of 1973, as Amended.	FC
5. Federal Water Project Recreation Act. Washington level review of the FEIS will bring the project into full compliance.	PC
6. Fish and Wildlife Coordination Act. Agency comments and recommendations are discussed in Appendix A, Section VI, Part A, which includes the Fish and Wildlife Coordination Act Report.	PC
7. Land and Water Conservation Fund Act.	FC
8. National Historic Preservation Act. Completion of archeological surveys and final coordination with the SHPO will bring full compliance.	PC

TABLE 1-1 (Cont'd)
RELATIONSHIP OF PLANS TO ENVIRONMENTAL PROTECTION
STATUTES OR OTHER ENVIRONMENTAL REQUIREMENTS
REELFOOT LAKE, TENNESSEE AND KENTUCKY

FEDERAL STATUTES	ALL PLANS
9. National Environmental Policy Act. Signing of the Record of Decision will bring this project into full compliance.	PC
10. Farmland Protection Policy Act.	FC
11. Watershed Protection and Flood Prevention Act. No requirements for Corps projects.	NA
12. Wild and Scenic River Act. There are no wild and scenic rivers in the project area.	NA
EXECUTIVE ORDER/MEMORANDA	ALL PLANS
1. Executive Order 11988, Floodplain Management.	FC
2. Executive Order 11990, Protection of Wetlands.	FC
3. Executive Order 11593, Protection and Enhancement of the Cultural Environment. Signing of the Record of Decision will bring full compliance.	PC

FC - In Full Compliance
PC - In Partial Compliance
NA - Not Applicable

2. TABLE OF CONTENTS

3. NEED FOR AND OBJECTIVES OF ACTIONS

Heavy agricultural use around Reelfoot Lake has contributed excessive amounts of sediment to the lake. In addition, the lack of periodic flushing, once provided by the Mississippi River and the inability to adequately manage lake levels have resulted in hypereutrophic conditions that are seriously threatening the lake. The Congress, Memphis District Corps of Engineers, the Tennessee Wildlife Resources Agency (project sponsor), and various cooperating agencies are responding to the need for wetland preservation/restoration, fishery improvement, and restoration of waterfowl habitat.

Project Authority

Recognizing the concerns of Federal and state agencies, local officials, and individuals; the Committee on Environment and Public Works of the U. S. Senate passed a Senate Committee Resolution on 2 August 1984. The Committee on Public Works and Transportation of the U. S. House of Representatives passed a House Committee Resolution on 8 August 1984. These resolutions requested the Chief of Engineers to review the report on the Mississippi River and Tributaries project. . . and other pertinent reports with a view to determining whether any modifications of the recommendations contained therein are advisable, with particular reference to the need and feasibility of improvements in the vicinity of Reelfoot Lake, Tennessee, in the interest of flood control, sediment control, water quality, water supply, fish and wildlife preservation and enhancement, recreation, regional development, and allied purposes.

Public Concerns

The continued degradation of Reelfoot Lake as a unique National Natural Landmark (U. S. Department of the Interior, National Park Service, 1988) will eventually lead to the loss of an irreplaceable natural resource. This loss would be felt not only by the environmental community, recreational users, and public in general, but specifically by scientists and schools at all levels that have been utilizing Reelfoot Lake as an ecological laboratory for years. Long term economic losses would be devastating to area resorts, stores, bait shops, commercial fishing, restaurants, and tour guide services.

Planning Objectives

NATIONAL OBJECTIVE

The Water Resources Council's *Economic and Environmental Principles for Water and Related Land Resources Implementation Studies* states that The Federal objective of water and related land resources project planning is to contribute to national economic development consistent

with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements. Contributions to the national economic development (NED) objective are achieved by increasing the net value (expressed monetary units) of the nation's output of goods and services. Water and related land resource management plans must develop long-range goals and priorities for the study area that are consistent with the NED objective.

PLANNING OBJECTIVES

After determining the existing and future needs of the project area, a set of planning objectives was established to guide the formulation of alternatives. Planning objectives stem from the national, state, and local water and related land resource management needs. These objectives have been developed through problem analysis and a public involvement program and have provided the basis for formulation of alternatives, impact assessment, and evaluation. The planning objectives are:

1. Protect, restore, and preserve the wetland ecosystems of Reelfoot Lake and Lake Isom National Wildlife Refuge.

2. Intensify soil conservation efforts.

3. Restore waterfowl habitat.

4. Restore fish and wildlife habitat.

5. Restore bottomland hardwoods.

6. Maintain long-range productivity of wetlands and forests.

7. Minimize cost and maximize outputs.

PERFORMANCE CRITERIA

During the past twenty years; numerous research projects have been undertaken concerning the degradation of Reelfoot Lake. The conclusions, observations, and recommendations of these various reports have contributed to the formulation of the TWRA Fifty Year Plan for Reelfoot Lake, the USFWS EIS, and now, this DEIS. As a result, performance criteria has gradually evolved based upon predicted losses identified in the various reports and those predicted environmental benefits of each restoration feature. The specific expectations, expressed in terms of tons of sediment, habitat unit values (HUVs), waterfowl use days (WUDs), and/or acrefeet of water are identified in each feature description and in Appendix A, Section II.

4. ALTERNATIVES

This section briefly describes the project alternatives retained for further analysis and the various project alternatives examined and eliminated during the screening process, and it also summarizes the potential environmental impacts associated with each alternative in the final array. For a more detailed description of plan formulation, the screening process, and the final array of alternatives, see the plan formulation section of the Main Report.

Without Condition (No Federal Action)

Even a cursory evaluation of "trends" in and around the study area will readily indicate a continued degradation of natural resources in the Reelfoot Lake area. The long term effects of siltation, high turbidity, ponding, poor water quality, and loss of species diversity are still being experienced. Pollution in the form of agricultural- and construction-related erosion; pesticide run-off; sewage and other industrial discharge; and ditching and filling for agricultural, residential, and industrial encroachment will continue to take their toll. General degradation of the existing environment will result in lowered biological productivity, decreased biodiversity, and overall losses to most plant and animal populations. Most fish and wildlife species will decrease proportionally to the loss in quality and quantity of their respective habitat. Fish populations will decline with the encroachment of marsh and scrub/shrub swamp. Raccoons and other furbearers such as minks, beavers, and muskrats will also decline

Features Considered in Preliminary Analysis

Several alternatives were considered in the early stages of the study for fish and wildlife habitat restoration, recreation, and related purposes. These alternatives included no Corps action and structural alternatives. The alternatives that were retained for further study provided the basis for formulation and evaluation of a comprehensive plan that meets the planning goals and objectives.

Numerous alternatives were investigated in 1988, and those determined to be feasible, or that appeared to be in the Federal interest, and desired by potential non-Federal sponsors were combined into three comprehensive plans. The plans were discussed with the TWRA in order to determine which features were still of interest. Several features were eliminated while additional features outlined in the 1989 Reelfoot Joint Venture Project draft report were added for fish and wildlife habitat restoration.

No Corps Action. No Corps action was considered as an alternative to structural alternatives and provides the without project conditions for evaluation of structural alternatives. Based on coordination with local interests, the States of Tennessee and Kentucky, and other Federal interests, it appears likely that changes will be made in water level management at Reelfoot Lake with or

without Corps action. For the purpose of this study, it was assumed that the existing water management plan will continue as long as the spillway stoplogs and radial arm gate are functional, then riprap or other protective measures will be placed at the spillway to extend its life as a weir.

Alternative Spillway. The construction of an alternative spillway would provide a safe and more versatile structure for water level control at Reelfoot Lake in the interest of flood control, fish and wildlife habitat restoration, and allied purposes. The current spillway is not able to effectively manage water levels at Reelfoot Lake. A new spillway with a broader range of water management capabilities is needed to provide seasonal water level fluctuations of the lake.

Glady Hollow Diversion. Glady Hollow currently flows out of the hills southeast of the Blue Basin (see Plate 7, Feasibility Report). The stream then crosses to the north of Highway 21 and flows alongside Highway 21 to where it enters Blue Basin at the existing spillway. It was proposed to reroute Glady Hollow into an existing ditch which flows south of Shelby Lake into Running Reelfoot Bayou. The purpose of the proposed diversion was to prevent sediment from Glady Hollow from entering Blue Basin. On recent field investigations no deposition of sediment from Glady Hollow appeared to occur around the spillway.

Harris Ditch Pumping Station. A proposed Harris Ditch Pumping Station would consist of 3 - 20 cubic feet per second (cfs) pumps for a total station capacity of 60 cfs. The station would be located on Harris Ditch at the mainline Mississippi River Levee south of Tiptonville (Figure 6). The purpose for the pumping station is to provide an outlet for ~~Harris Ditch~~ during high stages ~~on~~ the Mississippi River. The drainage area served by Harris Ditch includes overflow from Reelfoot Lake via the Reelfoot Lake Washout located near the southwest corner of the lake and a normal drainage area of 4450 acres generally located between Reelfoot Lake and the Mississippi River Levee.

Washout Diversion Channels and Harris Ditch Cleanout. The Corps of Engineers is currently scheduled to replace the culverts under the Mississippi River levee at Harris Ditch with three culverts as part of the MR&T maintenance program to provide additional drainage . In conjunction with the culvert replacement, TWRA is proposing to divert drainage to the west of the Washout and into Harris Ditch. Local interests are proposing to clean out Harris Ditch from the Washout to the main line Mississippi River levee.

Dredged Circulation Channels. Dredged circulation channels were proposed to connect the three major basins of the lake (Blue, Buck, and Upper Blue Basin) to each other and the alternative spillway channel to aid in lake water level management (see Plate 6, Feasibilty Report). The channels would need to have a bottom elevation of at least 274.2 NGVD to accommodate the preferred water level management scheme using the alternative spillway (for periodic major drawdowns). These channels would provide improved circulation between major pools during normal lake stages and minimize isolation of major pools in extremely low stages. Additionally,

under the preferred water level management routine, the channels would aid in the periodic drawdown of the lake using the new spillway.

Reelfoot Creek Sediment Retention Basin. Reelfoot Creek is estimated to provide approximately 50 percent of the sediment entering Reelfoot Lake. Construction of a sediment retention basin to prevent continual deposition of sediment into the lake would be an effective feature for fish and wildlife habitat restoration. A sediment retention basin was examined for Reelfoot Creek (Figure 8) during the reconnaissance study. For reconnaissance level purposes, the location used was that determined in previous studies. However, optimization of the location and design will be examined in the feasibility phase.

Waterfowl Management Areas. Waterfowl reservoirs are planned for the east side of Running Reelfoot Bayou up to the 285 foot contour between Reelfoot Lake and Free Bridges (Figure 9). A total of 850 acres would be required with 58 acres utilized for levee construction. Fewer wells may be required if water can be used from Reelfoot Lake. The area would be terraced along 1 to 1.5 foot contour intervals with no terraces crossing roads or streams. The terraces will have a 25 foot to 35 foot bottom width, a 12 foot crown, and 2 to 3 foot height.

Lake Isom Restoration. It has been proposed to increase the water level management capabilities in the Lake Isom Refuge. The existing maximum water surface elevation is 280.5' with all stoplogs in place at the refuge floodgate. The proposed water level management capabilities include the ability to drawdown the water level to elevation 274 NGVD and to raise it to elevation 282 NGVD. The raising of the water surface 1.5' above the existing maximum elevation would occur within a 2-3 week period. An estimated ten 1,000 gpm wells would be required. In order to achieve these capabilities, the floodgate (stoplog structure) at the southern end of Lake Isom will need to be replaced. The new structure would have a weir length of 15'. Additionally the emergency spillway would require modification to achieve a width of 125' at an elevation of 282.5' NGVD. The dam embankment on the southern part of the refuge would require modification to achieve a length of 1,240', a crown width of 15', and an elevation of 285'.

Aquatic Vegetation Control. A cookie cutter dredge has been used to cut the vegetation in certain areas of the lake. In order to control the aquatic vegetation, continuation of the use of the cookie cutter dredge is recommended. One additional means may be to use herbicide in conjunction with a major lake drawdown. This feature was not analyzed separately but was included in the analysis of other features since aquatic vegetation problems result from a combination of several other problems. Appendix A addresses the aquatic vegetation problem in more detail and provides recommendations from the Corps Aquatic Plant Control Operations Support Center.

Walnut Log Sediment Control. This alternative consists of diverting drainage from a roadside ditch into a nearby WMA to prevent sediment from entering Bayou du Chien and eventually, Reelfoot Lake. Additional measures to prevent sediment deposition into the lake would be to construct sediment basins in the hills east of Walnut Log.

Bayou du Chien Cleanout. This alternative consists of an environmentally sensitive cleanout of Bayou du Chien to remove debris and sediment. The feature would prevent the restriction of flows into Reelfoot Lake and provide an open channel for boating.

Bayou du Chien Channel Enlargement. This alternative consists of approximately 16 miles of channel enlargement along the existing alignment of Bayou du Chien from the southwest corner of Hickman, Kentucky, to the Upper Blue Basin of the lake. Flood control would be provided for southwest Hickman and for croplands and woodlands served by the channel.

Dredging in Critical Deposition Areas. This alternative calls for the removal of sediment from areas expected to be filled in the next 25 to 50 years. These areas considered for dredging are critical for maintaining flow between basins, for flood control storage and access to the lake. Existing depths in these critical deposition areas are less than 3 feet at a normal pool elevation of 282.2.

Reelfoot Creek Reservoirs. These reservoirs would be used to control the erosion from the Reelfoot Creek Basin while also providing flood control and water supply capabilities. This alternative calls for two reservoirs on Reelfoot Creek. One of the reservoirs would be located on North Reelfoot Creek and have a maximum pool of 2,000 acres and a permanent pool of 800 acres; the other would be located on South Reelfoot Creel and have a maximum pool of 1,800 acres and a permanent pool of 1,100 acres.

Reelfoot & Indian Creek Diversion Channel. This diversion channel would divert sediment-laden flood discharges from Reelfoot and Indian Creek around the lake but allow continued discharge into the lake during non-flood periods. The diversion channel would begin just downstream of the Tennessee Highway 22 crossing over Reelfoot Creek, parallel the bluff line east of Reelfoot Lake to Tennessee Highway 21, then follow existing field drains to join Running Reelfoot Bayou about 6,000 feet downstream of the spillway.

Dredged Boat Channels. These channels would be used to connect relatively small pools to the three major basins and would improve the efficiency of discharge into and out of these storage areas. They would also provide improved access routes to popular remote fish and wildlife recreation areas. A total of 11.7 miles of channel were included in this alternative.

Alternative Water Supply (Reelfoot Creek Reservoirs). The structural components of this alternative are the same as those described for the Reelfoot Creek Reservoirs. The design and operation of the reservoirs could be such that some of the capacity of the structures would be retained for water supply without adversely affecting the flood control and sediment control capabilities of the reservoirs.

Alternative Water Supply (Mississippi River). A key component of this alternative is enlargement of the Bayou du Chien channel from Hickman, Kentucky, to the Upper Blue Basin of the lake. This channel enlargement would provide a significant reduction in the flooding of southwest Hickman and woodlands and croplands adjacent to the Bayou du Chien channel. To provide an alternative water supply during dry periods, a pumping station would be located just west of Hickman. The design considered could convey about 33,000 acre-feet of supplemental water to the lake in 45 days.

Alternative Water Supply (Groundwater). This would also provide an alternative water supply sufficient to provide about 33,000 acre-feet of supplemental water in 45 days. The source of the supplemental water for this alternative would be seventy 18-inch diameter wells and pumps to be placed adjacent to Buck and Blue Basins.

Alternative Water Supply (Upper Bayou du Chien). The upper Bayou du Chien channel which empties in the Mississippi River just north of Hickman, Kentucky, was considered as a possible source of water. Conveyance of water from upper Bayou du Chien to the Reelfoot Lake basin would require construction of a channel through the ridge dividing the two basins with enlargement of the lower Bayou du Chien channel.

Features Eliminated From Further Study

Initial evaluation of the alternatives described in the preceding paragraphs resulted in the elimination of a number of features from consideration in the final array of alternatives. Some of the plans not considered in the final array of alternatives are feasible but were dropped because of a lack of non-Federal interest, or because more efficient features had similar outputs.

Dredging in Critical Deposition Areas. This feature was eliminated during the reconnaissance study when it was realized that the tremendous number of stumps on the lake bottom made the proposal cost prohibitive. There was also serious doubt about obtaining water quality certification. A greater need is for the prevention of additional sediment from entering the lake. Therefore, this feature was eliminated from further consideration.

Walnut Log Sediment Control. Currently, sediment enters a roadside grader ditch from the hills above Walnut Log Road. Sediment deposition into the ditch appears to be minimal. Likewise, the sediment does not reach Bayou du Chien or the Upper Blue Basin of the lake. Cleanout of the ditch is anticipated to continue as needed. Likewise, diversion of the drainage ditch into a wildlife management area alongside the ditch could be achieved by the potential local sponsor through the use of a backhoe.

Bayou du Chien Channel Enlargement. This feature was previously analyzed for potential flood control benefits and determined to be feasible. However, the potential non-Federal sponsor

has not expressed an interest in pursuing this feature. In addition, this feature would increase the potential for sediment deposition into the lake. Therefore, enlargement of the Bayou du Chien channel was not examined further.

Bayou du Chien Cleanout. After a cursory analysis, it was determined that he potential local sponsor could selectively remove fallen trees from the channel in order to provide boating access from the upper Blue Basin to southwest Hickman, Kentucky. However, recent field investigations revealed no blockages in Bayou du Chien from Walnut Log to the Upper Blue Basin. Additional sediment could enter the lake as a result of removal of fallen trees, but it would be less than from a channel cleanout. Therefore, no further Corps action is recommended on Bayou du Chien.

Alternative Water Supply (Mississippi River). This feature, though potentially feasible, was eliminated from further consideration due to a lack of local sponsor support and the more critical need for other features.

Alternative Water Supply (Groundwater). Previous analyses included this feature in studies at Reelfoot Lake. However, potential water quality problems (due to iron content) and a lack of non-Federal interest resulted in the elimination of this feature.

Reelfoot & Indian Creek Diversion Channel. This alternative is one of three which was designed primarily for controlling the deposition of sediment into the lake. This alternative was expected to be slightly more effective than either the Reelfoot Creek Reservoirs or the Sediment Retention Basin on Reelfoot Creek. However, because of anticipated adverse impacts, the diversion channel was not considered in the final array.

Reelfoot Creek Reservoirs. Reservoirs on North and South Reelfoot Creeks, a short distance upstream of their confluence with Reelfoot Creek, would capture an estimated 70 percent of the sediment from that basin. This volume of sediment would amount to about 35 percent of the total sediment entering the lake and surrounding wetlands. In addition to their sediment retention capabilities, the reservoirs would also have limited water supply and flood control capabilities. The large acreage required for the permanent and maximum pools and the high construction costs for the dams and outlet structures however, make this the most expensive alternative considered. The Sediment Retention Basin was the only sediment control alternative retained in the final array of alternatives.

Dredged Boat Channels. Although this alternative appears to be feasible, there is no apparent non-Federal sponsor or Corps interest in the implementation of this alternative. Therefore, it was not included in the final array of alternatives.

Alternative Water Supply (Reelfoot Creek Reservoirs). The most critical need for water supply is likely to occur after a drawdown or during extreme dry periods. The water supply

capabilities of the reservoirs are only sufficient to refill Reelfoot Lake from a normal pool deficit of about 1 foot. Other water supply alternatives considered are less costly and have greater capacities; therefore, this water supply alternative was eliminated.

Alternative Water Supply (Upper Bayou du Chien). Based on information gathered in other Corps studies, the upper Bayou du Chien channel has insufficient base flow during the later summer and fall months to be considered a viable source of water. Therefore, this alternative was dropped from consideration in the early stages of the study.

Glady Hollow Diversion. According to a 1986 report by the Tennessee Department of Health and Environment entitled *Summary of Sedimentation Studies At Reelfoot Lake, 1982 -1986*, Glady Hollow Ditch delivers 12,342 tons of sediment per year into Reelfoot Lake at the existing spillway. However, at the present time it appears that most of the sediment drops out somewhere between Glady Hollow and the state park campground. Due to the extensive costs (based on quantity estimates), apparent lack of need, and a lack of potential benefits, this diversion was not pursued.

Harris Ditch Pumping Station. Some flood control benefits would be provided by construction of the pumping station at Harris Ditch. The majority of these benefits arise from prevention of damages to streets and roads within area. Investigations indicated that agricultural inundation does not occur frequent enough during the growing season to affect farming and there are no ecosystem restoration benefits associated with this alternative.

Washout Diversion Channels and Harris Ditch Cleanout. There are no documented data on sediment drop in the Washout, and the Washout is still extremely deep (40 - 45 feet; pers. comm. Paul Brown, TWRA, 1993). Therefore, significant aquatic degradation has not been identified at this time.

Features Considered in Detail

The resulting plans are the final array of alternatives. These alternatives are described in the paragraphs which follow.

Implementation of Water Level Management Practices. Water level management is expected to have positive impacts on several of the problems identified. Implementation of the proper water level management will help control the amount of aquatic vegetation within the lake and thereby address the problem of loss of aquatic habitat. Water level management can also impact the problem of loss of waterfowl habitat by providing additional acres of habitat through fluctuation of water elevations during the appropriate seasons of the year. Implementation of water level management will also indirectly impact all opportunities identified in the study by restoring and increasing aquatic and waterfowl habitat in and around Reelfoot Lake.

Twenty-seven different water level management scenarios were initially considered during the study, however most have been eliminated due to a variety of reasons. Table 3 lists all alternative management scenarios that were considered and the reasons for or against implementation. One preliminary alternative suggested returning the lake to uncontrolled, natural water fluctuations. While this may appear ideal in some respects, damages to private and public property could be extreme during periods of high water. For this reason, this alternative was not considered further. The following three water level management alternatives have been selected for detailed evaluation.

Water Management Alternative 1 - No Action. With this alternative, water level management would continue as described in the existing conditions. The U.S. Fish and Wildlife Service obtained permission in 1991 to operate lake levels under what is known as the Interim Plan of Operation as described in the July 1989 Reelfoot Lake Water Level Management Final Environmental Impact Statement. Under the Interim Plan, water levels may fluctuate annually up to 282.7 m.s.l. during the period of April 16 - November 14 and fluctuate up to 283.2 m.s.l. during the period of November 15 - April 15. This procedure would continue as the No Action alternative.

Water Management Alternative 2 Dynamic Water Level Fluctuation with Major Periodic Drawdown. This alternative is described in the 1989 Environmental Impact Statement prepared by the U.S. Fish and Wildlife Service as Alternative 6 (Preferred Alternative). Under this water level management scenario, the level of Reelfoot Lake would be managed more dynamically than in the past, depending on the natural moisture regime in particular years. The intent would be to manage for a more natural water level regime typical of alluvial lakes. Management would strive for at least a two-foot fluctuation each year. Lake levels would be allowed to fluctuate to at least 283.0' m.s.l. before considering opening any gates of the spillway. Manipulation of the spillway gates could occur between 283.0' - 283.5' m.s.l. depending upon climatic events and runoff in the watershed, seepage impacts of the Mississippi River, and other factors affecting lake hydrology or management needs based on biological indicators of the lake's ecosystem. Additional spillway gates would be opened when the lake level reaches approximately 283.5' m.s.l., except with the occurrence of unusual storm events when opening additional gates at lower elevations would be prudent. As the lake level recedes from elevations above 283.5' m.s.l., the gates would be closed between the same 0.5' intervals until the lake is stabilized at 283.0 m.s.l.

Fluctuations of the lake level of 1 to 2 feet below elevation 282.2 m.s.l. will generally occur dependent upon climatic conditions. However, periodic gate manipulation or artificial lowering of the lake level to approximately 280.0' m.s.l. may be used to accomplish specific practices to improve fisheries and wildlife habitat, control vegetation, or other management needs. Under this operating procedure, the lake could reach levels as high as 284.0' m.s.l. or as low as 280.0' m.s.l. in any given year. High water levels would generally occur in winter and spring; low water levels would generally occur in the summer and early fall. However, unusual climatic events such as natural flooding or drought conditions would occasionally exaggerate the water level extremes or modify

their seasonal occurrence. The gate manipulation procedures of this alternative would be modified to accommodate required changes based on experience or biological indicators.

A major periodic drawdown would involve lowering the lake level four feet (from 282.2' m.s.l. to 278.2' m.s.l.) with a new water control structure. The drawdown would start on June 1 and completed by July 15 or earlier if possible. A minimum of 120 days would be allowed for drying and aeration of the exposed lake bottom. The water control structure would be closed in mid-November. Refilling of the lake would be dependent upon ground water recharge and rainfall. The lake would be refilled to 283.3' m.s.l. and held at that level until June 1 of the following year. Under average climatic conditions, the lake would refill to this elevation by mid to late winter. The major periodic drawdown would be repeated as needed every 5 to 10 years. Dredging of existing circulation channels will be required to facilitate the four foot drawdown. Specific decisions concerning timing and need of subsequent drawdowns would be made on the basis of monitoring physical and biological conditions resulting from the first or previous drawdown. Post construction environmental monitoring will be cost shared by TWRA and the Corps for two years. Long term monitoring (5 – 10 years) is presently being discussed with TWRA, USFWS, the University of Memphis, and the University of Tennessee at Martin.

Water Management Alternative 3 - Interim Plan with Major Periodic Drawdown. This alternative is a combination of Alternative 1 - No Action, as described above, with a major periodic drawdown as described in Alternative 2 above. Lake water levels would be allowed to fluctuate up to 282.7' m.s.l. during the period of April 16 ' November 14 and up to 283.2' m.s.l. during the period of November 15 - April 15. A major drawdown to elevation 278.2' m.s.l. would occur every 5 to 10 years as necessary. The drying and refilling times would be as described previously.

Construct Alternative Spillway. The alternative spillway feature is proposed to replace the existing outlet structure on Running Reelfoot Bayou built in 1931. As mentioned previously, the existing structure has outlived its design life and is showing signs of deterioration. The radial gate on the structure is rarely used because of structural deterioration. Severe seepage is occurring beneath the structure and the future stability of the structure is unknown.

A new outlet structure is required to implement the major periodic drawdown of the lake as described above. The existing structure does not have the outlet capacity to draw down the lake in the required time period, in that the design of the existing structure does not lend itself to a drawdown activity. The existing structure is designed as an overflow weir, therefore, the deteriorated radial gate would have to be used to implement a drawdown. This would not meet the time limitations described and would reduce the overall benefits of a major drawdown. Environmental benefits resulting from repair of the existing spillway will be the same as those associated with the No Action Alternative.

The alternative spillway feature was designed based on several criteria determined by the study team. They are as follows:

a. The structure must have the flexibility for implementation of various water management schemes, including periodic major drawdowns within the prescribed time periods.

b. The structure must provide flood control equal to the existing structure.

c. Impacts to existing wetlands, parks, and roads must be minimized.

Based on these criteria, the study team formulated alternatives for the construction of the alternative spillway. Seven alternative sites, as shown on Plate 1 were evaluated for the new spillway structure. A comparison matrix, Plate 2, along with other considerations shown on Plate 3, was prepared to help in the evaluation of alternative spillway sites. All of these plates are found in the feasibility report. After extensive review and comparison of the alternatives, Alternative Site 6 was selected as the optimum location for the proposed spillway structure.

Along with the alternative spillway, a new inlet channel, outlet channel and bridge will be required. The study team determined that separation of the bridge and spillway will be beneficial to the project. If the bridge and spillway were combined, similar to the existing structure, the spillway would be required to support highway traffic. This would require that the deck structure on the spillway be a minimum of 48' wide (two 2' lanes and two 12' shoulders). This would greatly increase the depth of the proposed structure and possibly foundation requirements over the design based on separate structures. Separation of the structures also eliminates any potential future problems concerning maintenance responsibilities between state highway and environmental agencies.

Optimization of the alternative spillway design was performed based on the flow capacities required for the proposed major periodic drawdown of the lake. Designs were considered which incorporated 4, 6, and 8 gated structures. Each gate is a 20'wide vertical lift gate. This type of design allows for flow under the gates that will be beneficial to fish passage through the structure. It was determined through hydraulic analysis, that the proposed 6 gate structure has the capacity to draw down the lake to elevation 278.2 m.s.l. in the 45 day time period taking normal precipitation levels into account. Outlet flow rates will be limited to the existing capacity of Running Reelfoot Bayou, therefore no downstream flooding is expected due to the periodic drawdown of the lake.

Plate 4 of the feasibility report shows the proposed design of the 6 gate alternative spillway, the inlet and outlet channels, and the new bridge.

Construct Sediment Basin on Reelfoot Creek. Sediment deposition has been identified as one of the major problems at Reelfoot Lake. It has been determined that approximately 50% of the sediment deposited in the lake is transported by Reelfoot Creek. During the Reelfoot Lake, Tennessee and Kentucky, Reconnaissance Study an evaluation was performed which indicated that the construction of a single, large sediment basin on the lower portion of Reelfoot Creek would be

beneficial in addressing the problem of sediment deposition in the lake. During the feasibility study, an in-depth sediment study was performed which documents the expected benefits and costs of the construction of a sediment retention basin on Reelfoot Creek.

The sediment basin proposed in the Reconnaissance Study consisted of an earthen levee approximately 16,800 feet in length. This basin would encompass approximately 2,570 acres at the design water elevation of 305.0'. During the feasibility study, the size of the proposed sediment detention basin was optimized to provide the most cost efficient structure. Four alternative size basins (including the Reconnaissance design) were evaluated. Plate 5 of the feasibility report shows the four alternative levee locations. The design water elevation of 305.0' was maintained for all alternatives. Parametric cost estimates were prepared for the four alternatives along with estimates of benefits for the different size structures. After evaluation of the preliminary costs and benefits, Alternative #1 was selected as the optimum design. After the completion of the optimization process, a complete sediment evaluation was performed in accordance with the selected alternative. The construction of a sediment retention basin on Reelfoot Creek will address several of the problems identified in the study including: Loss of Aquatic Habitat, Declining Water Quality, and Loss of Waterfowl Habitat. It will also either directly or indirectly address all opportunities listed in the previous section of this report.

Construct Dredged Circulation Channels. The dredged circulation channels feature was proposed during the Reconnaissance Study. The purpose of the channels is to provide for better circulation of water between the major basins within the lake. The studies indicate that improved water circulation will improve the problem of declining water quality. Construction of these channels will also provide greater water level management capability within the lake and this feature is considered essential to implementing the periodic major drawdown of the lake discussed previously. This feature will also allow easier boating access to some areas of the lake and therefore will address several of the opportunities identified in this study.

The initial design of this feature during the Reconnaissance Study included approximately 13 miles of dredged channels in the lake. These channels were proposed to have a maximum bottom elevation of 274.0' m.s.l.. During the feasibility study, optimization of this feature was performed. Three different bottom elevations for the channels were considered which included 274.0', 276.0' and 278.0'. After evaluating construction quantities, impacts on water level management, impacts on existing wetlands, and discussions with the sponsor, it was determined that circulation channels with bottom elevation of 278.0' will address the problems identified in the study.

By increasing the maximum depth of the proposed circulation channels to 278.0', the excavation quantities are reduced to approximately 27,500 cubic yards from approximately 595,000 cubic yards for the 274.0' elevation channels and 254,000 cubic yards for the 276.0' elevation channels. The total length of dredged circulation channels at elevation 278.0' is approximately 3.2 miles compared to approximately 15 miles for the channels at elevation 274.0' and 13 miles for channels at elevation 276.0'. Potential negative impacts to the environment from excavation within wetlands and disposal

of excavated material are greatly reduced. Dredged circulation channels with bottom elevation of 278.0' will adequately address the requirements of a major periodic drawdown to elevation 278.2' as described previously in this report.

The proposed dredged circulation channels are shown on Plate 6 of the feasibility report. Two dredged boat access channels are included in the proposed feature. These channels are required for access to the lake during major periodic drawdowns for water quality sampling and monitoring. The locations of the proposed channels follow existing dredged channels and ditches within the lake. This design will also help to minimize negative impacts and reduce construction costs.

Shelby Lake Restoration/Waterfowl Management Units. Prior to the construction of the Mississippi River levees, the Reelfoot Lake spillway, and Highway 21, Shelby Lake was a natural oxbow lake surrounded by cypress trees and replenished regularly by flood waters from Reelfoot Lake and the Mississippi River. Since the construction of these items, the site has slowly silted in and has been cleared for agricultural use. A small remnant of the original lake is still too wet for agriculture and has now grown up in willows. This is all that is left of the original natural lake. Plate 7 of the feasibility report is a copy of the 1934 U.S.G.S. quad map which clearly shows Shelby Lake just south of Highway 21.

Plates 8 and 9 show the proposed Shelby Lake feature as it has been formulated. The purpose of this feature is to restore the area to the historical wetland condition and to provide waterfowl and wetland habitat. The design of this feature includes shallow excavation of Shelby Lake (0 to 6 feet) and construction of low level terraces for seasonal impoundment of water. The restored Shelby Lake would cover approximately 170 acres at the normal pool elevation of 280.0' m.s.l.. The six seasonally flooded waterfowl areas would cover approximately 483 acres and approximately 312 acres of forest hardwood habitat is included in the feature to provide diversity and cover. Restoration of this area is expected to produce high levels of migratory waterfowl benefits similar to other waterfowl management units already in use in the Reelfoot Lake area.

Lake Isom Restoration. The Lake Isom feature is located just south of Shelby Lake and Reelfoot Lake along Running Reelfoot Bayou, the main outlet from Reelfoot Lake. Lake Isom is a Federal Wildlife Refuge which is owned and operated by the U.S. Fish and Wildlife Service. This feature has been formulated to address the problem of loss of waterfowl habitat in the Reelfoot Lake area.

Similar to Shelby Lake, Lake Isom was also recharged frequently by flood waters from Reelfoot Lake and the Mississippi River before the construction of the Mississippi River levees, the Reelfoot Lake spillway and Highway 21. It once existed as a natural wetland complex which provided excellent aquatic and waterfowl habitat. Along with the changes in hydrologic conditions due to the levees and construction around Reelfoot Lake, Lake Isom has also experienced a long term drying effect partly due to alterations in Running Reelfoot Bayou. The bayou was channelized in 1959 and

the flowline of the bayou is currently approximately 15 feet lower than the normal water level of Lake Isom.

The proposed feature at Lake Isom is to provide the capability of increased water level management within the lake. The management capability will include the potential for raising the water level in the lake by up to two feet. The higher water levels would generally be during the winter months for increased waterfowl habitat. Also, more capability for fluctuation of the water levels throughout the year would be possible if the plan is implemented. The plan calls for annual water level fluctuations between elevation 279.0' and elevation 282.0'. The increased annual fluctuation is expected to help control the amount of aquatic vegetation within the lake and therefore improve waterfowl and aquatic habitat.

In order to implement this feature, the elevation of the existing levee at Lake Isom must be raised by two feet. A new outlet structure that has the capability to raise the water level to elevation 282.0' will also be required. Six pumps will be constructed to augment natural water supply to Lake Isom for raising the water elevation, particularly during dry years. A borrow area has been selected within the boundaries of Lake Isom as a source of material for raising the elevation of the levee. The selected site will be excavated in a manner to provide aquatic and waterfowl habitat.

Formulation of Alternative Plans

After the cost and benefit evaluation for the selected features was performed, the features were grouped together into alternative plans for further evaluation. This grouping allows for a cost effectiveness evaluation of the alternative features for selection of the recommended plan. The features included for the formulation of alternative plans include:

- **Implementation of Water Level Management Practices**
  - **Alternative 1 – No Action**
  - **Alternative 2 – Dynamic Water Level Fluctuation with Major Periodic Drawdown**
  - **Alternative 3 – Interim Plan (existing) with Major Periodic Drawdown**
- **Alternative Spillway**
- **Dredged Circulation Channels**
- **Sediment Basin on Reelfoot Creek**
- **Shelby Lake Restoration/Waterfowl Management Units**
- **Lake Isom Restoration**

The Alternative Spillway feature must be constructed in order to implement the Water Level Management Practices Alternative 2 and Alternative 3 features. Because of this, these features are considered to be dependent features and were not evaluated independently. A total of 14 alternative plans (including the no-action plan) were formulated from the features. The plans, costs, benefits, and effects are as follows:

No-Action Plan. This plan is based on the future without project conditions described previously in this report. No Corps of Engineers project would be implemented under this alternative. Environmental resources will continue to degrade and Reelfoot Lake will continue to fill with sediment. The Environmental Appendix and Final E.I.S. document the expected loss of environmental habitat for the future without project condition. The existing outlet structure will continue to deteriorate and at some time will require replacement. Intermediate steps, such as stabilizing the structure with rock, could be taken to maintain the water level in the lake. A temporary fix of this nature would cause the existing structure to function as a weir and limit the usefulness of the structure.

Eventually, the existing outlet structure must be replaced in order to maintain its function. It is anticipated that the size and location of a replacement structure will be similar to the proposed alternative spillway feature previously discussed in this report whether constructed by the Corps or by some other entity. Therefore, the cost estimate for this structure was used as a basis for the economic analysis of the future without project condition.

Alternative Plan 1a. Alternative plan 1a consists of the Alternative Spillway and Water Level Management Practices Alternative 1. This plan will provide for the replacement of the existing deteriorated control structure and water level management equal to the existing condition. Implementation of this plan would ensure that Reelfoot Lake continues to exist in a condition equal to the exiting condition without the fear of failure of the existing spillway and bridge structure. This plan will ensure the continuation of existing recreation and commercial fishing activities as well as flood control protection presently provided by Reelfoot Lake.

Table 4
Alternative Plan 1a
Benefit and Cost Summary
(1 October 1998 P.L.)

Total First Cost:		$ 9,709,000
Average Annual Cost:		$ 834,100
Average Annual Benefits:		
		Cost per Benefit
Fish & Wildlife Restoration, Terrestrial:	50 AHUV	$ 16,682
Economic Benefits:	$ 923,000	

Alternative Plan 2a. Alternative plan 2a consists of the Alternative Spillway, Water Level Management Practices Alternative 1, and Circulation Channels. This plan will provide the same benefits as Alternative Plan 1a but will also provide additional water quality benefits within the lake from the addition of the circulation channels. Some additional recreation benefits may be realized due to easier access to the various basins within the lake. The estimated average annual costs and benefits of this plan are listed below.

Table 5
Alternative Plan 2a
Benefit and Cost Summary
(1 October 1998 P.L.)

Total First Cost:		$ 10,248,000
Average Annual Cost:		$ 882,900
Average Annual Benefits:		
		Cost per Benefit
Fish & Wildlife Restoration, Terrestrial:	50 AHUV	$ 17,658
Aquatic Habitat Restoration:	130 AHUV	$ 6,791
Economic Benefits:	$ 961,400	

Alternative Plan 2b. Alternative plan 2b consists of the Alternative Spillway, Water Level Management Practices Alternative 2, and Circulation Channels. This plan will provide the same benefits as Alternative Plan 2a but will also provide substantial waterfowl and aquatic benefits due to the seasonal fluctuation and periodic major drawdowns included in the Water Level Management Practices Alternative 2. Implementation of this plan will require significant real estate acquisitions due to raising the water level within the lake. Potential negative impacts are due to the effect of a periodic drawdown of the lake on the local economy.

Table 6
Alternative Plan 2b
Benefit and Cost Summary
(1 October 1998 P.L.)

Total First Cost		$ 12,518,000
Average Annual Cost:		$ 1,119,300
Average Annual Benefits:		
		Cost per Benefit
Fish & Wildlife Restoration, Terrestrial:	290 AHUV	$ 3,860
Aquatic Habitat Restoration:	4,946 AHUV	$ 226
Annual Waterfowl Use Days:	7,125,000	$ 0.16
Economic Benefits:	$ 1,465,300	

Alternative Plan 2c. Alternative plan 2c consists of the Alternative spillway, Water Level Management Practices Alternative 3, and the Circulation Channels features. Alternative plan 2c will

provide the same benefits as plan 2a plus the additional aquatic benefits provided by the periodic drawdown described previously. Plan 2c does not require the real estate interests needed for implementation of higher water levels within the lake. This plan, however, does not provide the large number of waterfowl benefits estimated for plan 2b due to the increased water levels within Reelfoot Lake.

Table 7
Alternative Plan 2c
Benefit and Cost Summary
(1 October 1998 P.L.)

Total First Cost:		$ 10,248,000
Average Annual Cost:		$ 882,900
Average Annual Benefits:		
		Cost per Benefit
Fish & Wildlife Restoration, Terrestrial:	50 AHUV	$ 17,658
Aquatic Habitat Restoration:	3,090 AHUV	$ 286
Economic Benefits:	$ 1,249,500	

Alternative Plan 3a. This alternative plan consists of the Alternative Spillway feature, the Circulation Channels, Water Level Management Practices Alternative 1, and the Reelfoot Creek Sediment Detention Basin. The inclusion of the sediment detention basin will have a significant impact on the amount of sediment being deposited in Reelfoot Lake from Reelfoot Creek. Other benefits will be similar to Alternative Plan 2a. The estimated costs and benefits of plan 3a are listed below.

Table 8
Alternative Plan 3a
Benefit and Cost Summary
(1 October 1998 P.L.)

Total First Cost:		$ 21,496,000
Average Annual Cost:		$ 1,883,500
Average Annual Benefits:		
		Cost per Benefit
Fish & Wildlife Restoration, Terrestrial:	374 AHUV	$ 5,036
Aquatic Habitat Restoration:	1,316 AHUV	$ 1,431
Annual Waterfowl Use Days:	1,590,800	$ 1.18
Economic Benefits:	$ 1,179,300	

Alternative Plan 3b. Alternative Plan 3b consists of the Alternative Spillway, Circulation Channels, Water Level management Practices Alternative 2, and the Sediment Detention Basin features. This plan provides the maximum level of benefits for this combination of features due to the inclusion of the seasonal water level fluctuations and the periodic major drawdown of Reelfoot Lake. The implementation of this combination of features would provide significant benefits to the lake.

Table 9
Alternative Plan 3b
Benefit and Cost Summary
(1 October 1998 P.L.)

Total First Cost:		$ 23,766,000
Average Annual Cost:		$ 2,119,900
Average Annual Benefits:		
		Cost per Benefit
Fish & Wildlife Restoration, Terrestrial:	614 AHUV	$ 3,453
Aquatic Habitat Restoration:	6,132 AHUV	$ 346
Annual Waterfowl Use Days:	8,715,800	$ 0.24
Economic Benefits:	$ 1,683,200	

Alternative Plan 3c. Alternative Plan 3c is similar to Alternative Plan 3b except that the seasonal water level fluctuation of the lake is not included. This plan consists of the Alternative Spillway, the Circulation Channels, Water Level Management Plan Alternative 3, and the Reelfoot Creek Sediment Detention Basin. The estimated costs and benefits are listed below.

Table 10
Alternative Plan 3c
Benefit and Cost Summary
(1 October 1998 P.L.)

Total First Cost:		$ 21,496,000
Average Annual Cost:		$ 1,883,500
Average Annual Benefits:		
		Cost per Benefit
Fish & Wildlife Restoration, Terrestrial:	374 AHUV	$ 5,036
Aquatic Habitat Restoration:	4,276 AHUV	$ 440
Annual Waterfowl Use Days:	1,590,800	$ 1.18
Economic Benefits:	$ 1,467,400	

Alternative Plans 4a, 4b, and 4c. Alternative Plans 4a, 4b, and 4c are similar to Alternative Plans 3a, 3b, and 3c except for the inclusion of the Shelby Lake Restoration/Waterfowl Management Units feature in each of the three plans. The inclusion of this feature is expected to generate both aquatic and waterfowl benefits for the Reelfoot Lake area. Real estate acquisition would be necessary to implement the Shelby Lake feature, however the expected benefits are significant. The construction of this feature will help to return this wetland area to a more historic condition.

Table 11
Alternative Plan 4a
Benefit and Cost Summary
(1 October 1998 P.L.)

Total First Cost:		$ 26,459,000
Average Annual Cost:		$ 2,326,800
Average Annual Benefits:		
		Cost per Benefit
Fish & Wildlife Restoration, Terrestrial:	1,050 AHUV	$ 2,216
Aquatic Habitat Restoration:	1,344 AHUV	$ 1,731
Annual Waterfowl Use Days:	4,045,800	$ 0.58
Economic Benefits:	$ 1,317,700	

Table 12
Alternative Plan 4b
Benefit and Cost Summary
(1 October 1998 P.L.)

Total First Cost:		$ 28,729,000
Average Annual Cost:		$ 2,563,200
Average Annual Benefits:		
		Cost per Benefit
Fish & Wildlife Restoration, Terrestrial:	1,290 AHUV	$ 1,987
Aquatic Habitat Restoration:	6,160 AHUV	$ 416
Annual Waterfowl Use Days:	11,170,800	$ 0.23
Economic Benefits:	$ 1,821,600	

Table 13
Alternative Plan 4c
Benefit and Cost Summary
(1 October 1998 P.L.)

Total First Cost:		$ 26,459,000
Average Annual Cost:		$ 2,326,800
Average Annual Benefits:		
		Cost per Benefit
Fish & Wildlife Restoration, Terrestrial:	1,050 AHUV	$ 2,216
Aquatic Habitat Restoration:	4,304 AHUV	$ 541
Annual Waterfowl Use Days:	4,045,800	$ 0.58
Economic Benefits:	$ 1,605,800	

Alternative Plans 5a, 5b, and 5c. These alternative plans are similar to Alternative Plans 4a, 4b, and 4c except for the inclusion of the Lake Isom Restoration feature. Lake Isom is currently a waterfowl refuge operated by the U.S. Fish and Wildlife Service. Implementation of the proposed feature is expected is generate a high level of waterfowl benefits which will help to restore this area closer to the historical wetland condition. The cost estimate for Lake Isom includes a small amount of real estate interests due to the proposed increase of the water level of the lake. The estimated costs and benefits of these proposed alternative plans are as follows.

Table 14
Alternative Plan 5a
Benefit and Cost Summary
(1 October 1998 P.L.)

Total First Cost:		$ 27,802,000
Average Annual Cost:		$ 2,466,100
Average Annual Benefits:		
		Cost per Benefit
Fish & Wildlife Restoration, Terrestrial:	1,229 AHUV	$ 2,007
Aquatic Habitat Restoration:	1,454 AHUV	$ 1,696
Annual Waterfowl Use Days:	6,272,000	$ 0.39
Economic Benefits:	$ 1,340,000	

Table 15
Alternative Plan 5b
Benefit and Cost Summary
(1 October 1998 P.L.)

Total First Cost:		$ 30,072,000
Average Annual Cost:		$ 2,702,500
Average Annual Benefits:		
		Cost per Benefit
Fish & Wildlife Restoration, Terrestrial:	1,469 AHUV	$ 1,840
Aquatic Habitat Restoration:	6,270 AHUV	$ 431
Annual Waterfowl Use Days:	13,397,000	$ 0.20
Economic Benefits:	$ 1,843,900	

Table 16
Alternative Plan 5c
Benefit and Cost Summary
(1 October 1998 P.L.)

Total First Cost:		$ 27,802,000
Average Annual Cost:		$ 2,466,100
Average Annual Benefits:		
		Cost per Benefit
Fish & Wildlife Restoration, Terrestrial:	1,229 AHUV	$ 2,007
Aquatic Habitat Restoration:	4,414 AHUV	$ 559
Annual Waterfowl Use Days:	6,272,000	$ 0.39
Economic Benefits:	$ 1,628,100	

Comparison of Alternative Plans

After completion of the formulation of the alternative plans and estimation of the benefits and costs of each plan, a comparison was performed to evaluate the various plans. Initial screening of all alternatives was performed by evaluating various criteria including acceptability, completeness, efficiency, effectiveness, and partnership context. The comparison includes the cost per benefit evaluation for each category of benefit for each plan. The benefit categories include fish and wildlife terrestrial habitat restoration, aquatic habitat restoration, waterfowl habitat restoration and recreation and commercial fishing benefits. The terrestrial and aquatic habitat benefits are measured in annual habitat unit values (AHUV). This is a measure of the improvement of the environment due to the proposed changes. Waterfowl habitat restoration is measure in waterfowl use days (WUD's). This is

a prediction of the number of waterfowl that will use an area due to improved environment. Recreation and commercial fishing benefits are measured in dollars based on environmental and economic evaluations of the effected habitat areas.

Costs were calculated for all proposed features and alternative plans. Both expected first costs and average annual equivalent costs were calculated. The average annual equivalent cost includes not only the annualized first cost, but also considers other economic factors such as future expenses forgone and the predicted impacts on the economy. Cost per benefit comparisons were performed using the expected annual benefits of each alternative plan and the average annual plan cost. Appendix D, the economic appendix, provides a complete breakdown of the annualized costs for the alternative plans. Table 24 provides a summary of the benefits and costs used for the comparison of the alternative plans. Charts 1 through 3 provide a comparison of the alternative plans based on the efficiency of the outputs.

In addition to comparing the costs and benefits of the alternative plans, each plan was evaluated for its effectiveness in addressing the problems and opportunities identified previously in this study. Table 25 provides the results of this evaluation. Ranking of the alternative plans, as shown in Table 23 was performed based on benefit category and cost. This table clearly indicates that the plans which include water level management Alt. 2 (5b, 4b, 3b, 2b) generally have the highest overall benefits.

Table 17
Ranking of Alternative Plans by Benefits and Cost

	1	2	3	4	5	6	7	8	9	10	11	12	13
	Highest Benefits										Lowest		
	Benefits												
Terrestrial AHUV	5b	4b	5c	5a	4c	4a	3b	3c	3a	2b	2c	2a	1a
Aquatic AHUV	5b	4b	3b	2b	5c	4c	3c	2c	5a	4a	3a	2a	1a
Waterfowl Use Days	5b	4b	3b	2b	5c	5a	4c	4a	3c	3a	2c	2a	1a
Economic Benefits	5b	4b	3b	5c	4c	3c	2b	5a	4a	2c	3a	2a	1a
	Highest				Average Annual Cost								
	Lowest												
Cost	5b	4b	5c	5a	4c	4a	3b	3c	3a	2b	2c	2a	1a

Ranking was also performed on the basis of cost per unit benefit for the various environmental benefits for the 13 alternative plans. This ranking indicates the plans that are most efficient per category of benefit, however this ranking is not fully indicative of the effectiveness of the plan in addressing the problems and opportunities identified in this study.

Table 18
Ranking of Alternative Plans by Cost per Unit Benefit

	1	2	3	4	5	6	7	8	9	10	11	12	13
	Lowest Cost/Benefit										Highest Cost/Benefit		
Terrestrial AHUV	5b	4b	5c	5a	4c	4a	3b	2b	3c	3a	1a	2a	2c
Aquatic AHUV	2b	2c	3b	4b	5c	3c	4c	5c	3a	5a	4a	2a	
Waterfowl Use Days	2b	5b	4b	3b	5c	5a	4c	4a	3c	3a			

In summary, the alternative plans which provide the highest levels of environmental and economic benefits are the plans which include the water level management practices alternative 2. These plans also, in general, have the highest costs. The plans which show the least cost per environmental benefit are also, in general, the plans which include the water level management practices alternative 2. This is due to the high levels of benefits expected from the seasonal increase of the water level and the periodic drawdown of the lake as previously described in this report.

Alternative plan 5b provides the highest level of benefits in all environmental and economic benefit categories evaluated in this study. Next, plans 4b, 3b, 5c, and 2b, respectively, provide the highest levels of benefits considering all benefit categories, as shown in Table 17. Efficiency of the alternative plans varies according to the benefit category being examined as shown in Table 18 above. Plans 2b, 5b, 2c, and 4b provide the most efficient output of benefits in at least one of the benefit categories. However, only plans 5b and 4b effectively address all of the problems and opportunities identified. Plan 5b is similar to plan 4b except that it includes the Lake Isom Restoration feature. This feature significantly increases both terrestrial and aquatic habitat benefits along with waterfowl habitat benefits. Because of the relatively low cost of the Lake Isom Restoration feature, plan 5b provides lower cost per unit benefits than plan 4b in all but one of the benefit categories evaluated as shown in Table 18. Therefore, plan 5b was found to be both more efficient and more effective than plan 4b.

Comparative Impacts of Plans

Table 19 compares the base and without-project conditions and lists the impacts of each detailed plan on the significant resources of the project-affected area. Plan economic characteristics are also compared. The significant resources are individually described in Section 5 of this final EIS, and the impacts of each alternative plan on each significant resource are detailed in Section 6.

TABLE 19
COMPARATIVE IMPACTS OF ALTERNATIVES

Alternatives	Significant Resources
	Aquatic Resources
Base	Reelfoot Lake is one of the most productive commercial and sport fishing lakes in Tennessee (USDI 1989); its reputation as an outstanding fishing lake began in the early 1890's (Johnson et. al. 1988). Although fishes in the lake are presently abundant and diverse, the percent composition (biomass) of the game fish has declined over the years, while the percent composition of non-game fish has increased (Johnson et al. 1988).
Future W/O Project	Continued silting and high turbidity levels will obviously degrade water quality and result in a loss of productivity. Standing crops of fish will be reduced as the water quality and spawning habitat is further degraded. A shift in species composition and loss of species diversity are also very probable. Fish populations will also obviously decline as open water is annually lost to the encroachment of marsh and ~~scrub/shrub swamp. Succession to~~ drier habitat will eventually lead ~~to a loss in~~ waterfowl habitat.
Alternative Plan 1a	Since this plan incorporates the same water level management as the Future W/O Project plan; there will be essentially no change in the aquatic resources as they relate to water management. The new spillway will provide more efficient operation, but this will not affect aquatic resources. Sediment inflows will continue.
Alternative Plan 2c	If benefits to aquatic resources were to be ranked; Plan 2c would fall between Plan 2a and Plan 2b because the major periodic drawdown benefits would be the same as those of 2b. However, 2c would not experience the aquatic benefits of the dynamic water level fluctuation.
Alternative Plan 3a	Addition of the new sediment basin will greatly improve water quality in terms of turbidity levels and restricted loss of depth. Most of the aquatic benefits will be confined to the Buck Basin area of the lake. The new sediment basin will intercept approximately 70 percent of the sediment inflows of Reelfoot Creek. This also equates to a total future- W/O- project loss of Buck basin in approximately 150 years and a depth loss of 1.8 feet during the fifty (50) year project life.

TABLE 19 (cont.) COMPARATIVE IMPACTS OF ALTERNATIVES	
Alternative Plan 3b	This plan represents the most that can be done for aquatics on Reelfoot Lake. It is a beneficial combination of Plans 2b and 3a.
Alternative Plan 3c	Benefits will be slightly less than Plan 3b because of the lack of an annual dynamic water level fluctuation.
Alternative Plan 4a	Aquatic benefits will be the same as Plan 3a plus additional aquatic benefits derived from the 170 acre Shelby Lake.
Alternative Plan 4b	Aquatic benefits will be the same as Plan 3b plus additional aquatic benefits derived from the 170 acre Shelby Lake.
Alternative Plan 4c	Aquatic benefits will be the same as Plan 3c plus additional aquatic benefits derived from the 170 acre Shelby Lake.
Alternative Plan 5a	Aquatic benefits will be the same as Plan 4a plus additional aquatic benefits derived by restoration of Lake Isom. This restoration will provide an additional 18 inches of seasonal depth and an additional 360 surface acres of water.
Alternative Plan 5b	Aquatic benefits will be the same as Plan 4b plus additional aquatic benefits derived by restoration of Lake Isom. This restoration will provide an additional 18 inches of seasonal depth and an additional 360 surface acres of water.
Alternative Plan 5c	Aquatic benefits will be the same as Plan 4c plus additional aquatic benefits derived by restoration of Lake Isom. This restoration will provide an additional 18 inches of seasonal depth and an additional 360 surface acres of water.

TABLE 19 (cont.)
COMPARATIVE IMPACTS OF ALTERNATIVES

Alternatives	Significant Resources
	Bottomland Hardwood Forest
Base	The project area contains approximately 12,000 acres of bottomland hardwood forest (this includes 4,700 acres of forested swamp).
Future W/O Project	The acreage of bottomland hardwoods is expected to increase due to probable cleared land acquisitions and reforestation by Reelfoot Lake WMA and two federal refuges. Also, the successional conversion of marsh and shrub/scrub swamp to regenerating bottomland hardwoods that results from the continued sediment deposition and vegetative decomposition will continue. Approximately 700 acres of marsh and shrub/scrub swamp will be converted to regenerating bottomland hardwoods during the next 50 years. Sediment deposition in the Grassy Island area will impact approximately 600 acres of bottomland hardwoods with a net loss of 264 AHUVs.
Alternative Plan 1a	Approximately 30 acres of bottomland hardwoods and 6 acres of forested swamp would be permanently removed by construction of the alternative spillway. This equates to a permanent loss of 19.7 AHUVs. However, an additional right-of-way will be acquired for the new outlet channel. This 115 acres of cleared agricultural wetlands would be acquired and planted in bottomland hardwood trees as a hardwood restoration feature. This stand of regenerateing bottomland hardwoods will produce 63 AHUVs.
Alternative Plan 2a	Circulation channel construction impacts to hardwoods will be minor because most of the excavation activity will be within existing channels. Impacts, positive and negative, associated with the new spillway and outlet channel will be same as above.
Alternative Plan 2b	Same as above. In addition, water level management will restore hydrology to approximately 286 acres of bottomland hardwoods between the elevations 283.0 and 284.0 feet M.S.L. This will provide a gain of approximately 240 AHUVs.
Alternative Plan 2c	Same as Plan 2a.

TABLE 19 (cont.) COMPARATIVE IMPACTS OF ALTERNATIVES	
Alternative Plan 3a	Same as Plan 2a, except that additional hardwood benefits will be provided in two catagories by construction of the proposed sediment basin on Reelfoot Creek. Future intercepted sediment will protect approximately 600 acres of bottomland hardwoods in the Grassy Island area. This amounts to a gain of approximately 324 AHUVs. In addition, 247 acres of trees will be planted within the flood zone of the sediment dam. These regenerating hardwoods will provide approximately 115 AHUVs.
Alternative Plan 3b	Same as Plan 2b plus the sediment basin benefits described in 3a.
Alternative Plan 3c	Same as Plan 2c plus the sediment basin benefits described in 3a.
Alternative Plan 4a	Same as Plan 3a plus habitat units gained as the result of trees planted on 282 acres of cropland. This will produce 155 AHUVs.
Alternative Plan 4b	Same as Plan 3b plus habitat units gained as the result of trees planted on 282 acres of cropland. This will produce 155 AHUVs.
Alternative Plan 4c	Same as Plan 4a.
Alternative Plan 5a	Same as Plan 4a plus habitat units gained as the result of restored hydrology at Lake Isom. This will produce 275 AHUVs.
Alternative Plan 5b	Same as Plan 4b plus habitat units gained as the result of restored hydrology at Lake Isom. This will produce 275 AHUVs.
Alternative Plan 5c	Same as Plan 5a.

TABLE 19 (cont.)
COMPARATIVE IMPACTS OF ALTERNATIVES

Alternatives	Significant Resources
	Wetlands
Base	Approximately 12,000 acres of bottomland hardwood forest, 500 acres of forested swamp, 430 acres of scrub/shrub swamp, 3,434 acres of marsh, and 188 acres of submerged macrophytes are found within the project area. Within Lake Isom National Wildlife Refuge, there are 380 acres of bottomland hardwoods, 417 acres of forested swamp, 140 acres of shrub swamp, and 45 acres of farmed wetland.
Future W/O Project	The amount of wetlands will increase as sediment inflows and the associated vegetative build-up continue. Without project, approximately 3,900 acres of open water (39 % of total) will be converted to marsh and scrub/shrub swamp and approximately 700 acres of existing marsh and scrub/shrub swamp will gradually go to regenerating bottomland hardwoods during the 50 year project life.
Alternative Plan 1a	Project construction of the new spillway will eliminate six acres of forested swamp. Approximately 115 acres of prior converted farmland will be planted in bottomland hardwoods. Also, approximately 5 acres of open water and 10 acres of riparian habitat will result from construction of the new outlet channel. Other than that, there will be very little change from the future W/O project conditions.
Alternative Plan 2a	The only additional change to Plan 1a is that temporary impacts will be associated with the dredging of approximately 12 acres circulation channels. Approximately 4 acres of these channels will be converted from marsh to open water.
Alternative Plan 2b	Initially, there will be very little perceptable change as this alternative water management plan is implemented. However, after several years of annual fluctuation and periodic drawdowns, the vegetative encroachment upon open water will stabilize.
Alternative Plan 2c	There will be wetland community changes similar to those above, but not as significant.

TABLE 19 (cont.) COMPARATIVE IMPACTS OF ALTERNATIVES	
Alternative Plan 3a	Same as Plan 2c plus sediment degradation of 600 acres of bottomland hardwoods will cease and the predicted vegetative encroachment on 1,000 acres of open water in Buck Basin will be prevented. In addition, approximately 650 acres of prior converted farmland in the pool area of Reelfoot Creek above and below the sediment dam will be converted to various wetland types in the form of waterfowl areas, reforestation of bottomland hardwoods, and borrow pit wetlands.
Alternative Plan 3b	Same as Plan 2b plus sediment dam benefits as described above.
Alternative Plan 3c	Same as Plan 2c plus sediment dam benefits as described above.
Alternative Plan 4a	Same as Plan 3a plus 935 acres of prior converted farmland will be converted to various wetland types in the form of waterfowl areas, an oxbow lake, and reforested bottomland hardwoods.
Alternative Plan 4b	Same as Plan 3b plus benefits described above in Plan 4a.
Alternative Plan 4c	Same as Plan 3c plus benefits described above in Plan 4b.
Alternative Plan 5a	Same as Plan 4a plus 275 AHUVs will result from restoration of hydrology to the Lake Isom wetland community.
Alternative Plan 5b	Same as Plan 4b plus the Lake Isom benefits described above in Plan 5a.
Alternative Plan 5c	Same as Plan 4c plus the Lake Isom benefits described above in Plan 5a.

TABLE 19 (cont.)
COMPARATIVE IMPACTS OF ALTERNATIVES

Alternatives	Significant Resources
	Waterfowl Habitat
Base	Nearly 250 species of resident and migratory bird species inhabit the study area (FWS 1989). The Reelfoot Lake area provides important habitat for migratory and resident waterfowl. From 1992 through 1996, peak populations of ducks and geese averaged approximately 132,500 and 72,600, respectively.
Future W/O Project	According to the U. S. Fish and Wildlife Service Final EIS, 1989, annual fluctuations of peak duck populations would continue to occur. Goose populations have been increasing in past years and this trend may continue. In the long term, however, the ability of Reelfoot Lake to provide adequate habitat for waterfowl would be impaired by continuing sedimentation. Open water areas would continue to decrease and vegetation would continue to succeed toward less productive species.
Alternative Plan 1a	No significant change from existing conditions.
Alternative Plan 2a	Same as Plan 1a.
Alternative Plan 2b	This plan would provide an additional 1,900 acres of shallow water for resting and feeding. Also, long term, proper water level management will stabilize vegetative encroachment and favor desirable species. Populations are expected to increase by 20 % following a drawdown year; then experience an average 10 % increase each subsequent year until the next drawdown.
Alternative Plan 2c	Slight increases will gradually occur during project life due to the periodic drawdown.
Alternative Plan 3a	Same as Plan 2a plus sediment interception benefits in Buck Basin that are attributed to construction of the sediment dam on Reelfoot creek. This dam will preserve approximately 1,400 acres of open water during the 50 year project life. In addition, waterfowl management areas constructed within the basin will provide an estimated 2,520,000 WUDs.
Alternative Plan 3b	Same as Plan 2b plus benefits described in Plan 3a.

TABLE 19 (cont.) COMPARATIVE IMPACTS OF ALTERNATIVES	
Alternative Plan 3c	Same as Plan 2c plus benefits described in Plan 3a.
Alternative Plan 4a	Same as Plan 3a plus the construction of the Shelby Lake/Waterfowl Area will provide approximately 650 acres of shallow water habitat that will produce an estimated 2,073,552 WUDs.
Alternative Plan 4b	Same as Plan3b plus the Shelby Lake benefits.
Alternative Plan 4c	Same as Plan3c plus the Shelby Lake benefits.
Alternative Plan 5a	Same as Plan 4a plus an additional 1,436,500 WUDs that result from Lake Isom improvements.
Alternative Plan 5b	Same as Plan 4b plus an additional 1,436,500 WUDs that result from Lake Isom improvements.
Alternative Plan 5c	Same as Plan 4c plus an additional 1,436,500 WUDs that result from Lake Isom improvements.

TABLE 19 (cont.)
COMPARATIVE IMPACTS OF ALTERNATIVES

Alternatives	Significant Resources
	State and Federal Holdings
Base	The Reelfoot Lake area contains approximately 31,256 acres of publicly owned land and water. The Reelfoot State Park, Tennessee Department of Environment and Conservation (formerly Tennessee Department of Health and Environment), owns and manages 279 acres of land; and the Tennessee Wildlife Resources Agency (TWRA) owns and manages the 18,700-acre Reelfoot Wildlife Management Area. The U.S. Fish and Wildlife Service (USFWS) manages the 10,427-acre Reelfoot National Wildlife Refuge (NWR); the USFWS leases 7,847 acres from the State of Tennessee for the Reelfoot NWR and owns the remaining 2,580 acres (541 acres in Tennessee and 2,039 acres in Kentucky). In addition, the USFWS owns and operates the 1,850-acre Lake Isom NWR which is located approximately five miles south of Reelfoot Lake.
Future W/O Project	Reelfoot WMA and the two NWRs will likely expand: but at a very limited rate.
Alternative Plan 1a	Lands associated with the new spillway construction will be transferred to TWRA, the project sponsor. The inlet channel (6 acres), spillway (30 acres), and the reforestation lands (115 acres) along each side of the outlet channel will most likely be retained by TWRA. However, the outlet channel right-of-way, or a portion thereof, may be transferred to Reelfoot Lake State Park as a recreational fishing facility. The new Highway 21 bridge and associated highway right-of-way will go to the Tennessee Department of Transportation.
Alternative Plan 2a	Same as Plan 1a.
Alternative Plan 2b	Implementation of the FWS preferred water level management plan will require acquisition of additional lands up to the 285' elevation. Approximately 600 acres will be acquired by TWRA and the Corps of Engineers. Lands acquired in Tennessee will most likely go to TWRA and those lands acquired in Kentucky will most likely go to the U. S. Fish and Wildlife Service.

TABLE 19 (cont.) COMPARATIVE IMPACTS OF ALTERNATIVES	
Alternative Plan 2c	Same as Plan 2a.
Alternative Plan 3a	Same as Plan 2a plus 2,197 acres of land in the Reelfoot Creek basin will be acquired by TWRA and the Corps of Engineers. After project completion, TWRA will operate and maintain the sediment dam and the proposed Reelfoot Creek WMA.
Alternative Plan 3b	Same as Plan 2b plus the 2,197 acres described above.
Alternative Plan 3c	Same as Plan 2c plus the 2,197 acres described above.
Alternative Plan 4a	Same as Plan 3a plus 935 acres of farmland south of Reelfoot Lake will be acquired by TWRA for the Shelby Lake/Waterfowl Management Area.
Alternative Plan 4b	Same as Plan 3b plus the 935 acres described above.
Alternative Plan 4c	Same as Plan 3c plus the 935 acres described above.
Alternative Plan 5a	Same as Plan 4a plus a flowage easement for 105 acres of cropland southwest of Lake Isom NWR will have to be acquired in order to implement the new water management plan (higher water levels) for Lake Isom.
Alternative Plan 5b	Same as Plan 4b plus a flowage easement for 105 acres of cropland southwest of Lake Isom NWR will have to be acquired in order to implement the new water management plan (higher water levels) for Lake Isom.
Alternative Plan 5c	Same as Plan 4c plus a flowage easement for 105 acres of cropland southwest of Lake Isom NWR will have to be acquired in order to implement the new water management plan (higher water levels) for Lake Isom.

TABLE 19 (cont.)
COMPARATIVE IMPACTS OF ALTERNATIVES

Alternatives	Significant Resources
	Endangered and Threatened Species
Base	The only federally listed endangered species occurring in the study is the interior least tern (*Sterna antillarum axthalassos*). Interior least terns nest and feed primarily on the Mississippi River, but these terns occasionally feed in the open water areas of the lake. Reelfoot Lake supports one of the largest concentrations of wintering bald eagles (threatened) in the eastern United States.
Future W/O Project	Although the lake is expected to experience severe degradation and loss of surface area during the next 50 years; the status of these species is expected to remain similar to existing conditions.
Alternative Plan 1a	This plan should not adversely impact any of these species.
Alternative Plan 2a	This plan should not adversely impact any of these species.
Alternative Plan 2b	There may be some temporary impacts associated with a periodic major drawdown. If a major fish kill occurs as a result of a summer drawdown, the forage base for eagles may be reduced the following fall. Stable waterfowl populations will offset this problem.
Alternative Plan 2c	Same as Plan 2b.
Alternative Plan 3a	Same as Plan 2a. In addition, eagles will benefit from the improved water conditions in Buck Basin. Also, eagles can roost in trees that will eventually be provided by the reforestation of 247 acres and feed on waterfowl that utilize the 360 waterfowl management unit.
Alternative Plan 3b	Same as Plan 2b plus Plan 3a above.
Alternative Plan 3c	Same as Plan 2c plus Plan 3a above.
Alternative Plan 4a	Same as Plan 3a plus the additional roost trees, open water and waterfowl areas provided by the Shelby Lake Area. This area is strategically located so as to provide a link, or corridor between Lake Isom and Reelfoot Lake.

TABLE 19 (cont.) COMPARATIVE IMPACTS OF ALTERNATIVES	
Alternative Plan 4b	Same as Plan 3b plus 4c comments above.
Alternative Plan 4c	Same as Plan 3c plus 4c comments above.
Alternative Plan 5a	Same as Plan 4a plus additional winter water on Lake Isom will enhance fish forage and waterfowl as a food source.
Alternative Plan 5b	Same as Plan 4b plus additional winter water on Lake Isom will enhance fish forage and waterfowl as a food source.
Alternative Plan 5c	Same as Plan 4c plus additional winter water on Lake Isom will enhance fish forage and waterfowl as a food source.

	Recreation
Base	Outdoor recreation, both consumptive and non-consumptive, is a vital component of the local economy. An estimated $3,832,062 are expended annually on area recreational activities. (See Appendix D) Consumptive recreation accounts for approximately 72% (343,555 man-days) of the total annual recreational use. In fact, fishing is by far the single most popular recreational activity in the study area; about 322,806 man-days are annually spent fishing.
Future W/O Project	Water based recreation will decline severely as the lake continues to fill and deteriorate.
Alternative Plan 1a	Same as future W/O.
Alternative Plan 2a	Same as future W/O.
Alternative Plan 2b	A gradual improvement in lake conditions will maintain recreation use levels then an increase in visitation will occur. A tremendous jump in visitation will occur in the drawdown year as sightseers come to witness the drawdown.
Alternative Plan 2c	Similar to Plan 2b. However, long term visitation will not be as high as 2b because of a lack of dynamic water level management.
Alternative Plan 3a	Same as Plan 2a except that recreational fishing should increase in the Buck Basin area as water conditions improve due to the sediment basin.

TABLE 19 (cont.)
COMPARATIVE IMPACTS OF ALTERNATIVES

Alternative Plan 3b	Same as Plan 2b except that recreational fishing should increase in the Buck Basin area as water conditions improve due to the sediment basin.
Alternative Plan 3c	Same as Plan 2c except that recreational fishing should increase in the Buck Basin area as water conditions improve due to the sediment basin.
Alternative Plan 4a	Same as Plan 3a except there will be a slight, gradual increase in wildlife observation at the new Shelby Lake/Waterfowl Management Area.
Alternative Plan 4b	Same as Plan 3b except there will be a slight, gradual increase in wildlife observation at the new Shelby Lake/Waterfowl Management Area.
Alternative Plan 4c	Same as Plan 3c except there will be a slight, gradual increase in wildlife observation at the new Shelby Lake/Waterfowl Management Area.
Alternative Plan 5a	Same as Plan 4a except there will be a slight, gradual increase in wildlife observation and sportfishing at Lake Isom NWR.
Alternative Plan 5b	Same as Plan 4b except there will be a slight, gradual increase in wildlife observation and sportfishing at Lake Isom NWR.
Alternative Plan 5c	Same as Plan 4c except there will be a slight, gradual increase in wildlife observation and sportfishing at Lake Isom NWR.

TABLE 19 (cont.)
COMPARATIVE IMPACTS OF ALTERNATIVES

Alternatives	Significant Resources
	Agricultural Lands
Base	The lands adjacent to Lake Isom and Reelfoot are primarily in row crops. Primary crops are rice, soybeans, wheat, grain sorghum, and corn.
Future W/O Project	Lake conditions will not affect area agricultural lands.
Alternative Plan 1a	Construction of the outlet channel for the new spillway would result in the loss of 165 acres of farmland.
Alternative Plan 2a	Same as Plan 1a.
Alternative Plan 2b	Slightly higher winter water levels (0.3 foot) may have an affect on approximately 600 acres of cropland in Kentucky.
Alternative Plan 2c	Same as Plan 1a.
Alternative Plan 3a	Same as Plan 2a plus approximately 2,054 acres of farmland will be acquired for the for the new sediment basin. However, 676 acres of this will be leased back to area farmers under a state wildlife management program.
Alternative Plan 3b	Same as Plan 2b plus Plan 3a.
Alternative Plan 3c	Same as Plan 3a.
Alternative Plan 4a	Same as Plan 3a plus approximately 935 acres of farmland will be acquired for the for the new Shelby Lake/Waterfowl Management area. However, 360 acres of this will be leased back to area farmers under a state wildlife management program.
Alternative Plan 4b	Same as Plan 2b plus Plan 4a.
Alternative Plan 4c	Same as Plan 4a.
Alternative Plan 5a	Same as Plan 4a plus a flowage easement for 105 acres of adjacent cropland will be acquired because of anticipated higher water levels at Lake Isom.
Alternative Plan 5b	Same as Plan 2b plus Plan 4b.
Alternative Plan 5c	Same as Plan 5a.

TABLE 19 (cont.)
COMPARATIVE IMPACTS OF ALTERNATIVES

	Cultural Resources
Base	The new Reelfoot Lake spillway and the Lake Isom Project areas have had an intensive survey conducted. There were 13 sites and eight isolated finds. All of the cultural materials were found within the Lake Isom right-of-way. The eight isolated finds are ineligible for National Register of Historic Preservation nomination and further work is not recommended. Of the thirteen sites, four have been evaluated as potentially eligible and testing is recommended. None of the sites are within or near any proposed construction area. Report is on file and the SHPO coordination is found in Appendix A, Section VIII. All other public land, including the Reelfoot lakeshore and Lake Isom has been surveyed.
Future W/O Project	No changes to cultural resources is anticipated.
Alternative Plan 1a	Any unsurveyed portions of the rights-of-way would be surveyed, and sites would be tested for significance. Any significant sites would be avoided during construction or mitigated.
Alternative Plan 2a	Circulation channels are in previously dredged areas. No additional surveys required.
Alternative Plan 2b	No additional requirements.
Alternative Plan 2c	No additional requirements.
Alternative Plan 3a	Same as 1a.
Alternative Plan 3b	No additional requirements.
Alternative Plan 3c	No additional requirements.
Alternative Plan 4a	Same as 1a.
Alternative Plan 4b	No additional requirements.
Alternative Plan 4c	No additional requirements.
Alternative Plan 5a	Surveys complete. No sites within the proposed construction area.

TABLE 19 (cont.)
COMPARATIVE IMPACTS OF ALTERNATIVES

Alternative Plan 5b	No additional requirements.
Alternative Plan 5c	No additional requirements.

	Noise
Base	The study area is relatively noise free due to it rural setting. Most existing noise is associated with agricultural and recreational activities.
Future W/O Project	Slight decrease in outdoor recreational noise due to continued lake degradation and loss of open water.
Alternative Plan 1a	There would be an increase in noise during project construction due to equipment operation.
Alternative Plan 2a	Same as Plan 1a.
Alternative Plan 2b	Same as Plan 1a.
Alternative Plan 2c	Same as Plan 1a.
Alternative Plan 3a	Same as Plan 1a.
Alternative Plan 3b	Same as Plan 1a.
Alternative Plan 3c	Same as Plan 1a.
Alternative Plan 4a	Same as Plan 1a.
Alternative Plan 4b	Same as Plan 1a.
Alternative Plan 4c	Same as Plan 1a.
Alternative Plan 5a	Same as Plan 1a.
Alternative Plan 5b	Same as Plan 1a.
Alternative Plan 5c	Same as Plan 1a.

TABLE 19 (cont.)
COMPARATIVE IMPACTS OF ALTERNATIVES

Alternatives	Significant Resources
	Air Quality
Base	Air quality is good to above average due to its rural setting and is in attainment for all air quality standards.
Future W/O Project	Air quality is not expected to change.
Alternative Plan 1a	Machinery emissions and airborne dust would slightly degrade air quality during construction and maintenance. However, project-induced impacts to air quality would be minor and of short duration.
Alternative Plan 2a	Same as Plan 1a.
Alternative Plan 2b	Same as Plan 1a.
Alternative Plan 2c	Same as Plan 1a.
Alternative Plan 3a	Same as Plan 1a.
Alternative Plan 3b	Same as Plan 1a.
Alternative Plan 3c	Same as Plan 1a.
Alternative Plan 4a	Same as Plan 1a.
Alternative Plan 4b	Same as Plan 1a.
Alternative Plan 4c	Same as Plan 1a.
Alternative Plan 5a	Same as Plan 1a.
Alternative Plan 5b	Same as Plan 1a.
Alternative Plan 5c	Same as Plan 1a.

TABLE 19 (cont.)
COMPARATIVE IMPACTS OF ALTERNATIVES

	Aesthetic Value
Base	Aesthetic value of the study area is closely associated with the diverse wetland communities of Reelfoot Lake and Lake Isom.
Future W/O Project	Aesthetic value of the study area will likely increase slightly due to probable land acquisitions and reforestation by the state WMA and the federal refuges.
Alternative Plan 1a	Vegetative clearing associated with construction would temporarily reduce aesthetic value. Also, project features would alter the appearance of the landscape; however, establishment of bottomland hardwoods and turfing rights-of-way should offset negative impacts to aesthetics.
Alternative Plan 2a	Same as Plan 1a.
Alternative Plan 2b	Same as Plan 1a.
Alternative Plan 2c	Same as Plan 1a.
Alternative Plan 3a	Same as Plan 1a.
Alternative Plan 3b	Same as Plan 1a.
Alternative Plan 3c	Same as Plan 1a.
Alternative Plan 4a	Same as Plan 1a.
Alternative Plan 4b	Same as Plan 1a.
Alternative Plan 4c	Same as Plan 1a.
Alternative Plan 5a	Same as Plan 1a.
Alternative Plan 5b	Same as Plan 1a.
Alternative Plan 5c	Same as Plan 1a.

TABLE 19 (cont.)
COMPARATIVE IMPACTS OF ALTERNATIVES

Alternatives	Significant Resources
	Displacement of People
Base	Although recreation business has gradually declined because of lake deterioration; there has been no detectable displacement.
Future W/O Project	Many of the area's residents could be displaced due to loss of jobs associated with a significant reduction of the area's recreation based businesses as lake degradation and loss of open water continues.
Alternative Plan 1a	No people would be displaced because of plan implementation. The small percentage of farmland lost will not displace persons. Project construction workers will contribute to the local economy.
Alternative Plan 2a	Same as Plan 1a.
Alternative Plan 2b	There will be a very gradual, slight increase in recreation related business as the lake responds to a desirable water level management plan. There will also be a jump in visitation during the periodic drawdowns, as sightseers flock to the area.
Alternative Plan 2c	There will be a jump in visitation during the periodic drawdowns, as sightseers flock to the area.
Alternative Plan 3a	Same as Plan 1a.
Alternative Plan 3b	Same as Plan 1a and Plan 2b
Alternative Plan 3c	Same as Plan 3b.
Alternative Plan 4a	Same as Plan 1a.
Alternative Plan 4b	Same as Plan 1a and Plan 2b
Alternative Plan 4c	Same as Plan 4b.
Alternative Plan 5a	Same as Plan 1a.
Alternative Plan 5b	Same as Plan 1a and Plan 2b.
Alternative Plan 5c	Same as Plan 5b.

TABLE 19 (cont.)
COMPARATIVE IMPACTS OF ALTERNATIVES

Alternatives	Significant Resources
	Community Cohesion
Base	The cultural heritage of the project area is linked directly to a rural way of life based on agriculture, outdoor recreation, and commercial fishing. The preservation of lifestyle is based on the continued existence of adjacent farmland and the natural resources provided by Reelfoot Lake.
Future W/O Project	There would be a gradual conversion of some small farms to larger farm complexes, but the base agricultural economy will not change and will not be affected by lake conditions. However, as the lake degradation continues, all associated businesses will become severely impacted.
Alternative Plan 1a	There is local concern about the amount of state and federal tax money spent on the new spillway. However, some are supportive, realizing that the spillway will fail at some point in time. Approximately 165 acres of cropland will be lost to spillway/outlet channel construction and reforestation.
Alternative Plan 2a	Same as Plan 1a.
Alternative Plan 2b	Local business will slowly improve as lake conditions improve. However, local business owners are very opposed to the drawdown.
Alternative Plan 2c	Local business owners are very opposed to the drawdown.
Alternative Plan 3a	Approximately 2,054 acres of farmland will be lost to the sediment basin.
Alternative Plan 3b	Same as Plan 2a and Plan 3a.
Alternative Plan 3c	Same as Plan 2c and Plan 3a.
Alternative Plan 4a	Approximately 935 acres of farmland will be lost to the construction of the Shelby Lake/Waterfowl Management Area.
Alternative Plan 4b	Same as Plan 2a and Plan 42.

TABLE 19 (cont.)
COMPARATIVE IMPACTS OF ALTERNATIVES

Alternative Plan 4c	Same as Plan 3c and Plan 4a.
Alternative Plan 5a	A flowage easement of 105 acres of cropland will be required just west of Lake Isom NWR.
Alternative Plan 5b	Same as Plan 2a and Plan 5a.
Alternative Plan 5c	Same as Plan 4c and 5a.

Alternatives	Significant Resources
	Local Government Finance, Tax Revenues, and Property Values
Base	The area of local government finance is concerned with items such as tax base, property values, and tax revenues. Each of these, and other items, are important because they impact the financial condition of local government units. Financial soundness is important because it often determines the level and quality of the necessary public services provided by local governments
Future W/O Project	Under future without-project conditions, there would be a significant decrease in lakeside property values and a corresponding drop in tax revenue as the area businesses can no longer operate due to the deterioration of the lake as a recreational attraction.
Alternative Plan 1a	Spillway construction activities will contribute somewhat to local sales tax revenues. Approximately 165 acres of cropland will be removed from the tax base.
Alternative Plan 2a	Channel construction activities will contribute somewhat to local sales tax revenues. Channel right-of-ways are on public land.
Alternative Plan 2b	Tax revenues will slowly increase as recreational businesses respond to improved lake conditions.
Alternative Plan 2c	Similar to Plan 2b, but not the same level of improvement.
Alternative Plan 3a	Approximately 2,054acres of cropland will be removed from the tax base.
Alternative Plan 3b	Same as Plan 2b and Plan 3a.

TABLE 19 (cont.) COMPARATIVE IMPACTS OF ALTERNATIVES	
Alternative Plan 3c	Same as Plan 2c and Plan 3a.
Alternative Plan 4a	Approximately 935 acres of cropland will be removed from the tax base.
Alternative Plan 4b	Same as Plan 3b and Plan 4a.
Alternative Plan 4c	Same as Plan 3c and Plan 4a.
Alternative Plan 5a	A flowage easement of 105 acres of cropland will be required just west of Lake Isom NWR.
Alternative Plan 5b	Same as Plan 4b and Plan 5a.
Alternative Plan5c	Same as Plan 4c and Plan 5a.

TABLE 19 (cont.)
COMPARATIVE IMPACTS OF ALTERNATIVES

Alternatives	Significant Resources
	Displacement of Businesses and Farms
Base	Recreation related businesses have steadily declined as the lake resource has deteriorated over the years.
Future W/O Project	Under future without-project conditions, area farms will not be affected by lake conditions. However, those recreation related businesses, such as bait shops, resorts, and restaurants will be severely impacted as the open water decreases and the lake degradation continues.
Alternative Plan 1a	No businesses will be displaced by this plan. However, construction of the new outlet channel will remove 165 acres from the agricultural base. This involves one landowner.
Alternative Plan 2a	Same as Plan 1a.
Alternative Plan 2b	Revenues will slowly increase as recreational businesses respond to improved lake conditions.
Alternative Plan 2c	Same as Plan 1a.
Alternative Plan 3a	Same as Plan 1a plus 2,054 acres of cropland will be acquired for the sediment basin project. This involves 22 landowners.
Alternative Plan 3b	Same as Plan 1a and Plan 3a.
Alternative Plan 3c	Same as Plan 2c and Plan 3a.
Alternative Plan 4a	Same as Plan 3a plus 935 acres of cropland will be acquired for the Shelby Lake/Waterfowl Management Area project. This involves 5 landowners.
Alternative Plan 4b	Same as Plan 3b and Plan 4a.
Alternative Plan 4c	Same as Plan 3c and Plan 4a.
Alternative Plan 5a	Same as Plan 4a plus a flowage easement for 105 acres of cropland will be acquired west of Lake Isom NWR.
Alternative Plan 5b	Same as Plan 4b and Plan 5a.
Alternative Plan 5c	Same as Plan 4c and Plan 5a.

TABLE 19 (cont.)
COMPARATIVE IMPACTS OF ALTERNATIVES

Alternatives	Significant Resources
	Public Services and Facilities
Base	The area of public services and facilities is concerned with the ability of local government to provide the basic public services; e.g., education, police protection, and roads and bridges.
Future W/O Project	Under future without-project conditions, the ability to provide such services will be slightly hindered. The area's tax base is expected to be somewhat decreased when the lake degradation causes a drop in property values and business income. This will cause a corresponding drop in tax revenues needed to provide these services.
Alternative Plan 1a	No improvement can be expected without implementation of an acceptable water management Plan.
Alternative Plan 2a	No improvement can be expected without implementation of an acceptable water management plan.
Alternative Plan 2b	This plan would prevent the erosion of property values and corresponding decrease in tax base expected under future without-project conditions. This would maintain the area's ability to provide such basic public services as education, police protection, and roads and bridges.
Alternative Plan 2c	Same as Plan 1a.
Alternative Plan 3a	Same as Plan 1a plus 2,045 acres of cropland will be acquired for the sediment basin project.
Alternative Plan 3b	Same as Plan 2b and Plan 3a.
Alternative Plan 3c	Same as Plan 2c and Plan 3a.
Alternative Plan 4a	Same as Plan 3a plus 935 acres of cropland will be acquired for the Shelby Lake/Waterfowl Management Area.
Alternative Plan 4b	Same as Plan 3b and Plan 4a.
Alternative Plan 4c	Same as Plan 3c and Plan 4a.

TABLE 19 (cont.)
COMPARATIVE IMPACTS OF ALTERNATIVES

Alternative Plan 5a	Same as Plan 4a plus a flowage easement for 105 acres of cropland west of Lake Isom NWR must be acquired.
Alternative Plan 5b	Same as Plan 4b and Plan 5a
Alternative Plan 5c	Same as Plan 4c and Plan 5a.

Alternatives	Significant Resources
	Community and Regional Growth
Base	Growth in the communities within the project area is directly related to agriculture and recreational business.
Future W/O Project	Recreational business is expected to decrease significantly under future without-project conditions as the lake degradation continues. The drop in business will mean significant declines in the local economy.
Alternative Plan 1a	Without a change in water level management; this alternative would not contribute appreciably to community growth.
Alternative Plan 2a	Same as Plan 1a.
Alternative Plan 2b	This plan would prevent the declines expected in the local economy under future without-project conditions. It would maintain and increase the area's commercial fishing and recreation related businesses, income, employment, tax base, public services, and urban and rural population necessary to maintain the area's economy at present levels.
Alternative Plan 2c	Same as Plan 1a.
Alternative Plan 3a	Same as Plan 2a
Alternative Plan 3b	Same as Plan 2b.
Alternative Plan 3c	Same as Plan 2c.
Alternative Plan 4a	Same as Plan 3a.
Alternative Plan 4b	Same as Plan 3b.

TABLE 19 (cont.)
COMPARATIVE IMPACTS OF ALTERNATIVES

Alternative Plan 4c	Same as Plan 3c.
Alternative Plan 5a	Same as Plan 4a.
Alternative Plan5b	Same as Plan 4b.
Alternative Plan 5c	Same as Plan 4c.

Alternatives	Significant Resources
	Employment
Base	The area's employment is concentrated in timber, commercial fishing, recreational business, and agriculture.
Future W/O Project	Under future without-project conditions, there would be a significant decrease in commercial fishing and recreation related employment as a result of the lake degradation and the continued loss of open water.
Alternative Plan 1a	Temporary employment opportunities may result from new project construction; but the long term employment situation will not be changed.
Alternative Plan 2a	Same as Plan 1a.
Alternative Plan 2b	The initial employment status will not change, other than the aforementioned construction opportunities. However, area employment will stabilize then slowly improve as the lake restoration occurs and recreational use increases.
Alternative Plan 2c	There will be some improvement, but not as significant as Plan 2b.
Alternative Plan 3a	Same as Plan 1a.
Alternative Plan 3b	Same as Plan 2b.
Alternative Plan 3c	Same as Plan 2c
Alternative Plan 4a	Same as Plan 1a.
Alternative Plan 4b	Same as Plan 2b.

TABLE 19 (cont.)
COMPARATIVE IMPACTS OF ALTERNATIVES

Alternative Plan 4c	Same as Plan 2c.
Alternative Plan 5a	Same as Plan 1a.
Alternative Plan 5b	Same as Plan 2b.
Alternative Plan 5c	Same as Plan 2c.

5. AFFECTED ENVIRONMENT

Environmental Conditions

General Description of the Project Area. Reelfoot Lake is located within the Mississippi Alluvial Plain in portions of Lake and Obion counties in northwest Tennessee and a section of Fulton County in southwest Kentucky. The lake is situated between the Mississippi River to the west and north and loess bluffs and upland hills to the east. With a surface area of approximately 15,500 acres at normal pool (282.2 feet NGVD), Reelfoot Lake is the largest natural lake in Tennessee. Approximately 10,200 acres of the lake are open water and the remaining acreage is marsh and swamp. The lake can be generally divided into three distinguishable basins - Blue Basin, Buck Basin, and Upper Blue Basin.

The Reelfoot Lake area contains approximately 31,256 acres of publicly owned land and water. The Reelfoot State Park, Tennessee Department of Environment and Conservation (formerly Tennessee Department of Health and Environment), owns and manages 279 acres of land; and the Tennessee Wildlife Resources Agency (TWRA) owns and manages the 18,700-acre Reelfoot Wildlife Management Area. The U.S. Fish and Wildlife Service (USFWS) manages the 10,427-acre Reelfoot National Wildlife Refuge (NWR); the USFWS leases 7,847 acres from the State of Tennessee for the Reelfoot NWR and owns the remaining 2,580 acres (541 acres in Tennessee and 2,039 acres in Kentucky). In addition, the USFWS owns and operates the 1,850-acre Lake Isom NWR which is located approximately five miles south of Reelfoot Lake. In 1987 the new Reelfoot Lake Teaching and Researching Facility was established at the University of Tennessee at Martin. Only 40 miles from Reelfoot Lake, UT Martin is the nearest University to the lake.

Climatology. A weather station at Reelfoot NWR, Samburg, Tennessee, has collected sufficient climatological data for the calculation of normal (i.e., average value over 1951-1980 time period) average monthly temperatures and normal monthly precipitation totals (NOAA 1989,1990). The two warmest months are usually July (79.9 degrees F) and August (78.0 degrees F), and the coolest

months are most often January (34.9 degrees F) and February (38.8 degrees F). Typically, the wettest months at Reelfoot Lake are March (5.05 inches) and May (4.89 inches); and the driest months are September (3.08 inches) and October (2.55 inches). The Reelfoot Lake watershed receives an average of 49 inches of precipitation annually (McIntyre et al. 1986).

Hydrologic Characteristics. Reelfoot Lake was subjected to flood waters from the Mississippi River until a levee was constructed along the east bank of the river between 1910 and 1920, preventing surface inflow from the river. Prior to the construction of the levee, flood waters from the river could induce lake levels as much as 10-12 feet above normal. A highway (now Tennessee Hwy. 22) was constructed along the southern shore of the lake between 1915 and 1919; this highway effectively restricted the natural drainage of the lake. During this same time period an 80-foot spillway was built at a controlling elevation lower than the natural outlets. In 1929, the Tennessee Legislature authorized the construction of the existing spillway. This spillway, completed in 1931, was built at an elevation of 282.2 feet NGVD. The State of Tennessee granted responsibility of controlling lake levels to the USFWS in 1941. The USFWS maintained water levels at Reelfoot Lake as close to 282.2 feet NGVD as possible for several decades.

The Reelfoot Lake Water Level Management Final Environmental Impact Statement was issued by the U.S. Department of the Interior Fish and Wildlife Service in July 1989. This EIS evaluated the water level management practices that have occurred at Reelfoot Lake in the past and made recommendations concerning future practices. The USFWS preferred alternative from the 1989 EIS was an Integrated Program of Dynamic Water Level Fluctuation Combined with Periodic Major Drawdown. This management plan has not been fully implemented. However, in 1991, an Interim Water Level Management Plan was implemented and is the current practice at Reelfoot Lake. The interim plan allows for the water level in the lake to fluctuate to elevation 283.2 during the non-growing season (November 15 - April 15) and to approximately elevation 282.7 the remainder of the year before opening the spillway gates.

At the normal pool elevation of 282.2 feet NGVD, Reelfoot Lake has a surface area of approximately 15,500 acres, an average depth of about 5.2 feet, and a volume of approximately 80,300 acre-feet. The Reelfoot Lake watershed is approximately 240 square miles. Reelfoot Creek and Indian Creek, originating in the uplands east of the lake, and Bayou du Chien, which drains alluvial bottomlands to the north, are the major tributaries to Reelfoot Lake. The lake outlet, Running Reelfoot Bayou, is located at the south end of the lake. Outflow from the lake into the bayou is controlled by a flashboard gated spillway and radial gate.

The three upper geohydraulic units in the Reelfoot Lake vicinity (in descending order) consist of a water-table aquifer, about 100 to 200 feet of Mississippi River alluvium; a confining unit, approximately 250 feet of fine sand and clay; and Memphis Sand, approximately 600 feet of highly permeable sand (TWRA 1985, Johnson et al. 1988). Precipitation is the principle source of recharge for the alluvial water-table aquifer. Other sources of recharge for the alluvial aquifer are surface runoff and underflow from the uplands east of the lake, seepage from the Mississippi River and its tributaries, and seepage from Reelfoot Lake. (TWRA 1985, Johnson et al. 1988)

Significant Resources

5.5 Discussions of existing conditions and future without-project conditions of significant resources are restricted to the Reelfoot Lake study area which is essentially Lake and Obion Counties in Tennessee and southern Fulton County in Kentucky. Agricultural practices, erosion control, public land acquisitions, and water quality are major factors influencing existing and future without-project conditions within the study area.

AQUATIC HABITAT

Reelfoot Lake has been identified as a hypereutrophic lake (Johnson et al. 1988, USFWS 1989). Hypereutrophic lakes are in an advance stage of eutrophication and are characterized by poor water quality and excessive plant growth. The aging process at Reelfoot Lake has been greatly accelerated by human activities. Agricultural and silvicultural activities have increased erosion on lands adjacent to the lake and, thus, increased sediment deposition into the lake. Since most of this sediment is eroded from agricultural fields, large amounts of agriculture-related nutrients, such as nitrogen and phosphorus, enter the lake (USFWS 1989). According to Denton (1987), nonpoint pollution is severely impacting Reelfoot Lake; and the principal source of nonpoint pollution is erosion from the uplands east of the lake.

Sedimentation studies (Tenn. Dept. of Health and Env. 1984, Denton 1986, McIntyre et al. 1986) were conducted at Reelfoot Lake to determine sedimentation rates, identify and quantify sediment sources, and develop measures that could be implemented to reduce sedimentation. Based on sedimentation rates, it was projected that Blue Basin, Buck Basin, and Upper Blue Basin would become too shallow (2-foot water depth) for most uses in 210, 110, and 60 years, respectively. It was estimated that collectively 93.4% of the sediment entering the lake was being transported by Reelfoot Creek (85.2%), Indian Creek (6.5%), and Bayou du Chien (1.7%). However, sediment-retention basins have been constructed on Indian Creek and a lake tributary that enters Buck Basin at Kirby Pocket since these studies were conducted. Also, several watershed lakes have been constructed in the uplands east of Reelfoot Lake.

Denton (1987) documented and interpreted the results of water quality monitoring in the Reelfoot Lake area by the Tennessee Department of Health and Environment (now Tennessee Department of Environment and Conservation) from 1976 through 1986. Data were collected from sampling stations in Reelfoot Lake, Reelfoot Creek, Indian Creek, and Running Reelfoot Bayou to measure numerous water quality parameters. A Water Quality Index (WQI) was used to compare parameter measurements to water quality criteria (i.e., values assigned to parameters that represent levels needed to protect water quality), compare parameter measurements among sampling stations, and establish water quality parameters of concern. Only data collected from January 1984 through December 1986 were used in the WQI since the purpose was to assess the current water quality status.

Two sampling stations were established in each of the three major basins of the lake - Blue Basin, Buck Basin, and Upper Blue Basin. Although measurements of specific water quality parameters varied among the six stations, The WQI evaluation indicated that water quality was best in Blue Basin and poorest in Upper Blue Basin. Most of the Reelfoot Lake parameters of concern were associated with eutrophication. These parameters included light transmission (Secchi disk), chlorophyll "a", biochemical oxygen demand, low dissolved oxygen, and high pH. High levels of nitrates and phosphorus, causative agents of eutrophication, were also highly ranked parameters of concern in the lake.

Reelfoot Creek had the poorest water quality of the three lake tributaries sampled. Mean values of four parameters (nitrate, phosphorus, suspended solids, and copper) exceeded water quality criteria; and significant water quality criteria violations were recorded for dissolved oxygen, pH, and fecal coliform bacteria. Significant levels of mercury, zinc, and nickel were also recorded at the Reelfoot Creek sampling station. Fecal coliform bacteria levels in Bayou du Chien consistently exceeded the criterion; and the criteria for mercury, copper, and zinc were surpassed at this station. Water quality at the Indian Creek sampling station was surprisingly good. Temperature and fecal coliform bacteria exceeded the criteria in only one and two samples, respectively. Copper, zinc, and mercury surpassed the criteria in 14% of the samples taken from Indian Creek; and phosphorus and suspended solids exceeded the criteria in 13% of the samples.

Since significant levels of mercury, zinc, nickel, and copper have been recorded; there is reasonable concern for the implications associated with sediment exposure during a drawdown. For this reason the monitoring plan that will be completed prior to project implementation will be fully coordinated with USFWS, TWRA, TDEC, and EPA.

At the Running Reelfoot Bayou (lake outlet) station, fecal coliform bacteria and chlorophyll "a" exceeded the criteria in 67% and 40% of the samples, respectively; and nitrates and phosphorus exceeded the criteria in 50% of the samples. Dissolved oxygen, temperature, biochemical oxygen demand, ammonia, and suspended solids did not meet water quality criteria. Also, pH levels above and below the criterion value range were observed at this station.

BOTTOMLAND HARDWOOD FOREST

Bottomland hardwood forests of the Mississippi Alluvial Valley have been reduced from approximately 24,690,000 acres historically to less than 4,938,000 acres today (Ducks Unlimited 1994). A net annual loss of 300,000 acres of bottomland hardwoods occurred within the conterminous United States between the 1950's and the 1970's; the greatest reductions during this period occurred in Louisiana, Mississippi, and Arkansas (Frayer et al. 1983). From the mid-1970's to the mid-1980's, almost 900,000 acres of bottomland hardwood forest were lost to agriculture in the Lower Mississippi Alluvial Plain (Hefner et al. 1994).

Bottomland hardwood forests are productive in terms of wildlife and commercial forest products; and, when flooded, these forests provide aquatic habitat for fish, waterfowl, and other wetland wildlife. White-tailed deer, swamp rabbits, gray and fox squirrels, wood ducks, and mallards are common game species found throughout this habitat type. These forests also support an abundance of song birds, small mammals, reptiles, and amphibians. Commercial forest products derived from these woodlands include lumber, veneer, and fuel.

WETLANDS

Wetlands are defined by Title 33, Part 323 CFR, dated 22 January 1977, Regulatory Program of the Corps of Engineers:

> "Wetlands means those areas that are inundated or saturated by surface water or ground water at a frequency and duration sufficient to support, and that, under normal circumstances, do support a prevalence of vegetation typically adapted for life in saturated soil conditions."

Most of the historically vast forested wetlands of the Reelfoot Lake drainage basin have been cleared and drained for agricultural purposes. Only small remnants of bottomland hardwood forests and forested swamps exist immediately adjacent to Reelfoot Lake and Lake Isom, along some drainages, and within low-lying areas that are unsuitable for farming and other development.

The vegetated wetlands associated with the Tennessee portion of the Reelfoot Lake area, including Lake Isom NWR, were quantified using Tennessee Wetland Inventory maps generated by the TWRA; and the wetlands within the Kentucky portion of Reelfoot Lake were measured from National Wetland Inventory maps produced by the USFWS. The wetland classification utilized by both map types was based on Cowardin et al. (1979). Study area wetlands were then placed into five general vegetative categories - bottomland hardwood forest, forested swamp, scrub/shrub swamp, persistent marsh, and submersed macrophytes. Although not identified on the wetland inventory maps, nonpersistent marshes exist in the Reelfoot Lake area (Henson 1990) and were included as a sixth vegetative category.

Bottomland hardwood forests are forested wetlands characterized by broad-leaved deciduous trees that are 20 feet tall or taller. Common tree species include green ash (*Fraxinus pennsylvanica*), American elm (*Ulmus americana*), hackberry (*Celtis occidentalis*), eastern cottonwood (*Populus deltoides*), sycamore (*Platanus occidentalis*), sweetgum (*Liquidambar styraciflua*), red maple (*Acer rubrum*), silver maple (*A. saccharinum*), pecan (*Carya illinoensis*), and various oaks (*Quercus* spp.). The Reelfoot Lake area contains approximately 13,139 acres of bottomland hardwood forest. These forests grow in temporarily, seasonally, semipermanently, and permanently flooded sites; and sites that are intermittently exposed.

Baldcypress (*Taxodium distichum*) trees, at least 20 feet tall, dominate the forested swamps in the Reelfoot Lake area. Approximately 502 acres of forested swamps exist within the study area, and the water regimes of these swamps range from seasonal to permanently flooded. Permanently

inundated baldcypress trees occur in portions of all three basins of the lake. The trunks of most of the permanently inundated trees have developed swollen buttresses; and these trees, with the exception of those growing in very shallow water, exhibit varying levels of decadence due to water stress (Henson 1990a).

Scrub/shrub swamps are dominated by woody vegetation less than 20 feet in height; these swamps contain true shrubs, young trees, and shrubs or trees that are small or stunted due to environmental conditions. Water regimes of scrub/shrub swamps in the study area vary from temporarily to permanently flooded. Major shrub and tree species found in these swamps include buttonbush (Cephalanthus occidentalis), swamp rose (Rosa palustris), red and silver maple, baldcypress, and black willow (*Salix nigra*). There are about 435 acres of scrub/shrub swamp in the study area.

Persistent marshes at Reelfoot Lake occur on sites with water regimes ranging from temporarily to permanently flooded; and they are characterized by rooted, emergent vegetation (i.e., erect herbaceous hydrophytes, excluding mosses and lichens) that usually remains standing at least until the start of the next growing season. Rose mallows (*Hibicus lasiocarpos* and *H. militaris*), southern smartweed (*Polygonum densiflorum*), swamp smartweed (*P. hydropiperoides*), common cattail (*Typha latifolia*), groundnut (*Apios americana*), swamp loosestrife (*Decondon verticillatus*), primrose willow (*Ludwigia leptocarpa*), water-willow (*Justicia americana*), and giant cutgrass (*Zizaniopsis miliacea*) are among the plants common to these marshes (Henson 1990a). The Reelfoot Lake area contains approximately 2,845 acres of persistent marsh.

Nonpersistent marshes are dominated by emergent vegetation that falls below the surface of the water or to the surface of the substrate at the conclusion of the growing season. According to Henson (1990d), typical plant species that occur in the nonpersistent marshes of Reelfoot Lake include American lotus (*Nelumbo lutea*), spatterdock (*Nuphor luteum*), white water lily (*Nymphaea odorata*), water smartweed (*P. amphibium*), southern smartweed, swamp smartweed, and pickerel weed (*Pontedera condata*). An estimated 634 acres of nonpersistent marsh was identified at Reelfoot Lake in 1986 (Henson 1990d).

Submersed macrophytes are vascular plants that grow primarily on or below the surface of the water for the majority of the growing season during most years. Henson (1990c) lists coontail (*Ceratophyllum demersum*) and curlyleaf pondweed (*Potamogeton crispus*) as abundant, and small pondweed (*P. pusillus*) and fanwart (*Cabomba caroliniana*) as common submersed macrophytes in the lake. Only 188 acres of submersed macrophytes were delineated on the wetland maps; however, it is important to note that submersed macrophyte zones can very drastically in size from year to year. In fact, curlyleaf pondweed entirely covered Buck and Upper Blue basin in the spring of 1993.

In addition to the aforementioned vegetative groups, small free-floating macrophytes are prevalent in the study area. Mosquito fern (*Azolla caroliniana*), smaller duckweed (*Lemna minor*), giant duckweed (*Spirodelia polyrhiza*), columbia watermeal (*Wolffia columbia*), and papillary watermeal (*W. papulifera*) are abundant in many nonpersistent marshes, swamps, and ditches

(Henson 1990d). A thick cover of floating macrophytes often obscures submersed macrophytes, particularly in very shallow areas (Henson 1990c).

Vast shallow-water areas created by sedimentation, nutrient-rich agricultural runoff, and stable water levels have provided conditions at Reelfoot Lake that are conducive to abundant aquatic plant growth (Tenn. Dept. of Health and Envir. 1984, TWRA 1985, Johnson et al. 1988, USFWS 1989). Encroachment of emergent aquatic plants into former open-water areas and expansion of woody vegetation into shallower regions provide evidence that ecological succession is rapidly occurring at the lake (USFWS 1989). Henson (1990b) studied vegetational succession at Reelfoot Lake; the following paragraph briefly summarizes some of his findings.

Since the early 1960's, extensive monotypic marshes of giant cutgrass have been replaced to a large extent by marsh-swamp transitional species of herbs, vines, shrubs, and immature trees. Southern smartweed competes with giant cutgrass and other persistent emergent species along shallow margins of marsh-swamp transitional zones and low-lying areas of persistent marsh. Southern smartweed also slowly induces edge encroachment into open water by trapping organic and inorganic material. Former giant cutgrass marshes have succeeded to marsh-swamp vegetation with little expansion of this grass into new areas; therefore, persistent marshes have declined drastically in recent years. Sediment deposition will continue to promote the invasion of aggressive competitor species, such as southern smartweed, into shallow areas of giant cutgrass marsh, converting these areas to nonpersistent marsh. These areas of nonpersistent marsh will gradually succeed to scrub/shrub swamps; and, in turn, these scrub/shrub swamps will slowly convert to forested swamps.

Although aquatic plants in Reelfoot Lake provide protective cover for young fish and furnish great amounts of food for fish and waterfowl (Johnson et al. 1988), excessive aquatic plant growth has been a problem in the lake for many years (Baine and Yonts 1937, Gersbacher and Norton 1939, Baker 1940, Steenis and Cottam 1945). Overly abundant aquatic vegetation impacts dissolved oxygen concentrations (Baine and Yonts 1937, Gersbacher and Norton 1937), inhibits water circulation (Johnson et al. 1988), and contributes to the accumulation of excessive residual nutrients (USFWS 1989). In addition, aquatic vegetation encroaches into open water areas; and heavy aquatic plant growth interferes with boating, fishing, and other water-related recreational activities.

Steenis and Cottam (1945) conducted experimental cuttings of aquatic pest plants at the lake in search of a method(s) by which to control obnoxious vegetation and encourage growth of plant species more palatable to waterfowl. They concluded that Hochney underwater cutters could be used to at least partially control giant cutgrass, spatterdock, and American lotus. However, they warned that control of one obnoxious species may result in the emergence of another aquatic pest plant that was formerly suppressed.

Burbank (1963) identified giant cutgrass, spatterdock, and American lotus as the primary aquatic pest plants in Reelfoot Lake. He reported that attempts to control giant cutgrass prior to 1948 with an underwater cutter and by burning were terminated. Underwater mowing was discontinued

because stumps frequently damaged the cutters, and burning was halted because complete root kills were never obtained. Burbank (1963) also evaluated the herbicidal treatment program at Reelfoot Lake that began in 1948. He concluded that herbicides had been helpful in controlling lotus; and although cutgrass acreage had been reduced very little over the 14 years of herbicide treatments, he implied that herbicides may have possibly prevented the spread of this species into new areas. Spatterdock had not been targeted for control and had only recently been considered a pest species. Unfortunately, spatterdock invaded areas where cutgrass had been eliminated or reduced. Some experimental herbicide applications were made on spatterdock but were ineffective.

Curlyleaf pondweed, an exotic species, was first discovered in Reelfoot Lake in 1959 (Cypert 1967). According to Cypert (1967), this plant spread rapidly after introduction and occupied approximately 2,000 acres of the lake by 1967. Experiments by the Reelfoot NWR and the Tennessee Game and Fish Commission (now TWRA) in 1964 revealed that Diquat herbicide would kill curlyleaf pondweed. However, it was thought that herbicidal control of this plant would probably have to be limited to small areas, such as boat trails, since the wide distribution and aggressiveness of curlyleaf pondweed made eradication or control of this plant with herbicides appear impractical. (Cypert 1967)

The TWRA introduced 30,000 white amur (*Ctenopharyngodon idella*), an exotic fish, into Reelfoot Lake in 1983 in an attempt to control submersed vegetation (Johnson et al. 1988). All submersed macrophytes declined drastically at all areas sampled within two years after stocking (Sliger and Henson 1987). Sliger and Henson (1987) reported that curlyleaf pondweed and coontail were dominant at all sample sites before the white amur introduction, but these plants were no longer pests two years after white amur introduction. However, curlyleaf pondweed and coontail increased during 1987, prompting white amur restocking (Henson and Sliger 1993). The TWRA released an additional 79,402 fish from 1988 through 1991. Submersed macrophytes recolonized most of the previously cleared areas by 1990, and populations in some zones approached or surpassed levels that existed prior to white amur introduction in 1983. (Henson and Sliger 1993).

Curlyleaf pondweed, coontail, and southern smartweed have been major aquatic pests in Reelfoot Lake during recent years (Dr. Wesley Henson, U. Tenn. at Martin, pers. comm.). Curlyleaf is presently the most prolific aquatic pest plant in the lake. The curlyleaf problem is most severe in Buck Basin and Upper Blue Basin. Although the amount of area infested with curlyleaf varies annually, Buck and Upper Blue basins were completely choked with curlyleaf during the spring of 1993 (Paul Brown, Reelfoot WMA, pers. comm.). Curlyleaf normally reaches maximum biomass during the principle fishing period (March-June) at the lake; this often makes large areas of the lake inaccessible to fishermen. The stems and leaves of the plants die during late June/early July and fall to the lake bottom, then coontail quickly replaces the curlyleaf and becomes the dominant aquatic plant during summer and fall. Coontail often becomes widespread, but does not become as densely matted as curlyleaf. At present, southern smartweed is not a problem in the lake because a severe freeze in 1989 killed most of the plants growing in shallow water areas; however, populations of southern smartweed are beginning to reestablish in these areas (Dr. Henson, pers. comm.).

According to Dr. Henson (pers. comm.), two other aquatic plants, water pennywort (*Alternanthera philoxeroides*) and Eurasian watermilfoil (*Myriophyllum spicatum*), could become pests in the future. Water pennywort has been increasing in abundance since 1986 and will probably become a pest in shallow areas of the lake. Eurasian watermilfoil is present in the watershed lakes east of Reelfoot Lake and could very possibly invade the lake itself.

Dr. William C. Zattau, Chief, Aquatic Plant Control Operations Support Center, Corps of Engineers (COE), Jacksonville, Florida, visited Reelfoot Lake at the request of the Memphis District, COE, to examine and evaluate the aquatic plant problem. In his site-investigation report (see Appendix A, Section III) Dr. Zattau recommends an integrated approach to controlling aquatic vegetation in the lake that would include water-level manipulation, mechanical control, and the use of systemic herbicides.

Under future without-project conditions, the swampbuster provision of the 1985 Food Security Act should limit the conversion of wetlands to agricultural lands. Also, the possible purchase and reforestation of cleared wetlands by Reelfoot WMA and the Reelfoot and Lake Isom NWRs could increase the amount of wetlands within the study area.

Waterfowl

According to Nichols and Hines (1987), the Southern Mississippi Flyway (i.e., Arkansas, Tennessee, Mississippi, Alabama, Louisiana) winters approximately 26-30% of the North American mallard population. Many portions of the Mississippi Delta north of the Gulf Coast are important wintering areas for mallards and wood ducks (Reinecke 1981); almost 1,500,000 mallards winter in the Mississippi Delta.

Nearly 250 species of resident and migratory bird species inhabit the study area (USFWS 1989). The Reelfoot Lake area provides important habitat for migratory and resident waterfowl. From 1992 through 1996, peak winter populations of ducks and geese have averaged approximately 132,500 and 72,600, respectively . The mallard (*Anas americana*) is the most common dabbling duck inhabiting the study area, followed by the American widgeon (*Anas americana*) and gadwall (*Anas strepera*). The ruddy duck (*Oxyura jamaicensis rubida*) and ring-necked duck (*Aythya collaris*) are the most common diving ducks. Other ducks found within the area include the black duck (*Anas rubripes*), American green-winged teal (*Anas crecca carolinensis*), blue-winged teal (*Anas discors*), wood duck (*Aix sponsa*), and northern shoveler (*Anas clypeata*). The Canada goose (*Branta canadensis*) is by far the most common goose at Reelfoot Lake.

STATE AND FEDERAL HOLDINGS

The Reelfoot Lake area contains approximately 31,256 acres of publicly owned land and water. The Reelfoot State Park, Tennessee Department of Environment and Conservation (formerly Tennessee Department of Health and Environment), owns and manages 279 acres of land; and the Tennessee Wildlife Resources Agency (TWRA) owns and manages the 18,700-acre Reelfoot

Wildlife Management Area. The U.S. Fish and Wildlife Service (USFWS) manages the 10,427-acre Reelfoot National Wildlife Refuge (NWR); the USFWS leases 7,847 acres from the State of Tennessee for the Reelfoot NWR and owns the remaining 2,580 acres (541 acres in Tennessee and 2,039 acres in Kentucky). In addition, the USFWS owns and operates the 1,850-acre Lake Isom NWR which is located approximately five miles south of Reelfoot Lake. In 1987 the new Reelfoot Lake Teaching and Researching Facility was established at the University of Tennessee at Martin. Only 40 miles from Reelfoot Lake, UT Martin is the nearest University to the lake.

ENDANGERED AND THREATENED SPECIES

The only federally listed endangered species occurring in the study area is the interior least tern (*Sterna antillarum axthalassos*). Interior least terns nest and feed primarily on the Mississippi River, but these terns occasionally feed in the open water areas of the lake. Reelfoot Lake supports one of the largest concentrations of wintering bald eagles (threatened) in the eastern United States; a peak population of 200 or more eagles is reached annually from late January through February. Bald eagles historically nested at Reelfoot Lake, but no confirmed reports of successful nests were recorded from 1962 through 1987 (Johnson et al. 1988). In an effort to reestablish a nesting population of bald eagles in the Reelfoot Lake area, a eagle hacking program was initiated in 1981 by the TWRA and the Tennessee Ornithological Society (Robert Hatcher, TWRA, pers. comm.). According to Robert Hatcher (pers. comm.), the program was terminated in 1988 after the goal of 43 successfully hacked eagles had been met. Successful nesting has been observed in the study area every year since 1988 (Robert Hatcher, pers. comm.).

The USFWS is also reviewing the status of several species in the Reelfoot Lake area to determine their candidacy for future listing as endangered species (USFWS 1989; Jodi Jenkins, USFWS, pers. comm.). These status review species consist of two mammalian species, eastern woodrat (*Neotoma floridana*) and Rafinesque's big-eared bat (*Plecotus rafinesquii*); two avian species, Bachman's sparrow (*Aimophila aestivalis*) and Bewick's wren (*Thryomanes bewickii*); one reptilian species, alligator snapping turtle (*Macrolemys temminckii*); and two plant species, smooth leafcup (*Polymnia laevigata*) and lake cress (*Armoracia lacustris*).

A Biological Assessment has not been prepared because there has been full coordination with the USFWS on this study and both agencies agree that there will be no adverse impacts to any of the listed species or their habitats.

In addition to the species listed or under status review by the USFWS, numerous plant and animal species are considered by the states of Tennessee and Kentucky to be endangered, threatened, or in need of management.

RECREATION

Outdoor recreation, both consumptive and non-consumptive, is a vital component of the local economy. An estimated $3,832,062 are expended annually on study area recreational activities. See Appendix D for the complete recreational use analysis.

Consumptive recreation accounts for approximately 72% (343,555 man-days) of the total annual recreational use. In fact, fishing is by far the single most popular recreational activity in the study area; about 322,806 man-days are annually spent fishing. Although the percentage of total recreational time expended hunting is much less than that expended fishing, hunting is considered an important outdoor sport in the study area since in accounts for about 20,749 recreational man-days annually.

Non-consumptive outdoor activities comprise approximately 28% (136,645 man-days) of the annual recreational use.

CULTURAL RESOURCES

The new Reelfoot Lake spillway and the Lake Isom Project areas have had an intensive survey conducted. There were 13 sites and eight isolated finds. All of the cultural materials were found within the Lake Isom right-of-way. The eight isolated finds are ineligible for National Register of Historic Preservation nomination and further work is not recommended. Of the thirteen sites, four have been evaluated as potentially eligible and testing is recommended. Evaluations of the remaining nine are pending the completion of analysis and data interpretation. None of the sites are within or near any proposed construction area.

The remaining project sites will be intensively surveyed during the preparation of Plans and Specifications. After the sites are located and a draft report has been written, discussions will be held with the State Historic Preservation Officer (SHPO) and other project sponsors to determine what other requirements are to be met--avoidance, testing, and/or mitigation. Coordination with the State Archeologist and other agencies has been conducted in a face-to-face meeting and over the phone

No changes to cultural resources sites within the project area are expected under future without project conditions.

Section 122 Items

The following items are not considered to be significant resources. However, legal requirements of Section 122, 1970 River and Harbors Act, Public Law 91-116, necessitate

addressing the impacts of each proposed plan upon these items. The succeeding paragraphs identify these items and briefly explain how they relate to the project-affected area.

NOISE

The study area is relatively noise free due to its rural setting. Exceptions to this are noises associated with outdoor recreation (e.g., hunting, fishing) and agricultural activities. At times, even in remote parts of the study area, noise levels may be high as a result of these activities. Under future without-project conditions, noise associated with outdoor recreational activities should decrease slightly due lake degradation and loss of open water. Agricultural noise should remain similar to existing conditions.

AIR QUALITY

The air quality in the study area for all criteria pollutants for the 1993-95 period was better than the National Ambient Air Quality Standards at all monitoring sites; with the exception of ozone, the measured concentrations were far below that allowed by the standards.

Due to its rural setting, air quality within the study area is good to above average. Temporary exceptions to this occur briefly when crop stubble is burned. Air quality is not expected to change under future without-project conditions.

AESTHETIC VALUE

The aesthetic value of the study area is closely associated with the diverse wetland communities. The area offers a variety of natural wetlands (such as forested swamps and bottomland hardwood forests), upland forests, and open water. There could be an increase in aesthetic value under future without-project conditions if cleared land is acquired and reforested as part of the expansions of the Reelfoot WMA and the Reelfoot Lake and Lake Isom NWRs.

DISPLACEMENT OF PEOPLE

Alternative plan impacts as they relate to the displacement of people are concerned with the direct and indirect consequences of plan implementation on areas of existing habitation. An example of a direct plan impact would be those persons forced to move because they inhabit lands required for project construction. An example of an indirect impact would be individuals compelled to move as a result of the decline in area recreational business and its accompanying loss of jobs as the lake degradation continues and open water is reduced. Under future without-project conditions, many of the area's residents could be displaced due to loss of jobs associated with the recreation and commercial fishing businesses.

COMMUNITY COHESION

The cultural heritage of the project area is linked directly to a rural way of life based on agriculture and the outdoor recreation business. The preservation of this lifestyle is based on the continued existence of the small farm and activities which support an agricultural based economy and the natural resources of the lake that support recreational business. Under future conditions, there will be a gradual loss of recreational business.

LOCAL GOVERNMENT FINANCE, TAX REVENUES, AND PROPERTY VALUES

The area of local government finance is concerned with items such as tax base, property values, and tax revenues. Each of these, and other items, are important because they impact the financial condition of local government units. Financial soundness is important because it often determines the level and quality of the necessary public services provided by local governments. Under future without-project conditions, there will be a significant decrease in lake shore property values and a corresponding drop in tax revenue as the lake can no longer provide a recreation resource.

DISPLACEMENT OF BUSINESSES AND FARMS

Alternative plan impacts as they relate to the displacement of businesses and farms are concerned with the direct and indirect consequences of plan implementation. An example of a direct impact will be those forced to move because they are located on land required for project construction. An example of an indirect impact will be businesses or farms compelled to leave as a result of the loss in area income as the lake degradation continues. Under future without-project conditions, many of the area's businesses could be displaced.

PUBLIC SERVICES AND FACILITIES

The area of public services and facilities is concerned with the ability of local government to provide the basic public services; e.g., education, police protection, and roads and bridges. Under future without-project conditions, the ability to provide such services will be slightly hindered. The area's tax base is expected to be decreased when the lake is severely reduced; causing a sharp drop in property values. This will cause a corresponding drop in tax revenues needed to provide these services.

COMMUNITY AND REGIONAL GROWTH

Growth in the communities within the project area is directly related to agriculture and recreation related businesses. Recreational business is expected to decrease significantly under future without-project conditions.

EMPLOYMENT

The area's employment is concentrated in commercial fishing, recreation, and agriculture. Under future without-project conditions, there will be a significant decrease in recreation related employment as a result of the decline in lake conditions.

ENVIRONMENTAL CONSEQUENCES

This section describes the effects of each detailed plan on the previously discussed significant resources and serves as the source of information for Table 19, Comparative Impacts of Alternatives, in Section 4. It is important to note that the dynamic nature of the study area and necessity of long-range projections made quantitative assessment of project impacts difficult, often impossible. In cases where impacts could not be assessed quantitatively, qualitative assessments were made based on available information and professional judgement.

All adverse environmental impacts associated with project implementation will be of a temporary nature. Examples include construction impacts and those associated with a periodic drawdown. Specific impacts are discussed throughout the following section for each respective resource and alternative plan. They are also described in detail in Appendix A, Sections II and IV.

Reelfoot Lake is presently utilized for commercial fishing as well as consumptive and non-consumptive recreation. As the lake continues to experience long term degradation; these uses will gradually diminish each year. Project implementation will not rectify previous environmental losses. However, the various features will prolong the 'life' of the lake for hundreds of years. These benefits are discussed in detail throughout the following section. If the selected plan is implemented; irretrievable ecosystem losses will be prevented.

Significant Resources

AQUATIC RESOURCES

Alternative Plan 1a

Since this plan incorporates the same water level management as the Future W/O Project plan; there will be essentially no change in the aquatic resources as they relate to water management. The new spillway will provide more efficient operation; but this will not affect aquatic resources. Sediment inflows will continue. As much as 249,000 tons of sediment enter the lake annually from Bayou du Chien, Reelfoot Creek, and Indian Creek. The Upper Blue Basin is currently experiencing the fastest rate of sediment deposition, followed by Buck Basin, then Blue Basin. The average depth of Buck Basin is presently being reduced at the rate of .43 inch per year. The Upper Blue Basin

average depth is being reduced at the rate of .75 inch per year. The average depth of the lake in modern historic conditions was 9.6 feet with some basins having a depth of 17.1 feet. The average lake depth has decreased to 6.8 feet, a decrease of 29%. As the average depth decreases, the acreage of lake bottom within the photic zone increases, creating a situation favorable for the spread of aquatic macrophytes. Emergent persistant vegetation continues to invade what has historically been open water habitat. The open water of the lake is expected to decrease by 38% or 3,900 acres within approximately 50 years. Decreased species diversity among aquatic animals, both vertebrate and invertebrate, also indicates altered habitat. Furthermore, as these plants die and fall to the bottom, they form layers of soft sediment composed primarily of undecomposed organic materials. Aerobic decomposition of this material adds to the lake's already high biological oxygen demand, particularly near the bottom of the water column.

Construction of the new spillway will temporarily increase turbidity levels in approximately 1/4 acre of water along the south shore at the new spillway site. Construction impacts and habitat losses are discussed in detail in Appendix A; Section IV, Section 404B, 1 Evaluation and Section II, Habitat Gains and Losses.

Alternative Plan 2a

Since this plan incorporates the same water level management as the Future W/O Project plan; there will be essentially no change in the aquatic resources as they relate to water management. The new spillway will provide more efficient operation; but this will not affect aquatic resources. Sediment inflows will continue. As much as 249,000 tons of sediment enter the lake annually from Bayou du Chien, Reelfoot Creek, and Indian Creek. The Upper Blue Basin is currently experiencing the fastest rate of sediment deposition, followed by Buck Basin, then Blue Basin. The average depth of Buck Basin is presently being reduced at the rate of .43 inch per year. The Upper Blue Basin average depth is being reduced at the rate of .75 inch per year. The average depth of the lake in modern historic conditions was 9.6 feet with some basins having a depth of 17.1 feet. The average lake depth has decreased to 6.8 feet, a decrease of 29%. As the average depth decreases, the acreage of lake bottom within the photic zone increases, creating a situation favorable for the spread of aquatic macrophytes. Emergent persistent vegetation continues to invade what has historically been open water habitat. The open water of the lake is expected to decrease by 38% or 3,900 acres within approximately 50 years. Decreased species diversity among aquatic animals, both vertebrate and invertebrate, also indicates altered habitat. Furthermore, as these plants die and fall to the bottom, they form layers of soft sediment composed primarily of undecomposed organic materials. Aerobic decomposition of this material adds to the lake's already high biological oxygen demand, particularly near the bottom of the water column.

During the summer of 1994, employees of the Tennessee Wildlife Resources Agency (TWRA) cleaned out Donaldson, Green Island, and Willow Bar Ditches with a rented amphibious excavator, under the auspices of a Section 404 Permit granted by the Memphis District, Corps of engineers. This permit was fully endorsed by the Tennessee Department of Environment and Conservation, the Environmental Protection Agency, and the U. S. Fish and Wildlife Service. Since that operation,

TWRA personnel have observed a substantial increase in circulation in the ditches (and consequently between basins) even during static water levels since the channel clean-out. The 3.2 miles of channel excavation include two 500' channels that will be linked to two separate existing boat ramps so as to provide boat access for university, state and federal agency monitoring during drawdown periods.

There will obviously be a temporary disturbance, especially to turbidity levels while the channels are being dredged. Since there are some concerns about possible high mercury levels in bottom sediment; sediment analysis has been conducted. Eight sediment samples were taken at five different proposed construction sites during June, 1999. Samples were then analyzed at A & L Laboratories, Memphis, Tennessee. Samples were tested for Arsenic, Chromium, Mercury, and Zinc. All metals at all five sites tested well below the 'Effects Range-Low' (ER-L) benchmark and the mean concentrations for metals in the earth's crust. The laboratory analysis report is included in Appendix A. Section IV. Any contaminated areas will be avoided. Specific impacts are also discussed in Appendix A, Section IV, Section 404 (B)(1) Evaluation.

There will be a slight improvement to aquatic resources with Plan 2a because the addition of circulation channels will greatly improve water movement within the lake, especially during slight rises and falls. These slight changes in flow patterns will improve food transport, water temperature and dissolved oxygen levels. Although an aquatic HEP or aquatic HES was not conducted, it is estimated that approximately 130 AHUVs will result from the improved water circulation associated with the new circulation channels. See Section I, Habitat Evaluation System Analysis, of Appendix A - Environmental.

Alternative Plan 2b

This plan will provide the greatest aquatic resource benefits of all of the alternative plans from a water management standpoint. In addition to those benefits described above in Plan 2a; this plan will provide annual dynamic lake fluctuation that will greatly improve feeding and rearing conditions and a periodic major drawdown that will consolidate bottom substrate that will, in turn, provide much improved spawning areas.

It is important to note here that this water level management proposal is the same as Alternative 6 - Integrated Program of Dynamic Water Level Fluctuation Combined with Periodic Major Drawdown, which is the preferred alternative described in the USFWS *Reelfoot Lake Water Level Management Environmental Impact Statement (EIS)*. Authority for implementation of the plan was granted by the Record of Decision (ROD) dated 25 September 1989. The ROD further states that implementation of the preferred alternative is subject to resolution of the following prerequisites: 1. Completion of archeological clearances. 2. Land acquisition or attainment of flowage easements up to 285' m.s.l. 3. Flood protection for recreation facilities. 4. Repair of sewage systems (complete). 5. Mitigation of bottomland hardwood losses due to higher water levels (complete). 6. Major fish kills associated with a drawdown. 7. Tourism impacts associated with a drawdown.

The "preferred plan" is the result of a detailed evaluation of water level management options

by an interdisciplinary panel of experts who participated in a workshop August 24 - 29, 1986. Proceeds of the workshop were published in a report titled *Water Management Alternatives at Reelfoot Lake: Results of a Workshop* (December, 1986). This report is included, as Appendix B, in the approved *USFWS Reelfoot Lake Water Level Management Environmental Impact Statement* (EIS). The executive summary of the workshop results is included in Section X of Appendix A - Environmental. The workshop panel evaluated numerous water management options, then submitted six water level management alternatives that were included in the above EIS. As stated above, Alternative six was recommended as the "preferred plan".

Although an aquatic HEP or aquatic HES was not conducted, it is estimated that approximately 4,946 aquatic AHUVs would result from implementation of the "preferred plan" as described above. See Section I, Habitat Evaluation System Analysis, of Appendix A - Environmental for more details.

The purpose of a major periodic drawdown is to encourage the decomposition of organic material in the lake bottom's soft sediments. Periodic drawdowns are a standard practice in lake fishery management and are designed to approximate the natural conditions experienced during a severe drought. Current plans call for the drawdown to begin on June 1 and have the lake lowered four feet by July 15. Following a 120 day drying period, the lake would then be filled to a level one foot above full pool and held at that level until the following June, then returned to the normal elevation. It is anticipated that a drawdown will be needed every 5 - 10 years. During the drawdown and immediately afterwards, the aquatic environment will receive a significant ecological shock resulting from insufficient water, poor water quality, and temporary nutrient surges. Over the long term the drawdown management practice will slow the eutrophication process by causing physical and chemical aquatic habitat improvements. The physical habitat changes expected include changes in substrate composition and aquatic macrophyte populations. This alternative will promote the oxidation of organic material contained in the soft sediments exposed during the drawdown. A four foot drawdown will expose approximately 5,000 acres of lake substrate to drying.

Aquatic invertebrates will respond to the habitat changes induced by this alternative. During this drawdown, the drying action will destroy a significant portion of Reelfoot benthic populations. However, recolonization should occur rapidly after refilling. The reduction in the biological demand near the bottom of the lake should help establish a population more indicative of improved water quality and habitat conditions. Slight improvements in water quality conditions, particularly oxygen availability and reduction in blue-green algae blooms, should also enhance conditions for zooplankton populations.

The drawdown will have varying impacts on the fishery of Reelfoot Lake. As water levels begin to fall during the drawdown, fish populations will become stressed. Fish will gather in portions of the lake and smaller fish will become more susceptible to predation. Many fish will become isolated in shallow pools and will most likely die as the oxygen is depleted. Also, fish kills in the deeper pools will be likely, but not to the extent of eliminating the total lake fishery. As the lake refills, the surviving fishery should realize habitat conditions more favorable than those existing prior to the drawdown. The greatest benefit of a drawdown will be the creation of readily available breeding

habitat for those species that require spawning beds.

Alternative Plan 2c

If benefits to aquatic resources were to be ranked; Plan 2c would fall between Plan 2a and Plan 2b because the major periodic drawdown benefits would be the same as those of 2b. However, 2c would not experience the aquatic benefits of the dynamic water level fluctuation. Although an aquatic HEP or aquatic HES was not conducted, it is estimated that approximately 130 aquatic AHUVs would be derived from the improved water circulation that results from placement of the circulation channels. In addition, approximately 3,090 AHUVs would result from implementation of a major periodic drawdown.

The purpose of a major periodic drawdown is to encourage the decomposition of organic material in the lake bottom. Periodic drawdowns are a standard practice in lake fishery management and are designed to approximate the natural conditions experienced during a severe drought. Current plans call for the drawdown to begin on June 1 and have the lake lowered four feet by July 15. Following a 120 day drying period, the lake would then be filled to a level one foot above full pool and held at that level until the following June, then returned to the normal elevation. It is anticipated that a drawdown will be needed every 5 - 10 years. During the drawdown and immediately afterwards, the aquatic environment will receive a significant ecological shock resulting from insufficient water, poor water quality, and temporary nutrient surges. Over the long term the drawdown management practice will slow the eutrophication process by causing physical and chemical aquatic habitat improvements. The physical habitat changes expected include changes in substrate composition and aquatic macrophyte populations. This alternative will promote the oxidation of organic material contained in the soft sediments exposed during the drawdown. A four foot drawdown will expose approximately 5,000 acres of lake substrate to drying.

Aquatic invertebrates will respond to the habitat changes induced by this alternative. During this drawdown, the drying action will destroy a significant portion of Reelfoot benthic populations. However, recolonization should occur rapidly after refilling. The reduction in the biological demand near the bottom of the lake should help establish a population more indicative of improved water quality and habitat conditions. Slight improvements in water quality conditions, particularly oxygen availability and reduction in blue-green algae blooms, should also enhance conditions for zooplankton populations.

The drawdown will have varying impacts on the fishery of Reelfoot Lake. As water levels begin to fall during the drawdown, fish populations will become stressed. Fish will gather in portions of the lake and smaller fish will become more susceptible to predation. Many fish will become isolated in shallow pools and will most likely die as the oxygen is depleted. Also, fish kills in the deeper pools will be likely, but not to the extent of eliminating the total lake fishery. As the lake refills, the surviving fishery should realize habitat conditions more favorable than those existing prior to the drawdown. The greatest benefit of a drawdown will be the creation of readily available breeding habitat for those species that require spawning beds.

Alternative Plan 3a

Negative impacts and habitat restoration values for this alternative will be the same as those for Alternative Plan 2a with the exception of those impacts, negative and positive, associated with the construction and operation of the new sediment basin on Reelfoot Creek. Addition of the new sediment basin will greatly improve water quality in terms of turbidity levels and restricted loss of depth. Most of the aquatic benefits will be confined to the Buck Basin area of the lake. The new sediment basin will intercept approximately 70 percent of the sediment inflows of Reelfoot Creek. This also equates to a total future- W/O- project loss of Buck basin in approximately 150 years and a depth loss of 1.8 feet during the fifty (50) year project life. Approximately 1,186 aquatic AHUVs will be derived from sediment interception by the new sediment basin.

Excavation of approximately 424,833 cubic yards of fill material for sediment dam construction will result in the creation of a 57 acre borrow pit that has been designed so as to provide fishery, waterfowl, and shorebird habitat. It is estimated that the borrow pit will function for at least 30 years of the total project life of 50 years. Approximately 85 AHUVs will be provided by this multipurpose borrow area.

An account of habitat units is found in Section II, Habitat Gains and Losses, and Section I, Habitat Evaluation System Analysis, of Appendix A - Environmental. Also, construction impacts associated with deposition of material in wetlands are fully addressed in Section IV, Section 404 (B) (1) Evaluation, of Appendix A - Environmental.

Alternative 3b

Negative impacts and habitat restoration values for this alternative will be the same as those for Alternative 2b combined with those impacts and habitat restoration values associated with the construction and operation of the sediment basin as described above.

Alternative 3c

Negative impacts and habitat restoration values for this alternative will be the same as those for Alternative 2c combined with those impacts and habitat restoration values associated with the construction and operation of the sediment basin as described above.

Alternative 4a

Negative impacts and habitat restoration values for this alternative will be the same as those for Alternative 3a combined with those impacts and habitat restoration values associated with the construction and operation of the Shelby Lake/Waterfowl Management Area. Shelby Lake was once a natural 170 acre oxbow lake surrounded by cypress trees and replenished by flood waters from Reelfoot Lake and the Mississippi River prior to the construction of the Mississippi River levees, the Reelfoot Spillway, and Highway 21. The lake will be restored to an approximation of a typical

"bell shaped oxbow bottom configuration with depths of one to six feet. A stop log structure at the lower end of the lake coupled with controlled water intake from Reelfoot Lake at the north end will provide precise water level management capability. The various bottom depths of the design and the water level control capability combine to provide excellent fishery, waterfowl, and shorebird habitat. This 170 acre lake will provide an estimated 105 aquatic AHUVs. In addition, wells at the upper end of waterfowl unit A, will provide cool, silt free water for the waterfowl management units that will eventually flow into Running Reelfoot Bayou. Benefits for this item were not calculated.

An account of habitat units is found in Section II, Habitat Gains and Losses, and Section I, Habitat Evaluation System Analysis, of Appendix A - Environmental. Also, construction impacts associated with deposition of material in wetlands are fully addressed in Section IV, Section 404 (B) (1) Evaluation, of Appendix A - Environmental.

Alternative 4b

Negative impacts and habitat restoration values for this alternative will be the same as those for Alternative 3b combined with those impacts and habitat restoration values associated with the construction and operation of Shelby Lake as described above.

Alternative 5a

Negative impacts and habitat restoration values for this alternative will be the same as those for Alternative 4a combined with those impacts and habitat restoration values associated with the construction and operation of a new control structure at the Lake Isom National Wildlife Refuge. The primary purposes of the Lake Isom feature are to restore hydrology to the wetland complex at Lake Isom. However, higher water levels, the introduction of well water, and improved water level management capability will obviously enhance the aquatic resources. The proposed water level management plan for Lake Isom with the new structure will raise the lake level 18 inches between October 15 and March 1. This equates to an additional 510 acres of surface water, most of which will be suitable for spawning habitat. Habitat types inundated by this additional 18" of water are as follows:

Bottomland Hardwoods	152 acres	Forested Swamp	25 acres
Open Water	6 acres	Scrub/shrub Swamp	5 acres
Cropland or moist soil	322 acres		

Also, since well water will sometimes be pumped into the area whenever rainfall is insufficient for raising water levels; water quality of the refuge will be improved by the input of sediment free and relatively cooler well water. In addition, the borrow pit that will be excavated for the earthen dam enlargement will be specifically designed so as to provide aquatic benefits. The borrow pit will have varied depths and an irregular shape. It will provide approximately 1.5 acres of open water habitat at a pool elevation of 280.0' because it will be connected to Isom Creek by a short ditch. The average depth of the pit will be 3 feet.

An account of habitat units is found in Section II, Habitat Gains and Losses, and Section I, Habitat Evaluation System Analysis, of Appendix A - Environmental. Also, construction impacts associated with deposition of material in wetlands are fully addressed in Section IV, Section 404 (B) (1) Evaluation, of Appendix A - Environmental.

Alternative 5b

Negative impacts and habitat restoration values for this alternative will be the same as those for Alternative 4b combined with those impacts and habitat restoration values associated with the construction and operation of the new Lake Isom control structure as described above.

Alternative 5c

Negative impacts and habitat restoration values for this alternative will be the same as those for Alternative 4c combined with those impacts and habitat restoration values associated with the construction and operation of the new Lake Isom control structure as described above.

BOTTOMLAND HARDWOOD FOREST

Alternative 1a

Approximately 30 acres of bottomland hardwoods and 6 acres of forested swamp would be permanently removed by construction of the alternative spillway. This equates to a permanent loss of 19.7 AHUVs. However, an additional right-of-way will be acquired for the new outlet channel. This 115 acres of cleared agricultural wetlands would be acquired and planted in bottomland hardwood trees as a hardwood restoration feature. This stand of regenerating bottomland hardwoods will produce 63 AHUVs.

An account of habitat units is found in Section II, Habitat Gains and Losses, and Section I, Habitat Evaluation System Analysis, of Appendix A - Environmental. Also, construction impacts associated with deposition of material in wetlands are fully addressed in Section IV, Section 404 (B) (1) Evaluation, of Appendix A - Environmental.

Alternative 2a

Circulation channel construction impacts to hardwoods will be minor because most of the excavation activity will be within existing channels. Project impacts associated with dredging of approximately 3 miles of circulation channels would consist of excavation of 62,555 cubic yards of material, most of which will be under water, and the deposition of this material in bottomland hardwood/wooded swamp/marsh wetlands adjacent to the existing channels. Clearing of bottomland hardwoods or wooded swamp would be minimal and limited to cutting of occasional trees for

equipment operation. Approximately 2 acres of wetlands will be filled as a result of these deposition activities.

An account of habitat units is found in Section II, Habitat Gains and Losses, and Section I, Habitat Evaluation System Analysis, of Appendix A - Environmental. Also, construction impacts associated with deposition of material in wetlands are fully addressed in Section IV, Section 404 (B) (1) Evaluation, of Appendix A - Environmental.

Impacts, positive and negative, associated with the new spillway and outlet channel will be same as above.

Alternative 2b

Impacts, positive and negative, associated with the new spillway and outlet channel will be same as above. In addition, water level management will restore hydrology to approximately 800 acres of bottomland hardwoods between the elevations 283.0 and 284.0 feet M.S.L. Under future -with-project conditions, seasonal raising of water levels will increase HQI values from 0.62 to 0.92. This will provide a net gain of approximately 56 AHUVs.

As a part of this feasibility study, a contract was issued to the University of Memphis, Biology Department to assist in the determination of vegetative impacts that would be associated with water level management proposals at Reelfoot Lake. Dr. Reza Pezeshki and three graduate students conducted a literature search and established wetland test plots in order to help predict impacts to the vegetative communities of Reelfoot Lake. The following summary is taken from Dr. Pezeshki's report which is entitled *Vegetation Impact Analysis of Reelfoot Lake, August, 1998.* The report is found in Section V, Part A, Vegetation Impact Analysis of Appendix A - Environmental.

Conclusions

"There is more than sufficient literature to support the hypothesis that various plant physiological functions are influenced by low soil redox potential conditions that result from stagnant and stable water levels. The extent of the impact is dependent on many factors including the species, timing, duration of soil reduction, and intensity of soil reduction. Low soil redox potential is a major factor in wetland ecosystems that influences not only plant survival and growth but also community development. In addition, plant response to low soil redox potential conditions also reflects a species ability to respond to such conditions by utilizing a variety of internal defense mechanisms. Nevertheless, many bottomland species, including those that are considered to be highly flood-tolerant, are impacted by reduced soil conditions. Such responses are indicative of the fact that the reducing soil conditions encompass not only soil oxygen deprivation but also the production of various phytotoxins. The impact of such conditions on plant species varies from temporary disruption of physiological processes and growth to serious damage to plant tissue and death. The reduced soil conditions substantially influence various critical plant processes including water relations, gas exchange, photosynthate partitioning, hormone balance, growth, nutrition, and biomass

production. The impact is more likely to affect seedlings and young saplings than mature trees. Saplings and trees with well-developed root systems are better equipped to endure reduced soil conditions than are young seedlings. Reelfoot Lake's current stable water level promotes reducing sediment conditions. Thus if no action is taken to remedy the reduced soil conditions at Reelfoot Lake, individual plants as well as plant communities may suffer both detrimental and irreversible effects.

From the literature it may be ascertained that lake water level drawdowns and manipulation are not only useful management techniques but may also be necessary in order to slow the effects of hypereutrophication on impounded lake systems. Drawdowns have been shown to compact and solidify loose sediment and organic matter, increase dissolved oxygen concentrations, improve water quality and nutrient availability, and increase biodiversity among plants and animals. Restoring the lake's hydrologic cycle by manipulating water level fluctuations has also been documented as to improving plant and animal communities. Such manipulation may even cause a shift in macrophytic vegetation communities from unwanted species to more desirable ones, thereby protecting navigation and recreation by controlling the invasion of certain pest species into open water.

Reelfoot Lake is a unique resource within the region and is of great economic and environmental importance. It provides commercial fishing (as well as superb sportfishing), multiple habitats for numerous species of which some are endangered, and an unlimited wealth of natural and cultural history. Reelfoot Lake is unique in itself, luring many tourists from across the nation to come and view its natural beauty. Such a resource should be preserved for the benefit of future generations. Preservation of the lake as a natural resource can only be accomplished through biologically sound management practices. The preferred management practice proposed by the USFWS includes a periodic major drawdown followed by yearly fluctuations in water elevation. Based on the limited amount of published scientific information on this practice, the proposed drawdown appears to be viable solution to the known biological problems at Reelfoot Lake.

An account of habitat units is found in Section II, Habitat Gains and Losses, and Section I, Habitat Evaluation System Analysis, of Appendix A - Environmental. Also, construction impacts associated with deposition of material in wetlands are fully addressed in Section IV, Section 404 (B) (1) Evaluation, of Appendix A - Environmental.

Alternative 2c

The major periodic drawdown will only have temporary impacts to bottomland hardwoods because it will occur only once in 5 to 10 years. Soils of the bottomland hardwood community will still remain saturated during the drawdown of 120 days. See the University of Memphis report summary in Alternative 2b above.

An account of habitat units is found in Section II, Habitat Gains and Losses, and Section I, Habitat Evaluation System Analysis, of Appendix A - Environmental.

Alternative 3a

Same as Plan 2a, except that additional hardwood benefits will be provided in two categories by construction of the proposed sediment basin on Reelfoot Creek. Future intercepted sediment will protect approximately 600 acres of bottomland hardwoods in the Grassy Island area. This amounts to a gain of approximately 324 AHUVs and a net gain of 90 AHUVs. In addition, 247 acres of trees will be planted within the flood zone of the sediment dam. These regenerating hardwoods will provide approximately a net gain of 87 AHUVs.

An account of habitat units is found in Section II, Habitat Gains and Losses, and Section I, Habitat Evaluation System Analysis, of Appendix A - Environmental. Also, construction impacts associated with deposition of material in wetlands are fully addressed in Section IV, Section 404 (B) (1) Evaluation, of Appendix A - Environmental.

Alternative 3b

Negative impacts and habitat restoration values for this alternative will be the same as those for Alternative 2b combined with those impacts and habitat restoration values associated with the construction and operation of the new sediment basin as described above.

An account of habitat units is found in Section II, Habitat Gains and Losses, and Section I, Habitat Evaluation System Analysis, of Appendix A - Environmental. Also, construction impacts associated with deposition of material in wetlands are fully addressed in Section IV, Section 404 (B) (1) Evaluation, of Appendix A - Environmental.

Alternative 3c

Negative impacts and habitat restoration values for this alternative will be the same as those for Alternative 2c combined with those impacts and habitat restoration values associated with the construction and operation of the new sediment basin as described above.

An account of habitat units is found in Section II, Habitat Gains and Losses, and Section I, Habitat Evaluation System Analysis, of Appendix A - Environmental. Also, construction impacts associated with deposition of material in wetlands are fully addressed in Section IV, Section 404 (B) (1) Evaluation, of Appendix A - Environmental.

Alternative 4a

Negative impacts and habitat restoration values for this alternative will be the same as those for Alternative 3a combined with those impacts and habitat restoration values associated with the construction and operation of the new Shelby Lake/Waterfowl Management Area. Project construction at the Shelby Lake area would include the planting of approximately 282 acres with bottomland hardwood seedlings. This feature will produce a net gain of 105 AHUVs.

An account of habitat units is found in Section II, Habitat Gains and Losses, and Section I, Habitat Evaluation System Analysis, of Appendix A - Environmental. Also, construction impacts associated with deposition of material in wetlands are fully addressed in Section IV, Section 404 (B) (1) Evaluation, of Appendix A - Environmental.

Alternative 4b

Negative impacts and habitat restoration values for this alternative will be the same as those for Alternative 3b combined with those impacts and habitat restoration values associated with the construction and operation of the new Shelby Lake/Waterfowl Management Area.

An account of habitat units is found in Section II, Habitat Gains and Losses, and Section I, Habitat Evaluation System Analysis, of Appendix A - Environmental. Also, construction impacts associated with deposition of material in wetlands are fully addressed in Section IV, Section 404 (B) (1) Evaluation, of Appendix A - Environmental.

Alternative 4c

Negative impacts and habitat restoration values for this alternative will be the same as those for Alternative 3c combined with those impacts and habitat restoration values associated with the construction and operation of the new Shelby Lake/Waterfowl Management Area.

An account of habitat units is found in Section II, Habitat Gains and Losses, and Section I, Habitat Evaluation System Analysis, of Appendix A - Environmental. Also, construction impacts associated with deposition of material in wetlands are fully addressed in Section IV, Section 404 (B) (1) Evaluation, of Appendix A - Environmental.

Alternative 5a

Negative impacts and habitat restoration values for this alternative will be the same as those for Alternative 4a combined with those impacts and habitat restoration values associated with the construction and operation of the new Lake Isom control structure. Future-without-project values for the Lake Isom NWR reflect continued stand deterioration and conversion to drier site species associations due to long term drying. Lack of hydrologic recharge is occuring due to channelization, levee construction, Reelfoot Dam, and construction of Highway 21. The area is also silting in as a result of sediment transfer from adjacent agricultural lands. Future-with-project conditions reflect restoration of wetland communities as a result of control structure renovation and installation of new water well/pumps that will raise seasonal water levels by as much as 2 feet. Hydrologic restoration will produce a net gain of 90 AHUVs.

As a part of this feasibility study, a contract was issued to the University of Memphis, Biology Department to assist in the determination of vegetative impacts that would be associated with water

level management proposals at Lake Isom. Dr. Reza Pezeshki and three graduate students conducted a literature search and established wetland test plots in order to help predict impacts to the vegetative communities of Lake Isom NWR. The following summary is taken from Dr. Pezeshki's report which is entitled *Vegetation Impact Analysis of Lake Isom, August, 1998.* The report is found in Section V, Part B, Vegetation Impact Analysis of Appendix A - Environmental.

Conclusions

"Limited case studies in other U.S. regions including Florida suggest that restoring a lake's hydrologic cycle by manipulating water level fluctuations may improve plant and animal communities. Such manipulation may even create a shift in macrophytic vegetation communities from unwanted species to more desirable ones, thereby protecting navigation and recreation by controlling the invasion of certain pest species into open water. It has also been shown that greentree reservoir techniques have increased and improved waterfowl habitat, yet such practices are still controversial since shifts in plant communities may occur due to prolonged flooding. Any changes in plant community structure would also affect wildlife communities living in that environment.

Preservation of Lake Isom as a natural resource can only be accomplished through biologically sound management practices which may include the proposed water level management. Due to the unique, modern nature of the proposed management practices, little scientific literature was available that compared the response of plants to pre-practice and post-practice environmental conditions. Conclusions drawn from this report must be considered in light of this lack of data. An effort was made to limit the case studies used within this report to areas located in the southeastern United States when possible. However, it is imperative to note that most case studies cited are not located within the vicinity of Lake Isom, and thus the vegetation communities in Lake Isom may respond differently to the proposed water level manipulations than those observed elsewhere.

The existing, almost static water levels of Lake Isom, promotes anaerobic conditions in the water and bottom sediments. Such anaerobic conditions result in reducing soil conditions characterized by low soil Eh. There is more than sufficient literature to support the hypothesis that various plant functions are influenced by low soil Eh conditions. The extent of the impact is dependent on many factors including the species, timing, duration of soil reduction, and intensity of soil reduction. Low soil Eh is a major factor in wetland ecosystems that influences not only plant survival and growth but also community development. In addition, plant response to low soil Eh conditions also reflects a species ability to respond to such conditions by utilizing a variety of internal defense mechanisms. Nevertheless, many wetland species, including those that are considered to be highly flood-tolerant, are impacted by reduced soil conditions.

The reduced soil conditions substantially influence various critical plant processes including water relations, gas exchange, photosynthate partitioning, hormone balance, growth, nutrition, and biomass production. The impact is more likely to affect seedlings and young saplings than mature trees. If no action is taken to remedy the reduced soil conditions at Lake Isom, individual plants as well as plant communities may suffer both detrimental and irreversible effects.

The proposed water level manipulation plan may help improve sediment and water aeration status particularly for the bottom sediments located in shallow area as well as sediments located along the lake's fringe. However, monitoring plans should be implemented to assess the present sediment conditions, plant, and wildlife communities and to monitor any changes that may occur as a result of induced water level fluctuations throughout the implementation of the plan.

An account of habitat units is found in Section II, Habitat Gains and Losses, and Section I, Habitat Evaluation System Analysis, of Appendix A - Environmental. Also, construction impacts associated with deposition of material in wetlands are fully addressed in Section IV, Section 404 (B) (1) Evaluation, of Appendix A - Environmental.

Alternative 5b

Negative impacts and habitat restoration values for this alternative will be the same as those for Alternative 4b combined with those impacts and habitat restoration values associated with the construction and operation of the new Lake Isom control structure.

Alternative 5c

Negative impacts and habitat restoration values for this alternative will be the same as those for Alternative 4c combined with those impacts and habitat restoration values associated with the construction and operation of the new Lake Isom control structure.

WETLANDS

Alternative Plan 1a

Project construction of the new spillway will eliminate six acres of forested swamp. Approximately 115 acres of prior converted farmland will be planted in bottomland hardwoods. Also, approximately 5 acres of open water and 10 acres of riparian habitat will result from construction of the new outlet channel. Other than that, there will be very little change from the future W/O project conditions.

An account of habitat units is found in Section II, Habitat Gains and Losses, and Section I, Habitat Evaluation System Analysis, of Appendix A - Environmental. Also, construction impacts associated with deposition of material in wetlands are fully addressed in Section IV, Section 404 (B) (1) Evaluation, of Appendix A - Environmental.

Alternative Plan 2a

The only additional change to Plan 1a is that temporary impacts will be associated with the dredging of approximately 12 acres of circulation channels. Approximately 4 acres of these channels will be converted from marsh to open water.

An account of habitat units is found in Section II, Habitat Gains and Losses, and Section I, Habitat Evaluation System Analysis, of Appendix A - Environmental. Also, construction impacts

associated with deposition of material in wetlands are fully addressed in Section IV, Section 404 (B) (1) Evaluation, of Appendix A - Environmental.

Alternative Plan 2b

Initially, there will be very little perceptable change as this alternative water management plan is implemented. However, after several years of annual fluctuation and periodic drawdowns, the vegetative encroachment upon open water will stabilize.

See the previously referenced report *Vegetation Impact Analysis of Reelfoot Lake* located in Section V, Part A of Appendix A - Environmental.

An account of habitat units is found in Section II, Habitat Gains and Losses, and Section I, Habitat Evaluation System Analysis, of Appendix A - Environmental. Also, construction impacts associated with deposition of material in wetlands are fully addressed in Section IV, Section 404 (B) (1) Evaluation, of Appendix A - Environmental.

Alternative Plan 2c

Initially, there will be very little perceptable change as this alternative water management plan is implemented. However, after several years of periodic ~~drawdowns, the vegetative encroachment~~ upon open water will stabilize.

See the previously referenced report *Vegetation Impact Analysis of Reelfoot Lake* located in Section V, Part A of Appendix A - Environmental.

An account of habitat units is found in Section II, Habitat Gains and Losses, and Section I, Habitat Evaluation System Analysis, of Appendix A - Environmental. Also, construction impacts associated with deposition of material in wetlands are fully addressed in Section IV, Section 404 (B) (1) Evaluation, of Appendix A - Environmental.

Alternative Plan 3a

Same as Plan 2a plus sediment degradation of 600 acres of bottomland hardwoods will cease and the predicted vegetative encroachment on 1,000 acres of open water in Buck Basin will be prevented. In addition, approximately 650 acres of prior converted farmland in the pool area of Reelfoot Creek above and below the sediment dam will be converted to various wetland types in the form of waterfowl areas, reforestation of bottomland hardwoods, and borrow pit wetlands. These borrow areas will be designed to provide 51 acres of freshwater marsh that will yield a net gain of 15 AHUVs.

An account of habitat units is found in Section II, Habitat Gains and Losses, and Section I, Habitat Evaluation System Analysis, of Appendix A - Environmental. Also, construction impacts

associated with deposition of material in wetlands are fully addressed in Section IV, Section 404 (B) (1) Evaluation, of Appendix A - Environmental.

Alternatives 3b

Negative impacts and habitat restoration values for this alternative will be the same as those for Alternative 2b combined with those impacts and habitat restoration values associated with the construction and operation of the new Sediment Detention Basin.

An account of habitat units is found in Section II, Habitat Gains and Losses, and Section I, Habitat Evaluation System Analysis, of Appendix A - Environmental. Also, construction impacts associated with deposition of material in wetlands are fully addressed in Section IV, Section 404 (B) (1) Evaluation, of Appendix A - Environmental.

Alternative 3c

Negative impacts and habitat restoration values for this alternative will be the same as those for Alternative 2c combined with those impacts and habitat restoration values associated with the construction and operation of the new Sediment Detention Basin.

An account of habitat units is found in Section II, Habitat Gains and Losses, and Section I, Habitat Evaluation System Analysis, of Appendix A - Environmental. Also, construction impacts associated with deposition of material in wetlands are fully addressed in Section IV, Section 404 (B) (1) Evaluation, of Appendix A - Environmental.

Alternative 4a

Negative impacts and habitat restoration values for this alternative will be the same as those for Alternative 3a combined with those impacts and habitat restoration values associated with the construction and operation of the new Shelby Lake/Waterfowl Management Area. This feature will contribute approximately 900 acres of various wetland habitat types including: marsh, open water, bottomland hardwoods, and moist soil units. This area will produce approximately a net gain of 296 AHUVs.

An account of habitat units is found in Section II, Habitat Gains and Losses, and Section I, Habitat Evaluation System Analysis, of Appendix A - Environmental. Also, construction impacts associated with deposition of material in wetlands are fully addressed in Section IV, Section 404 (B) (1) Evaluation, of Appendix A - Environmental.

Alternative 4b

Negative impacts and habitat restoration values for this alternative will be the same as those for Alternative 3b combined with those impacts and habitat restoration values associated with the construction and operation of the new Shelby Lake/Waterfowl Management Area.

An account of habitat units is found in Section II, Habitat Gains and Losses, and Section I, Habitat Evaluation System Analysis, of Appendix A - Environmental. Also, construction impacts associated with deposition of material in wetlands are fully addressed in Section IV, Section 404 (B) (1) Evaluation, of Appendix A - Environmental.

Alternative 4c

Negative impacts and habitat restoration values for this alternative will be the same as those for Alternative 3c combined with those impacts and habitat restoration values associated with the construction and operation of the new Shelby Lake/Waterfowl Management Area.

An account of habitat units is found in Section II, Habitat Gains and Losses, and Section I, Habitat Evaluation System Analysis, of Appendix A - Environmental. Also, construction impacts associated with deposition of material in wetlands are fully addressed in Section IV, Section 404 (B) (1) Evaluation, of Appendix A - Environmental.

Alternative 5a

Negative impacts and habitat restoration values for this alternative will be the same as those for Alternative 4a combined with those impacts and habitat restoration values associated with the construction and operation of the Lake Isom Restoration. Higher seasonal water levels will restore hydrology to the existing wetland complex and inundate an additional 510 acres with an increased water level of two feet. This action will produce approximately 179 additional AHUVs. See the previously referenced report *Vegetation Impact Analysis of Lake Isom* located in Section V, Part B of Appendix A - Environmental.

An account of habitat units is found in Section II, Habitat Gains and Losses, and Section I, Habitat Evaluation System Analysis, of Appendix A - Environmental. Also, construction impacts associated with deposition of material in wetlands are fully addressed in Section IV, Section 404 (B) (1) Evaluation, of Appendix A - Environmental.

Alternative 5b

Negative impacts and habitat restoration values for this alternative will be the same as those for Alternative 4b combined with those impacts and habitat restoration values associated with the construction and operation of the Lake Isom Restoration.

Alternative 5c

Negative impacts and habitat restoration values for this alternative will be the same as those for Alternative 4c combined with those impacts and habitat restoration values associated with the construction and operation of the Lake Isom Restoration.

WATERFOWL

Alternative Plans 1a and 2a

Same as existing conditions.

Alternative Plan 2b

This plan would provide an additional 1,900 acres of shallow water for resting and feeding. Also, long term, proper water level management will stabilize vegetative encroachment and favor desirable species. Populations are expected to increase by 20 % following a drawdown year; then experience an average 10 % increase each subsequent year until the next drawdown.

Alternative Plan 2c

Insignificant change.

Alternative Plan 3a

Same as Plan 2a plus sediment interception benefits in Buck Basin that are attributed to construction of the sediment dam on Reelfoot creek. This dam will preserve approximately 1,400 acres of open water during the 50 year project life. In addition, waterfowl management areas constructed within the basin will provide an estimated 2,520,000 WUDs.

Alternative Plans 3b - 5c

Similar to the above plans.

ENDANGERED AND THREATENED SPECIES

All Alternative Plans

None of the plans will adversely impact any of the species.

Section 122 Items

NOISE

All Alternatives

Noise would increase during initial construction due to equipment operation. Following construction, noise levels should return to normal over most of project area.

AIR QUALITY

All Alternatives

Machinery emissions and airborne dust during construction and maintenance activities would slightly degrade air quality. However, it is anticipated that project-related impacts to air quality would be minor and of short duration.

AESTHETIC VALUE

All Alternatives

Vegetative clearing associated with construction would temporarily reduce aesthetic value. Also, project features would alter the appearance of the landscape; however, establishment of bottomland hardwoods and turfing rights-of-way should offset negative impacts to aesthetics.

DISPLACEMENT OF PEOPLE

All Alternatives

None of the alternatives would result in the displacement of people. However, all of the alternatives could halt or significantly lessen the displacement of the area residents expected under future without-project conditions. Under future with-project conditions, the area income would be greatly enhanced over the levels expected without the project which would prevent the expected loss of area employment.

COMMUNITY COHESION

All Alternatives

Some landowners question the present need for the project and are opposed to selling their property. Other landowners are concerned over providing the necessary rights-of-way for project

construction. These concerns are present for all alternatives. No additional impacts to community cohesion are anticipated.

LOCAL GOVERNMENT FINANCE, TAX REVENUES, AND PROPERTY VALUES

All Alternatives

All alternatives would halt or significantly reduce the erosion of property values and tax base expected under future without-project conditions thereby maintaining revenues from taxes to the local government entities.

DISPLACEMENT OF BUSINESSES AND FARMS

All Alternatives

No businesses are expected to be displaced either directly or indirectly as a result of any of the alternatives. However, farmland will be acquired for project purposes. All alternatives would stop any displacement of the area businesses expected under future without-project conditions.

PUBLIC SERVICES AND FACILITIES

All Alternatives

All alternatives would prevent the erosion of property values and corresponding decrease in tax base expected under future without-project conditions. This would maintain the area's ability to provide such basic public services as education, police protection, and roads and bridges.

COMMUNITY AND REGIONAL GROWTH

All Alternatives

The alternatives would not contribute appreciably to community and regional growth. However, they would prevent the declines expected in the region's economy under future without-project conditions. They would maintain the area recreation related businesses, income, employment, tax base, public services, and urban and rural population necessary to maintain the area economy at present levels.

EMPLOYMENT

All Alternatives

All alternatives would prevent the expected declines in recreational related employment along with any decreases in secondary employment expected under future without-project conditions.

There would also be some opportunities for new employment associated with project construction, operation, and maintenance.

7. LIST OF PREPARERS/CONTRIBUTORS

Name	Discipline	Experience	Role
Mr. Effort Alexander	Economics	18 yrs. Economic Analysis, Memphis District, COE	Economic Analysis
Mr. Steve Alexander	Wildlife Biology	3 yrs. U.S. Fish and Wildlife Service	Appendix A, Section VI, Part A
Dr. Jerry Anderson, P.E.	Civil Engineering	Associate Professor, Water Resources Engineering, University of Memphis	GIS mapping
Ms. Martha Andrys	Real Estate	21 yrs. Real Estate Appraisal Memphis District COE	Appendix C
Ms. Jan Berry, P.E.	Civil Engineering	13 yrs. Engineering Div., Memphis District, COE; 3 yrs. Waterways Experiment Station, COE	Relocations
Mr. Gary Billingsley, P.E.	Civil Engineering	3 yrs. Planning Div., Memphis District, COE	Study Management and Feasibility Report
Mr. Rodney Conger	Civil Engineering	3 yrs. Groundwater Institute, University of Memphis	Appendix A, Section VII
Mr. Don Davenport	Hydraulic Engineering	14 yrs. Hydraulic and Hydrology Br., Memphis District, COE	Hydraulic and hydrology design
Mr. Tim Davis	Biology	8 yrs. Regulatory Functions Br., Memphis District, COE	Appendix A, Section IV
Rodger Funderburk, P.E.	Civil Engineering	8 yrs. Planning and Project Management, Memphis District, COE	Project Manager
Mr. Richard Hite	Forestry/Wildlife Biology	14 yrs. Natural Res. Mgmt., 11 yrs. Environmental Br., Memphis District, COE	Project Biologist/ DEIS Coordinator
Mr. Rob Martin	Wildlife Biology	5 yrs. Planning Division	Appendix A, Section I and II
Mr. Jim McNeil	Archeology	17 yrs. Environmental Br., Memphis District, COE	Contracting representative for archeological survey
Mr. Chip Newman, P.E.	Civil Engineering	18 yrs. Engineering Div., Memphis District, COE	Geotechnical design

Mr. Jamie Outlaw	Civil Engineering	6 yrs. GIS applications in water resources management, University of Memphis	GIS mapping support and groundwater modeling
Dr. Reza Pezeshki	Wetland Ecology	3 yrs. Wetland Ecology, Biology Department, University of Memphis	Appendix A, Section V
Mr. Wayne Quarles	Mechanical Engineering	26 yrs. Mechanical and Electrical Section, 1 yr. Structures Section, Memphis District, COE	Mechanical design and Review
Mr. David L. Reece	Fish & Wildlife Ecology	1 yr. Environmental Br., Memphis District COE; 5 yrs. Policy Division, HQ. USACE; 12 yrs. Environmental Br., New Orleans District, COE	Environmental review
Dr. John Smith, P.E.	Civil Engineering	Professor of Civil Engineering, University of Memphis	Wetland mapping review
Mr. Mike Watson	Structural Engineering	8 yrs. Structures Section, Memphis District, COE	Structural design and site layout
Mr. Jerry Welch	Civil Engineering	Certified Cost Consultant, 15 yrs. Cost Engineering, 3 yrs. Planning Div., 7 yrs. Flood Plain Mgmt., Memphis District, COE	Cost Engineering
Mr. Gregg Williams	Biology	1 yr. Environmental Br., Memphis District, COE, 6 yrs. environmental engineer, Carrier Corp.	Appendix A, Section IX
Dr. Bill Zattau	Biology	15 yrs. Biology and Wetland Ecology, COE	Appendix A, Section III

8. PUBLIC INVOLVEMENT

This chapter describes the public involvement program to date and discusses how public views guided and were incorporated into the study process. It also describes future public involvement and includes the list of agencies, groups, and individuals to whom the General Reevaluation Report/final EIS will be sent.

Public Involvement Program

A Memphis District interdisciplinary study team was formed to conduct the study. The team consisted of personnel from Planning, Engineering, and Real Estate Divisions. The purpose of the study team approach is to ensure the feasibility, desirability, and constructibility of any recommended alternative. Coordination with MRC counterparts, local interests, and Federal and state agencies was maintained throughout the study.

Public involvement played an important part in the reconnaissance study. With Federal cost sharing policies, only projects that are strongly supported by local interests can be implemented. Efforts were made to involve the public throughout the study. Public involvement efforts centered on involving environmental interests, Federal and state agencies, and local interests in briefings during the study.

A public meeting was held March 6, 1986 to describe the study process and obtain input from local, state, and other Federal interests on the problems and needs of the basin. A second public meeting was held June 25, 1987 to present the findings of the reconnaissance study.

In November 1992, a meeting was held at the Reelfoot Lake Wildlife Management Area office between Corps and TWRA personnel. Discussions included features to be analyzed during the study, current environmental problems and needs, status of other projects in the area, additional sources of information, and possible problems associated with features to be studied.

In January 1993, other Corps personnel attended follow-up meetings with TWRA and USFWS officials at Reelfoot Lake. The meetings were held to gather input from the two agencies on purposes of features to be investigated, potential solutions, and background data. A similar meeting was held in February 1993 with a representative of the Division of State Parks.

In March 1993, a meeting was held between Corps personnel and representatives of the Tennessee Division of Water Pollution Control. The meeting was held to brief the agency on features under investigation and to gain input from the agency.

In April 1993, a meeting was held between Corps personnel, TWRA, USFWS, Tennessee

Department of Environment and Conservation, and Soil Conservation Service representatives at the Airpark Inn at Reelfoot Lake. The meeting was held to update those involved as to the progress of the study and to gather input.

During July 1993, Corps representatives met with and provided an update to the Executive Director of the TWRA.

During July 1993, Corps representatives met with local interests in Hickman, Kentucky. The meeting was held to brief the Kentucky interests on the status of studies and to obtain their input. As previously mentioned, concerns centered around the potential for increased lake levels.

On 26 February 1996 the Interagency team met at the TWRA Office in Jackson, Tn.

On 10 October 1996 a slide presentation describing the Reelfoot Lake study process was presented to the Delta Conference at Memphis, Tn.

On 6 March 1997 members of the Corps, USFWS, and Tennessee Tech. University met at Cookeville, Tn. to discuss engineering proposals and habitat evaluation techniques.

On 25 April 1997 Corps representatives met with West Tennessee area developers to discuss any possible conflicts between proposed recreational developments south of the lake and features described in the draft feasibility study.

On 15 July 1997 district representatives met with the project sponsor (TWRA) to discuss cost sharing and funding requirements.

On 19 February 1998 Corps biologists conducted a 'field review' (on site) of technical issues with representatives of TWRA, FWS, Reelfoot Lake SP.

On 7 May 1998 there was another interagency meeting at Reelfoot Lake State Park. Attendees included representatives of the Kentucky Department of Fish and Wildlife Resources.

On 12 June 1988 members of the District Real Estate Division met with TWRA at Jackson, Tennessee.

On 31 December 1998, Corps representatives met with the Fulton County (Kentucky) Levee Board at Hickman, Kentucky. The meeting was held to brief the Kentucky interests on the status of studies and to obtain their input. As previously mentioned, concerns centered around the potential for increased lake levels.

On 25 March 1999 a Feasibility Review Conference was held at Reelfoot Lake State Park.

NEWSPAPER ARTICLES:

20 December 1993 - News article on the recon. study.

21 December 1993 - " " " " " " .

24 June 1994 – News release on the proposed drawdown.

25 August 1994 - " article on the feasibility study.

20 March 1995 - " " " " " " .

22 March 1995 - " " " " circulation channels.

April – August 1995 – Memphis District Newsletter to area newspapers about the Corps feasibility study.

23 June 1996- News article on study funding.

Coordination

Numerous environmental planning meetings were held throughout the study. Broad in scope, many of these meetings were held to identify and address environmental issues and concerns relative to the overall project. The objectives of these meetings were to minimize environmental conflicts, miscommunication, and project delays; maximize environmental expertise available for consultation; facilitate development of environmentally sensitive plan alternatives; identify potential environmental project features; and identify possible survey and impact assessment procedures. In addition, environmental meetings were held to address specific environmental issues. For example, meetings were held to develop environmental project features; plans for waterfowl and shore bird management areas. Meetings were also held to identify and select appropriate measures for assessing baseline conditions of and impacts to aquatic resources and wetlands. Among the attendees of various environmental meetings were representatives from the Memphis District, Jacksonville District Aquatic Plant Control Center, Natural Resources Conservation Service (NRCS), U.S. Fish and Wildlife Service (USFWS), U.S. Army Waterways Experiment Station, Tennessee Wildlife Resources Agency, Tennessee department of Environment and Conservation, University of Tennessee at Martin, University of Memphis, and Ducks Unlimited. Furthermore, extensive communication was established and maintained with key natural resources agencies such as the USFWS, NRCS, TWRA, and TDEC.

Implementation of the preferred plan will impact (positive) two National Wildlife Refuges, Reelfoot and Lake Isom. Special use permits and compatibility statements have been discussed with the refuge manager. These items will be prepared by the refuge(s) staff as a part of their review and comment for the DEIS.

Since the 'interagency team concept' was initiated early during the reconnaissance study; any present or anticipated agency conflicts with the study objectives were quickly identified and, in most cases, rectified. The only known agency conflict at this time is the possible impact of higher water levels on state park facilities as expressed by the Tennessee Division of State Parks. Hopefully, this issue will be resolved during the review process.

Distribution of this final EIS to the following agencies, groups, and individuals for their review and comment will satisfy requirements of the National Environmental Policy Act.

DEPARTMENT OF THE ARMY
MEMPHIS DISTRICT CORPS OF ENGINEERS
167 NORTH MAIN STREET B-202
MEMPHIS TN 38103-1894

Reply to
Attention of:

March 12, 1995

Planning Division
Environmental Analysis Branch

HQDA, SFIS-APP
ATTN: Mr. John O. Roach, Agency Liaison Officer
Office of the Federal Register
Alexandria, Va. 22331-0302

Dear Mr. Roach:

Enclosed are three signed copies of a notice of intent (NOI) to prepare a draft environmental impact statement for the Reelfoot Lake, Tennessee and Kentucky project. Please have this NOI published in the Federal Register.

Sincerely,

Donald M. Dunn, P.E.
Chief, Planning Division

Enclosures

Department of Defense

Corps of Engineers, Department of the Army

Intent to Prepare a Draft Environmental Impact Statement (DEIS) for the Reelfoot Lake, Tennessee and Kentucky Project.

Agency: Memphis District, U. S. Army Corps of Engineers, Department of Defense

Action: Notice of Intent

Summary: The study area is located in northwest Tennessee in Lake and Obion counties and in southwest Kentucky in Fulton County. The primary study outputs are features for the restoration of fish and wildlife habitat. This feasibility study is funded under MR&T, General Investigations and authorized by U.S. Senate Resolution dated 2 August 1984. The U.S. House of Representatives Resolution was dated 8 August 1984. Funds were provided to the U.S. Army Corps of Engineers, Memphis District, in December 1985 to conduct the reconnaissance portion of the investigation. The reconnaissance report was completed in May, 1988 but was not certified at that time. Following publication of the Corps Policy Guidance Letter No. 24, dated March 7, 1991, the state of Tennessee, acting through the Tennessee Wildlife Resources Agency, requested that the U.S. Army Corps of Engineers, Memphis District, update the May 1988 reconnaissance report to include fish and wildlife habitat restoration in addition to other Corps outputs.

Updating of the May 1988 reconnaissance report was initiated in November 1992 and completed in November 1993. The reconnaissance report was certified in December 1994 by the Assistant Secretary of the Army for Civil Works. The reconnaissance report identified a plan for restoration of the fish and wildlife resources and recommended proceeding into a cost shared feasibility study for more in-depth evaluations of the benefits and costs of implementing the recommended plan.

For Further Information Contact: Mr. Richard Hite, telephone (901) 544-3857, CELMM-PD-R, 167 North Main Street B-202, Memphis, Tn. 38103-1894.

Supplementary Information:

1. Proposed Action

Reelfoot Lake, formed by the earthquakes of 1811-1812, covers approximately 15,500 acres at the normal pool elevation of 282.2 NGVD in Tennessee and Kentucky. Reelfoot Lake is a nationally significant and unique natural resource. It is the largest natural freshwater lake in Tennessee and one of the largest in the nation. The lake provides nesting and feeding habitat for Bald and Golden Eagles.

This DEIS will address the variety of proposed features identified in the reconnaissance study as well as any new proposals that may surface during the feasibility study.

2. Alternatives

Numerous alternatives were evaluated during the reconnaissance study; including various sizes and locations for each identified feature. The purpose of this DEIS is to evaluate each alternative and provide updated documentation and coordination for the selected plan for habitat restoration and compare it to the No Action alternative.

3. Scoping Process

An intensive public involvement program has been set up to (1) solicit input from individuals and interested parties so that problems, needs, and opportunities within the study area can be properly identified and addressed and (2) provide status updates to concerned organizations and the public. Meetings with the local sponsor, public coordination meetings, interagency environmental meetings, and public presentations are ongoing. A public scoping meeting will be scheduled at a later date and interagency environmental meetings will continue on an as needed basis. Significant issues being analyzed include potential project impacts (negative and positive)

to fisheries, water quality, wetlands, waterfowl, endangered species, cultural resources, and the area economy. It is anticipated that the DEIS will be available for public review in August, 1998. A public meeting will be held during the review period to receive comments and address questions concerning the DEIS.

7 March 1995

Theodore C. Fox III
Colonel, Corps of Engineers
District Engineer

SECTION 8

RESPONSES
TO
PUBLIC REVIEW COMMENTS

SECTION 8

RESPONSES TO DRAFT FEASIBILITY REPORT AND DRAFT ENVIRONMENTAL IMPACT STATEMENT COMMENTS

LETTERS

1. U. S. Department of the Interior, James S. Lee, 4 August 1999

   a. **Comment.** Any discussions of future water level management activities should incorporate by reference the 1989 Reelfoot Lake Water Level Management Final Environmental Impact Statement prepared by the service, and the subsequent Record of Decision.

      Response. Concur. Revisions have been made to page 30 in the main report and page 3 in the FEIS.

   b. **Comment.** Page 6 – According to the Services's EIS, a steel radial gate was added to the spillway in 1948.

      Response. Concur. Correction has been made.

   c. **Comment.** Page 10 – The top of the stop logs are at elevation 282.2 NGVD.

      Response. Concur. Correction has been made.

   d. **Comment.** Page 18 – The Service does not consider curlyleaf pondweed as an aquatic pest.

      Response. Concur. Statement has been revised.

   e. **Comment.** Page 21 – There are 15,500 acres of open water habitat .

      Response. Concur. The figure has been corrected.

   f. **Comment.** Page 25 – Currently, The Service does not have the capability to hold water levels at elevations above 282.2' NGVD.

Response. Concur. The statement has been corrected.

g. **Comment.** Page 73 – The lease agreement between the Service and TWRA expires in 2016.

Response. Concur. The correction has been made.

h. **Comment.** Page 78 – We recommend that priority be given to construction of a new spillway and the sediment basin on Reelfoot Creek.

Response. Concur. The sediment basin is now listed as Phase two.

2. State of Tennessee, Justin P. Wilson, 9 August 1999

a. **Comment.** - - a more detailed examination of the data and information to ensure that dramatic releases of lake waters do not further degrade water quality downstream. Several streams in the Reelfoot Lake area, including Running Reelfoot Bayou, are Section 303(d) listed Streams. - - - the state cannot authorize any activity that would further degrade water quality in these streams.

Response. According to a water quality report provided by the Environmental Protection Agency; predictions of water quality changes resulting from changes in lake level and morphometry are partially dependent on significant changes in thermal stratification. The water level of Reelfoot Lake would have to be raised approximately 10 to 15 feet (current maximum depth is 15 feet) to insure that the lake seasonally stratifies to be able to predict changes in water quality resulting from thermal stratification (W.L. Smith, pers. Com.). Therefore, a change of a few feet in lake level will not affect water quality parameters related to thermal stratification.

Since this is an environmental restoration project; the objective is to improve various natural resources, including the water quality of Reelfoot Lake and the receiving streams. Note the following comparison:

No Action Alternative: Dissolved Oxygen will continue to decrease as the hypereutrofication increases. Organic and inorganic sediments will continue to build at the rate of .35 to .75 inches per year. Nutrient levels will continue to rise.

Preferred Alternative: Dynamic Water Level Fluctuation Combined with a Periodic Major Drawdown: Short term dissolved oxygen impacts associated with drawdown events can be expected. However, it must be noted that the quality of the water being discharged for a drawdown into Running Reelfoot will be of average or normal quality for the lake water. As the drawdown progresses, and D.O. concentrations decrease; the release water will deteriorate. However, these impacts are once every 5 to 10 years and water quality will improve in the lake above on an annual basis. This means that water released into Running Reelfoot over the long term will be of better quality than now. The 'impacted water', or extremely low water will be held in the lake until a refill is

completed in January or February, at which time releases would begin. The water conditions will have stabilized and improved before the releases begin.

It is also important to note that one of the important parameters addressed by Section 303(d) is Maximum Daily Thermal Loading. With the present spillway structure the only discharges are over the top of the spillway because of the stop-log design. This of course, means that higher temperature surface water is being released. With the new spillway design; water will be released through the gate bottoms; which means the cooler water will be released.

We must also note that the U. S. Fish and Wildlife Service currently has the authority to conduct drawdowns under the auspices of the 1989 Reelfoot Lake Water Level Management Final Environmental Impact Statement and the resultant 1991 Record of Decision.

b. **Comment.** Any proposed project should thoroughly examine impacts to rare and threatened habitat at Reelfoot Lake.

Response. As stated in the feasibility report and the DEIS, this is an ecosystem restoration project designed to enhance habitat for a wide variety of species. In addition to aquatic benefits; the proposed water level fluctuation and periodic drawdowns will provide ideal conditions for shorebirds. In addition, the water level fluctuation in combination with sediment reduction will improve a variety of wetland communities such as the marshes, forested swamps and bottomland hardwoods which will in turn improve habitat for avian species, mammals, reptiles, etc. Construction of the two waterfowl management areas plus Shelby Lake will provide approximately 1,275 acres of wetlands on lands presently cultivated for row crops. These various wetland types will provide excellent habitat for shorebirds, waterfowl and furbearers. The U. S. Fish and Wildlife Service Coordination Act Report states that the "proposed project is not likely to adversely affect any rare or endangered species or their habitats."

3. State of Tennessee, Department of Environment and Conservation, Gregory Denton, 28 July 1999

a. **Comment.** The Tennessee Water Quality Board has approved *Outstanding National Resource Water* status for Reelfoot Lake and associated wetlands. - - - a discussion of the potential ramifications of this designation may be in order for the final version.

Response. Concur. This information has been added to page 8 of the feasibility report.

b. **Comment.** The extreme summer drawdown discussed in the draft is a well-established fisheries management technique. However, its value as a method to improve water quality is less well established.

Response. There are studies and case histories cited in Appendix A, Section V, Part A that indicate water quality improvements associated with drawdowns. After the Public Meeting 20 July 1999 and receipt of comment letters, we found it necessary to investigate additional lake drawdowns in Florida, Louisiana, and Arkansas. We were recently told by state resource agency representatives that the fishery and water quality improved after drawdowns at nine different lakes throughout the three state area. In addition, fish kills were non-existent to insignificant and resort owners realized major increases in businesses for years after each drawdown.

c. **Comment.** The potential impacts of dramatic water releases from Reelfoot Lake on downstream waters have not been quantified or adequately considered.

Response. See Response 2 a.

d. **Comment.** In order to be able to authorize projects such as dam or spillway construction, we would need strong assurance that the applicant has the means to prevent offsite impacts.

Response. Spillway construction will be performed by a contract administered and inspected by the Corps of Engineers. Best Management Practices and all state water quality standards will be strictly adhered to. As stated on pages 37 and 39 of the feasibility report; to "Minimize Negative Environmental Impacts" was one of the selection criteria for spillway site selection. The spillway construction site was specificly chosen away from the water so as to minimize aquatic impacts. All issues related to material discharge have been carefully discussed in Appendix A, Section IV. The spillway design and construction will be to standard Corps engineering standards, including earthquake stability.

4. State of Tennessee, Bureau of State Parks, Walter Butler, 6 August 1999

a. **Comment.** The proposed construction of the spillway may impact a Rangers residence.

Response. There may be some impacts. However, the new spillway will be on the opposite side of Highway 21 approximately 1,000 feet from the residence. The new inlet channel will be approximately 400 feet behind the residence but dredging and other construction activities will be directed away from the dwelling.

b. **Comment.** Potential higher water levels may impact the park campgrounds.

Response. The recommended plan in the draft report did include higher water levels plus a periodic drawdown. However, as a result of comments received at the public meeting and by letter; the initial recommended plan has been modified and will be reflected in the final feasibility report. The modified plan also includes

a periodic drawdown. However, higher water levels are no longer proposed in this report, and water levels will not exceed those of the FWS "Interim Plan" which has been in effect since 1991.

c. **Comment.** There is little information in the report and EIS on the impacts to general recreation in the area.

Response. Recreation in the Reelfoot Lake area is discussed on page 21 of the main report and Table 19 (page 44) and page 69 in the FEIS. Recreation values are also found in Appendix D, Economic and Social Analysis.

5. Division of Natural Heritage, TDEC, Andrew Barrass, 28 July 1999

a. **Comment.** We would recommend that a (comprehensive biological) survey of the project site(s) be conducted prior to project implementation.

Response. During the field environmental assessment phase of the study, habitat evaluation plots were examined for each of the anticipated impact areas. Due to the extremely small areas; each site was thoroughly surveyed by two Corps biologists and later examined by two biologists from the U. S. Fish and Wildlife Service office at Cookeville, TN. Each area has also been subjected to a thorough HTRW and cultural resources survey. No species of special significance were noted.

b. **Comment.** - - - the construction techniques are questionable or not thoroughly documented.

Response. Construction techniques are not determined until plans and specifications are prepared. This is after the project is authorized and funded. During the construction phase, oversight will be provided by the Corps Environmental Branch, Corps inspectors (who enforce NPDES permits, BMPs, etc.), TWRA, U.S. Fish and Wildlife Service, TDEC (Div. Of Water), and Reelfoot Lake State Park.

c. **Comment.** There have been many advances in the development of bio-engineering techniques, native plant propagation, habitat restoration, and construction erosion control during the last few years. The DEIS however, does not address these accepted practices.

Response. See Response 5 b. [illegible]

d. **Comment.** The land use alternatives should review the significance of protecting contiguous forest tracts, forest communities and sensitive plant or animal populations. Rare plant populations and associated communities should be further evaluated prior to dredging or canal re-construction.

Response. One of the purposes of the proposed sediment basin is to protect the Grassy Island forest unit. In addition, 625 acres of presently cultivated fields will be planted in bottomland hardwoods. Plant communities were evaluated in the FWS FEIS and Appendix A, Section V, Part A of the Reelfoot Lake Feasibility Report. Also see Response 5 a.

e. **Comment.** The project area has a large number of rare, threatened, or endangered bird species. - - - Perhaps the Final-EIS should address the project benefits to these species.

Response. See Response 2 b.

f. **Comment.** The managed property should have a thorough field survey for all plant and animal species - - - Perhaps GIS mapping of habitat types could be a useful tool for - - -.

Response. See Response 2 b. GIS mapping of habitat types was included in this study via contract with the Groundwater Institute, University of Memphis; See Appendix A, Section VII.

g. **Comment.** Our department has routinely opposed - - - fragmentation of forested lands - - - canal corridors to be re-dredged should provide adequate buffers.

Response. Depth increases for these three existing channels is to provide water circulation and drawdown capability that is essential to the preservation of Reelfoot Lake. Average width of these channels is 32 feet and approximately 65 % forest canopy cover will remain. Comment noted.

h. **Comment.** Alternatives should acknowledge existing conservation agreements with various land management agencies (e.g. Tennessee Wildlife Resources Agency).

Response. See page 1 of the feasibility report; TWRA is the project sponsor. Also see "Coordination" on page 97 of the FEIS.

i. **Comment.** The land use alternatives should address the encroachment by adjacent properties of dissimilar land use(s).

Response. Descriptions of proposed land use alternatives on pages 37 - 52 of the feasibility report indicate obvious that these project features will reduce encroachment by adjacent properties.

j. **Comment.** - - - should address current land use(s) and compare long term and cumulative impacts to changes in land use or land management strategies.

Response. Current land uses are described in the *Existing Conditions* section (pages 11-21) of the feasibility report and Table 19 of the FEIS and also in the *Significant Resources* section (pages 61-68) of the FEIS. Long term/cumulative impacts are described in the *Future Without Project* section (pages 22-24) in the feasibility report, FEIS page 11, and FEIS Table 19. Long term impacts without project are compared to long term impacts with the various alternatives in the *Environmental Consequences* section of the FEIS, pages 72-89. Habitat restoration benefits have been calculated by comparing long term (50 year) conditions with-out project to long term (50 year) conditions with-project, by alternative, combinations. This information is found in Appendix A, Section(s) I and II.

k. **Comment.** The DEIS has not defined the end product of the assumed restoration of Shelby Lake and Lake Isom.

Response. The purpose of the Shelby Lake Restoration, as stated on page 47 of the feasibility report, is to "restore the area to the historical wetland condition and to provide waterfowl and wetland habitat." The purpose of the Lake Isom Restoration, as stated on page 51 of the feasibility report is to "provide the capability of increased water level management within the lake. The fluctuation will help to control aquatic vegetation and improve waterfowl and fish habitat."

l. **Comment.** A potential hazard to this positive effect to littoral plant communities is that exotic plants too could encroach in the newly created space (e.g. Purple loosestrife).

Response. See Response 2 b and Appendix A, Section V, Part A, pages 43-44 and page 60.

m. **Comment.** The DEIS has not addressed the Executive Order on Invasive Species.

Response. The subject(s) of vegetative encroachment, composition change and invasive species arose at the public meeting, subsequent meetings, and in the comment letters. TWRA and Reelfoot NWR representatives have stated that they will spray if necessary. This issue will also be addressed during the preparation and implementation of the required monitoring plan (see page EIS-19).

n. **Comment.** The report - - *Nonpoint-Source Pollutant Discharges of the Three Major Tributaries to Reelfoot Lake* - - - discusses pollutant loading to the Reelfoot Creek drainage. The hydraulic portion of the Final-EIS should include information from this report in the analysis of assumed water quality and nutrient loading from storm events.

Response. This report was used in the preparation of the feasibility report and the DEIS. However, we failed to include it in the *Literature Cited* section. Also

nutrient loading was addressed in the previously approved FWS FEIS. Water quality will also be included in the required monitoring plan.

6. Tennessee Wildlife Resources Agency, Dan Sherry, 28 July 1999

a. **Comment.** Page 10 – Where the word 'weir' occurs, the more correct term should be 'stop-log structure'.

Response. Concur. Correction has been made.

b. **Comment.** Page 23 - TWRA cannot commit to continued implementation of the Interim Water Level Management Plan without the project.

Response. Noted.

c. **Comment.** Page 25 – Water willow should be listed as one of the problem vegetative species in the lake.

Response. Concur. Water willow has been included.

d. **Comment.** Page 25 - Once opened (gates) are held at 282.2 NGVD except at such a time when maximum drawdown might occur which would pull water 5.8 feet lower (276.4 NGVD).

e. **Response.** According to the Reelfoot Lake NWR Annual Water Management Report: "As the water level recedes and approaches 283.2 ft. m.s.l. or 282.7 ft. m.s.l. again, the radial gate and/or small gates are closed."

f. **Comment.** Page 26 - . . . the frequency of drawdowns should be corrected from ". . . at least once every 10 years . . " to ". . as needed after 5 years."

Response. The FWS FEIS states: "Drawdowns would be requested as needed every 5 to 10 years."

g. **Comment.** Pages 26 & 28 – It (Walnut Log Ditch) should be identified, however, as a significant problem that should be handled by a local sponsor.

Response. Concur. The paragraph has been revised.

h. **Comment.** Page 27 - We do not necessarily agree that there is a greater need to prevent additional sediment from entering the lake than to remove existing lake sediment. We do agree that prevention of additional sediment is more practical.

Response. Concur. The statement has been revised.

i. **Comment.** Page 29, a & b – A more accurate statement as to why these features were eliminated would be due to cost and impracticability rather than lack of local

sponsor support. c. This heading should more clearly be stated "North and South Fork Reelfoot Creek Reservoirs"

Response. Concur. Revisions have been made.

j. **Comment.** Page 30 - TWRA probably will not continue water level management efforts if this project does not move forward.

Response. Noted.

k. **Comment.** Page 31 – Replace "periodic drawdown" with "water level management program".

Response. Concur. Statement has been revised.

l. **Comment.** Page 34 – The interim plan will probably not continue if the project does not move forward.

Response. Noted.

m. **Comment.** Page 35 . . . property should be included up to 285 m.s.l.

Response. Since the recommended plan has been changed to the Interim Plan plus a drawdown; easements are no longer required for implementation of the proposed cost-shared project.

n. **Comment.** Page 36 - . . . 285 m.s.l. acreage figures should be adjusted accordingly.

Response. See Response 6 m above.

o. **Comment.** Page 37 – Substitute water level management for "drawdown".

Response. Concur. Revision has been made.

p. **Comment.** Page 38 – Relocate the outlet channel to the west property line.

Response. Our Engineering Division is aware of this situation and the location of the outlet channel will be reevaluated during the preparation of plans & specs.

q. **Comment.** Page 41 – Prefer the word "lower" to "drawdown".

Response. Concur. Change has been made.

r. **Comment.** Page 46 – Donelson (sic) Ditch . . . has already been dredged.

Response. Donaldson Ditch remains as part of this feature because it may be another five years until construction begins and it might require 're-dredging'.

s. **Comment.** Page 73 – The USFWS lease will expire in year 2016, not 2001.

Response. Concur. The typo has been corrected.

t. **Comment.** Page 85 – Options such as the purchase of flowage easements should also be included.

Response. Concur. The Real Estate Plan reflects this verbage.

7. U. S. Environmental Protection Agency, Heinz Mueller, 2 August 1999.

a. **Comment.** It must be made clear in the final document which agency(ies) will be responsible for managing this structure.

Response. The State of Tennessee acting through TWRA as the non-federal sponsor will have operation and maintenance responsibility. See bottom of page 78 and Item (4) on page 79 in the feasibility report.

b. **Comment.** The results of the sediment analysis should be included in the final document.

Response. The results are found in Appendix A, Section IV and are summarized on page EIS-81.

c. **Comment.** An examination of existing production potential can be made of those agricultural parcels which will receive the small increment of additional inundation (.3 feet).

Response. See Response 4 b.

8. Kentucky Department of Fish and Wildlife Resources, C. Tom Bennett, 1 July 1999.

a. **Comment.** The Preferred Alternative . . . . could impact agricultural land in Kentucky. However, the report notes that compensation will be required, but there is no commitment to make such compensation . . . .

Response. Kentucky interests have been advised that higher water levels cannot be implemented without signed flowage easements or land sales from all willing sellers. However, this is no longer an issue; see Response 4 b.

9. Ellis R. Fant, 21 July 1999.

a. **Comment.** I am against the drawdown . . . it will accomplish nothing.

Response. See Response 3 b.

b. **Comment.** It (drawdown) does nothing to remove the siltation in the lake.

Response. The proposed sediment basin on Reelfoot Creek is for preventing further siltation of the lake.

c. **Comment.** It would definitely help the lake if the Mississippi River could be used to furnish running water through the lake.

Response. This alternative was evaluated during the first reconnaissance study and eliminated because of high cost and water quality problems.

d. **Comment.** It would also help the lake if a small dredge were put in the lake and just left there.

Response. Also evaluated during the first reconnaissance study and eliminated because of stumps, high cost, water quality and sediment disposal problems.

e. **Comment.** I can see a big impact on the economy if there is a draw down every 5 years or so.

Response. There may be temporary economic impacts during drawdown years. However, evidence from other 'drawdown' lake communities indicates clearly that one annual economic impact will be more than offset in the long run. See economic estimations in Table 24, Page 61 of the feasibility report.

f. **Comment.** The study shows the potential for a fish kill.

Response. See Response 3 b.

g. **Comment.** Will it affect the supply and quality of water in the aquifer?

Response. According to reports from USGS, EPA, and the Groundwater Institute at Memphis; a three to four foot drawdown will not impact the aquifer.

10. Henry Sanger, 23 July 1999.

a. **Comment.** If you cleaned out Upper Bayou De Chien channel . . . , that would get the lake a source of water.

Response. This was evaluated during the first reconnaissance study and eliminated because of cost and the fact that construction and subsequent accelerated velocities would only introduce more sediment into Reelfoot Lake. Also, considering

the small watershed between Reelfoot and Hickman; if there is low rainfall at Reelfoot, there will be similar precipitation on the Bayou De Chien watershed.

b. **Comment.** . . . get easements to the elevation of the top of the structure 286.2 MSL before you start construction.

Response. The gates are set approximately one tenth of a foot above a hundred year flood. With a 100 year flood approximately 4 feet of water will flow over the top of the existing structure as well as overflow at several other sites. It is standard practice to keep operating equipment and access above a 100 year flood. It is also standard practice to design structures to be flanked away from a structure whenever possible.

11. Suzanne Keefe, 25 July 1999.

a. **Comment.** I am very concerned about the impact that a periodic drawdown would have on this community . . . The tax base in Lake County is heavily supported by the tourist industry . . .

Response See Response 9 e.

b. **Comment.** . . . we are not convinced that a drawdown is the right step to save Reelfoot Lake.

Response. See Response 3 b.

12. Marjorie Davis, 26 July 1999.

a. **Comment.** . . . we want someone to assure us that a drawdown would do that.

Response. See Response 3 b.

b. **Comment.** If the drawdown fails and the lake does not refill . . .

Response. Based on an examination of approximately 50 years of historical rainfall, the lake typically would refill annually between 31 January and 28 February after a drawdown.

13. Joe D. Sanger, 27 July 1999.

a. **Comment.** If you . . . raise the water level of the lake, private property will be affected.

Response. See Response 4 b.

b. **Comment.** If you do build the new spillway at 286 feet, the Corp should get flood easements . . . up to that elevation . . .

Response. See Response 10 b.

c. **Comment.** Why is the silt retention basin . . . in phase 3 of the plan?

Response. See Response 1 h.

14. W. E. Hickman, 27 July 1999.

a. **Comment.** Am I correct in stating that extending the life of the Lake has top priority? If so, then why Shelby Lake restoration and Lake Isom restoration at this time?

Response. It is true that Reelfoot is the primary reason for the study. However, the authorization is to examine resource needs for Reelfoot Lake and vicinity.

b. **Comment.** Why has a new spillway site been chosen vs. a new spillway at the old site.

Response. See pages 37 – 41 in the feasibility report.

15. Jerome D. Shumate, 21 July 1999.

a. **Comment.** . . . silt enters Reelfoot from the hills on the east side of the lake. Why hasn't this problem been corrected before now?

Response. See Response 9b

b. **Comment.** I request that a board be formed consisting of five members who will have control of lake stages at Reelfoot.

Response. Noted.

16. Macie M. Roberson, no date.

a. **Comment.** It has been proposed that a member from Fulton County, Kentucky, one from Lake County, one from Obion County, a member from U.S. Fish and Wildlife (Service) and a member from TWRA to control or operate the spillway gates.

Response. Noted.

17. Timothy C. Naifeh, 22 July 1999.

a. **Comment.** . . . I am opposed to any implementation of a drawdown . . . it appears to me that a drawdown will result in a major fish kill.

Response. See Response 3 b.

b. **Comment.** . . . reroute the river and make a sediment basin . . . through Bayou De Chein coupled with dredging of Reelfoot Lake.

Response. See Responses 9, c and d.

c. **Comment** Reelfoot Creek is a major contributor of up to 80 % of the siltation coming into Reelfoot Lake . . . The drawdown . . . will in no way prevent siltation from entering the lake.

Response. See Response 9 b.

d. **Comment.** Further, the economic impact for Lake County, motel owners, . . . will be drastic and may not recover.

Response. See Response 9 e.

18. Lillian W. Currin, 27 July 1999.

a. **Comment.** I am writing to express my opposition to the plans.

Response. Noted.

19. Mary P. House, 28 July 1999.

a. **Comment.** I am very much opposed to plan, not only would it effect tourist trade at lake but would also alter the tax base in our small county . . .

Response. See Response 9 e.

20. Aaron Staulcup, no date.

a. **Comment.** I must question the feasibility of such a drastic proposal as having a drawdown without assurance that this action will prolong the life of the lake.

Response. See Response 3 b.

b. **Comment.** Lake County as well as Obion County and Fulton County, Kentucky will be adversely affected by a drawdown and the fluctuation the water of the lake.

Response. See Response(s) 9 e and 4 b.

21. James H. Vincent, 29 July 1999.

    a. **Comment.** No drawdown is necessary . . .

       Response. See Response 3 b.

    b. **Comment.** How would you fill it up rapidly enough?

       Response. See Response 12 b.

    c. **Comment.** How would you keep the area from growing up in weeds, etc. . . .

       Response. See Response 5 m.

    d. **Comment.** How can you justify ruining a great bald eagle wintering area?

       Response. See Response 2 b.

22. Candy Curlin, 29 July 1999.

    a. **Comment.** But we could not survive a drawdown!

       Response. See Response 9 e.

23. Marcia Perkins Mills, 29 July 1999.

    a. **Comment.** We are very concerned about the drawdown . . . . it will affect many of our customers and friends who depend on the lake for their livelihood.

       Response. See Response 9 e.

24. Commonwealth of Kentucky, Senator Bob Jackson, 2 August 1999.

    a. **Comment.** Historically, the mean sea level (msl) was set at 282.2, and we would like to see that maintained from March 16 – November 14. It was our understanding that the interim plan would only be operational until the feasibility study was completed and not as a matter of permanent record.

       Response. There is no connection between the U. S. Fish and Wildlife Service Interim Plan and the Corps of Engineers study.

    b. **Comment.** The old spillway is obsolete, but we question and object to the proposed elevation of 286 msl.

       Response. See Response 10 b.

c. **Comment.** In conjunction with the new spillway, it is imperative that the drainage ditch or outlet be enlarged or dredged to keep the water flowing so it will be capable of handling the new discharge.

Response. Discharges from the new spillway are not to exceed those of the old spillway. This requirement will be met in the development of the new spillway operation plan.

d. **Comment.** We question the validity of the need to raise the water levels to the proposed level.

Response. See Response 4 b.

25. Doug Goodman, 2 August 1999.

a. **Comment.** . . . the (spillway) outlet ditch be enlarged to handle the increased discharge capacity that the new spillway will provide.

Response. See Response 24 c.

b. **Comment.** I question the need for it (spillway) to be capable of holding water levels at 286 msl.

Response. See Response 10 b.

c. **Comment.** The cleanout of Bayou de Chien would . . . provide Reelfoot Lake with fresh water . . .

Response. See Response 10 a.

26. Edmund Willingham, 2 August 1999.

a. **Comment.** I am opposed to the Corps proposals.

Response. Noted

27. COL David K. Holland, USA (ret), 5 August 1999.

a. **Comment.** . . . on page 5, Section VII, Vol. 2 (GIS Contour Mapping by the Groundwater Institute) "Although the proposed increase in the water surface elevation for Reelfoot Lake is 287.5 feet." . . . I call for you to expunge such figures from the final Supplemental Environmental Impact Statement (SEIS).

Response. GWI was contracted to do contour mapping only; not to address water level recommendations. 287.5 was the upper limit of contours to be shown. Pages 5 and 6 have been removed from the report.

b. **Comment.** . . . against the severe drawdown . . .

Response. See Response 3 b.

c. **Comment.** . . . definition of "eutrophication".

Response. Definition is correct. However, Reelfoot Lake is classified as hypereutrophic.

d. **Comment.** I am concerned that the new structure will allow for much higher levels than are currently experienced.

Response. See Response 10 b.

e. **Comment.** Various comments on the sediment basin.

Response. The structure is designed to trap sediment; not to impound water.

f. **Comment.** Dredging proposal.

Response. See Response 9 d.

STATEMENTS MADE AT THE PUBLIC MEETING

20 JULY 1999

The following statements have been summarized by topic and the number of times ( ) voiced by separate individuals. The "response numbers" such as 'Response 9 e' refer to the letter responses above.

TOPIC	NUMBER	RESPONSE
Drawdown opposition:		
Will not work.	(4)	3 b
Health concerns and fish kill.	(3)	3 b
Loss of business income. and county tax loss.	(8)	3 b & 9 e
Doubts about refill.	(2)	12 b
Concern about veg. encroachment.	(2)	2 b & 5 l
Higher water levels:		
Cropland impacts.	(2)	4 b
State Park impacts.	(1)	4 b
Sediment Basin:		
Too large & Agric. Impact.	(2)	Noted
Want to dredge the lake.	(4)	9 d
Ground water concerns.	(1)	9 g

Written Comments Received During Public Review

- We agree with the new spillway, but the top elevation can not exceed 283.2 msl. The old spillway is obsolete, but we question and object to the proposed elevation of 286 msl.
- In conjunction with the new spillway, it is imperative that the drainage ditch or outlet be enlarged or dredged to keep the water flowing so it will be capable of handling the new discharge.
- We agree with the sediment retention area as part of the new project.
- We are asking that the dredging receive top priority in eliminating sedimentation and degradation of Reelfoot Lake.
- We question the validity of the need to raise the water levels to the proposed level. Kentucky residents and farmers want to preserve the lake for sports but NOT jeopardize the livelihood of our farmers.

I hope you will consider our concerns as you make your decision. We have been unable to find any compelling reasons for making this adjustment to Reelfoot Lake. Please feel free to contact me if you have additional questions. I look forward to receiving your response to our concerns.

Sincerely,

Bob Jackson
State Senator

CC: Governor Paul E. Patton
Commonwealth of Kentucky

101-conltr-990242

August 2, 1999

Mr. Jim Reeter
US Army Corp of Engineers
Memphis District
Public Affairs Office
167 N. Main Street, Room B-202
Memphis, TN 38103-1894

Dear Mr. Reeter:

I would like to express my concerns about Reelfoot Lake and the EIS and Feasibility Study.

I am a full-time farmer and landowner in Fulton County Kentucky. I have been involved with the discussions and meetings concerning the future of Reelfoot Lake from the beginning. TWRA and Corps officials have always indicated that they would not damage the property or livelihood of any individual in the state of Kentucky without proper compensation. I can tell you that with the Interim Plan now in operation, my farming operation has dramatically been impacted. Increased water levels and undisciplined control of the spillway flood gates has kept several acres of my farming operation out of production since the 1989 Decision of Opinion by Mr. James W. Pulliam, Jr., Regional Director of the Atlanta office of the Department of Fish and Wildlife. Prior to that change, known as the "Interim Plan", I was always able to plant my entire acreage annually. I totally disagree with any increase in water levels above the 282.2 msl (mean sea level). I can attest to the damage this has already brought about.

I feel that dredging has always been the answer to sedimentation removal in Reelfoot Lake, and not in one year but in a five or ten year plan. I agree with the sediment retention dams as a positive approach to controlling future decreases in water depth of the lake. Also, with the addition of sediment retention dams and new spillway, it is of utmost importance that the outlet ditch be enlarged to handle the increased discharge capacity that the new spillway will provide. I am not opposed to a new spillway. I feel that the new spillway is a positive approach to alleviating flooding of Kentucky crop land, if lake levels are properly maintained at the 282.2 msl. However, I question the need for it to be capable of holding water levels at 286 msl. I feel it would be more acceptable to the Kentucky residents if only 283.2 msl was the top of the new spillway. I mention this level because those of us in Kentucky have agreed to an increased level of 283.2 msl for the time period of November 15 through March 15. We feel that this is a positive gesture on behalf of Kentucky to address fluctuation levels of Reelfoot Lake. Even this level eliminates the possibility of growing winter wheat on our lands and could jeopardize the planting of corn, therefore, forcing us to soybeans as our only alternative

For farm operations, it is imperative that 282 msl be reinstated as the permanent level of Reelfoot Lake during the crop season of March 16 through November 14. The importance of this cannot be overstated. The farmlands surrounding Reelfoot Lake, both in Kentucky and Tennessee, have long been managed at this level. Also, the farm lands which provide food for wildlife and wintering waterfowl on the Reelfoot National Wildlife Refuge have been cropped at this level, and now with the increased water level, food supplies of these wildlife have been substantially reduced. This has lead to the encroachment of undesired vegetative growth such as willows on the previously farmed acreage.

The clean-out of Bayou de Chein, or Running Bayou, would also enhance the lands of Kentucky and provide Reelfoot Lake with the needed fresh water as addressed in the Feasibility Study

Kentucky and Tennessee should work together in solving the future of Reelfoot Lake However, it should never be to the detriment of any Kentucky resident.

I would appreciate your consideration of my concerns as you work toward a solution to the Reelfoot Lake levels Please feel free to contact me with any questions you may have.

Sincerely,

Doug Goodman
1928 State Route 309
Hickman, KY 42050

ph#502-236-3451

August 2, 1999

Memphis District
U.S. Army Corps of Engineers
Public Affairs Office
167 N. Main Street
Room B-202
Memphis, Tennessee 38103-1894

Dear Sir/Madam:

I have been following plans for Reelfoot Lake in the Lake County (Tenn.) Banner. I am opposed to the Corps proposals. Your pro conservancy stance is harming farmers in the area as your water is already taking land without payment. I think you'll get a class action suit. In addition, you don't have the money to buy land at fair market value, seeking to pay $1300 an acre when the land is worth $2000. I am a Lake County landowner and am distressed that the drive to have wildlife is riding on the backs of farmers.

Sincerely,

Edmund Willingham

5 August 1999

Memphis District
US Army Corps of Engineers
Public Affairs Office
167 N. Main Street, Room B-202
Memphis, TN 38103-1894

ATTN: Mr. Rodger Funderburk,
Project Manager, Reelfoot Lake Study

Dear Mr. Funderburk

Thank you for allowing me an extension of time for making this formal input to your study. I also wish to thank COL Krueger, for organizing and chairing the very important meeting at Reelfoot Lake on 20 July. Those sorts of interfaces are very important, and I welcomed the opportunity to attend and to make a short statement.

It is in the interest of clarity and emphasis that I submit these written pages. It has been my experience that transcripts of public testimony or meetings leaves much to be desired. My aim in submitting these pages is to inform you and your study group of my concerns. Please do not take any criticisms personally. Perhaps I may not be correct in some of my ideas, but I wish that you would consider them in the helpful manner in which I propose them.

Please consider adding a glossary to the study. Additionally, tone down the pedantic thrust of the presentation so that the reading public can better understand the ideas being presented. It is well to use an scholastic or learned term when first introducing a term or concept, but that should be followed by a more common and easily pronounceable word or words for easier reading and better understanding. An example is the use of Latin descriptors for various trees, fish, etc.; such as *Fraxinus pennsylvanica* for Green Ash, a relatively common tree in the Reelfoot area with which most of us are familiar. Other examples would include repeated use of *Taxodium* (or T.) *distichum* for Bald Cypress; *Betula nigra* vice River Birch, and so on.

I do thank you and your collaborators for producing some intriguing documents that show a great deal of work. The wording continually drove me back to dictionaries and reference documents to help understand what was being presented.

Please send me a full set of the final Supplementary Environmental Impact Statement or whatever form your final report takes.

Thank you again for allowing me to comment in this manner.

Sincerely,

David K. Holland

COL David K. Holland, USA (ret)
5508 Saddlewood Lane
Brentwood, TN 37027
615-373-4891

Thank you for furnishing me a copy of the Reelfoot Lake study, allowing me to make a brief, public statement, and to submit this written copy of comments which will be more detailed than the oral statement.

First, let me say that the basic aim is one that appeals to me. I know no one who wants to 'lose' or severely damage the lake. I can also support some of the ideas incorporated in the study. Secondly, I would have you know that I am not an 'outsider' or 'stranger' who only has an ax to grind in favor of some mollusk or industry, yet is not connected directly with the area. I grew up in Hickman, KY, and have been on and around Reelfoot for most of my life. My Army career took me away from those environs for periods of time, but I have kept an intimate contact with the lake and adjacent lands through many visits. My interests extend to farming operations that are adjacent to and greatly affected by the lake. My family are taxpayers in Kentucky and in Tennessee, which, coupled with heavy Federal taxes, gives us another basis to be interested in any plans affecting the lake. The lake impacts on us and a lot of other people in many ways.

That being stated, I would like to point out what appear to be inconsistencies or omissions in the study. It seems incongruous to me that the study is titled '*Reelfoot Lake Tennessee and Kentucky*'; which acknowledges the truth of the areas affected by the lake; yet your maps rarely, if ever, encompass the Kentucky parts of Fulton County that are actually affected. You cite Hickman, but I don't find a map showing that town. You cite 600 acres as being affected in Kentucky, but don't seem to have an awareness that thousands of Kentucky and Tennessee acres are seriously affected by high lake levels. A high level on that large body of water serves to keep the water table in the Kentucky and Tennessee lands adjacent to the lake so high that agriculture is severely impacted.

Additionally, a high lake level prevents the associated watershed from soaking up heavy rains. The latter situation has a double-barreled effect; first, it will not hold beneficial water for soil regeneration and for a metered flow toward the lake. Secondly, with the land being supersaturated most of the time, the water from large rains (which cannot be accommodated by the lake that is already too high) accumulates on the farm lands and inhibits agriculture, affects infrastructure, creates dangerous flooding on roads, and causes other problems.

While discussing high lake levels, your study needs to be consistent with what height you envision being attained and maintained. Although in part of the study documents, and in some of the statements made at the public meeting the figures of 283.2 NGVD, 283.5, 284.0, and possibly that of 285.0 NGVD were presented in one form or another; yet, on page 5, Section VII, Vol 2, subtitled "Critical Areas" one finds the following, disturbing statement, which I quote:

> "Although the proposed increase in the water surface elevation for Reelfoot Lake is 287.5 feet, the available data indicate that the extent of the study area chosen may not have been large enough to contain the lake at this elevation. Plates 2, 8, and 9 show dashed lines indicating that the areas reported were "closed" artificially, i.e. the 288 foot contour was not completely contained within the project area and a water surface at this elevation would likely not be contained within the study area." End of quote.

Please note that a surface elevation of 287.5 feet, NGVD, would inundate much of the surrounding territory, and is grossly unacceptable, even in conjecture. I call for you to expunge such figures from the final Supplemental Environmental Impact Statement (SEIS), at least have some plausible explanation for hiding those figures back in an obscure part of the document, while presenting lower elevations in all other portions of the documentation.

United States Department of the Interior

OFFICE OF THE SECRETARY
OFFICE OF ENVIRONMENTAL POLICY AND COMPLIANCE
Richard B. Russell Federal Building
75 Spring Street, S.W.
Atlanta, Georgia 30303

August 4, 1999

ER-99/546

District Engineer
U. S. Army Engineer District, Memphis
167 North Main Street, B-202
Memphis, TN 38103-1894

ATTN: Richard Hite (CEMVM-PM-E)

Dear Sir:

The Department of the Interior has reviewed the Draft Feasibility Report and Draft EIS for Reelfoot Lake, Lake and Obion Counties, TN, and Fulton County, KY, as requested.

General Comments

The Fish and Wildlife Service (Service), a bureau of this Department, supports the selection and implementation of the U.S. Army Corps of Engineer's preferred alternative 5b. The proposed structural components of this plan will enhance management opportunities for Reelfoot Lake and its associated wetlands, potentially providing significant habitat improvements for the area's fish and wildlife resources.

Operation of the existing spillway and water level management on Reelfoot Lake is currently the responsibility of the Service, which has not established seasonal elevations for fluctuating water levels on Reelfoot Lake. Any discussion of future water level management activities should incorporate by reference the 1989 Reelfoot Lake Water Level Management Final Environmental Impact Statement prepared by the Service, and the subsequent Record of Decision.

Specific Comments

Page 6, first paragraph - According to the Service's EIS, a steel radial gate was added to the spillway in 1948.

Page 10, third paragraph - The top of the stop logs are at elevation 282.2 NGVD.

Page 18, second paragraph - The Service does not consider curlyleaf pondweed as an aquatic pest on Reelfoot Lake. This plant provides a valuable food source for early migrating waterfowl.

Page 21, last paragraph - There are 15,500 acres of open water habitat at Reelfoot Lake.

Page 25, last paragraph - Currently, the Service does not have the capability to hold water levels at elevations above 282.2 NGVD.

Page 73, last paragraph - The Lease agreement between the Service and the Tennessee Wildlife Resources Agency expires in 2016.

Page 78, second paragraph - We recommend that priority be given to construction of a new spillway and the sediment retention basin on Reelfoot Creek. These structural components should address sedimentation and existing hyper eutrophic conditions in Reelfoot Lake.

Summary

With the exception of the general and specific comments outlined above, the Draft Feasibility Study and Draft Environmental Impact Statement adequately describe existing conditions and propose viable alternatives to address existing problems at Reelfoot Lake. The Service supports the selection of Alternative 5b as the preferred plan.

If you have questions concerning these comments, please contact Bruce Bell, 404/679-7089.

Thank you for the opportunity to provide comments on this Feasibility Report and EIS.

Sincerely,

James H. Lee

James H. Lee
Regional Environmental Officer

I would also like to weigh in on the side of those who spoke against the severe drawdown option that seems to be the shining jewel of the study. There was little doubt in my mind that the proposed drawdown would have serious effects on the economy of the area, and, after hearing the very profound pleas of those whose businesses and homes are directly affected, I cannot support that option. The idea of reducing the lake by half and allowing the resulting, stinking mess to be the situation for a significant part of a year is folly. It doesn't take a very vivid imagination to visualize almost nine square miles of mud, rotting vegetation, and fish dying of oxygen starvation. There would probably be increased predation on fish exposed in concentrations in small pockets of water, even before they succumbed to the lack of food and oxygen. There would be an unconscionable loss of the scenic vistas, beauty, and mystery associated with the lake for decades. How will the various fur-bearing animals and the deer cope with the depleted lake? The drawdown plan, in a word: STINKS!

The recovery from such drastic measures would take a longer time than the study suggests. The lake probably would not refill in a few months from local rains, and, if it did, the effects of the drawdown would still disssuade visitors, who are the backbone of the local economy. Businesses related to the lake would be forced into bankruptcy. Motels, restaurants, guides, boat builders, hunters, food sellers and outfitters would be bereft of customers and would be forced out of business. Where is the support for these?

The real shocker is that this supposed panacea for the lake is planned to be repeated every five to ten years. So, what is being planned is an action that would ruin the tourist trade for several years, and, just as tourists might be enticed back to the lake area, it would be subject to another round of drawdown.

The medicine is too strong for the patient, I fear. Perhaps the drawdown would be efficacious in reducing the lake's masses of vegetation, allowing culling of trash fish, and other possible gains, but the destruction of the businesses, harm to the fragile economy of the region, loss of jobs, and the loss to the tax base would be unacceptable. Later on, I will suggest a simpler, easier solution.

There seems to exist a group who want Reelfoot to become something it never was. They must visualize Reelfoot, or his cousin-in-literature, Hiawatha, nobly plying the waters of the pristine lake in their birchbark canoes. No restaurants, no boat rentals, no duck call makers, no fishing or hunting guides, no timber harvesting, and no commerce or signs of modern people to mar the primal scene. That seems to be the dream of more than a few. Those of us who are affected by the lake want to preserve it too, but not at the expense of our livelihood. The lake is not an icon, it is a lake, and lakes are subject to eutrophication. I digress here to add a definition of that term so that all who read this, if it is included in the final SEIS, will be enlightened as needed:

> **eutrophication**, aging of a lake or slow-moving stream by biological enrichment of its water. In a young lake the water is cold and clear, supporting little life. With time, plant and animal life burgeon and organic remains begin to be deposited. As the lake grows shallower and warmer, marsh plants take root and begin to fill in the basin. Eventually the lake gives way to bog, finally becoming dry land. The natural aging of a lake may span thousands of years. However, wastes and rampant vegetation can accelerate the aging process. Decomposition of dead algae reduces the water's dissolved oxygen content, adversely affecting fish and other aquatic life forms typical of a mature lake.

The definition says that lakes, like farm ponds, are destined to die. They are not forever.

Who is considering the tax base? Where are the advocates for producing food and fiber for the Nation? Who cares about the Hamiltons, Bunches, Hoggs, Caldwells, Boyettes, Calhouns, Goodmans, Parkers, Williams, Deckers, Jamisons, and all the other people responsible for making Fulton, Lake, and Obion Counties viable? Who cares about the farmers who a stewards of the lands surrounding the lake? The answers to all the above seems to be that NO ONE in the associated governmental agencies has given consideration to the world of taxpaying business people who provide the wherewithal for schemes such as the study. Hearken to those who make our Nation work.

ELEMENTS OF VOLUME 2, APPENDIX A, ENVIRONMENTAL ANALYSIS THAT SEEM TO BE VALUABLE FOR ADDITIONAL DISCUSSION AND IMPLEMENTATION

The letters from Dr. William Zattau and Mr. Funderburk, both dated in 1993, contain some interesting data. That of Dr. Zattau contains some specific recommendations. What has happened in the interim? Have any of Dr. Zattau's recommendations been implemented? Some of those were:

> beginning herbicide treatments earlier in the year before curlyleaf tops out,
> using ***fluridone*** (a systemic herbicide, trade name Sonar) in Buck Basin;
> obtaining accurate, seasonal baseline studies of the vegetation to be managed,
> spot treating nurseries (for weeds) in tributaries before turions are formed,
> expanding the use of the FWS 'cookie cutter' for cutting navigation trails during the fishing season.

> **Most importantly**, among Dr. Zattau's recommendations in his 21 June 1993 letter, (a copy of which is included in the Draft SEIS, Volume 2, Section III, Aquatic Plant Control), was that **a written, comprehensive management plan to address aquatic plant control** (emphasis mine) be developed. He gave several cogent and vital reasons that such a plan be developed. He did not identify a specific author for such a document and guide, but did say that the program, as discussed with agency personnel, seemed feasible.

Whomever is in charge should move immediately to implement Dr. Zattau's recommendations, especially the latter one. It seems strange to me that over the many years and millions of dollars invested in 'studying' the lake, that a written, comprehensive plan has not been produced and put into practice. Who is dragging their feet? What will it take to get such a document produced, approved, and implemented?

Dr. Zattau also recommended that an interagency Aquatic Plant Management Task Force be formed to focus on the vegetation problems. Although he deplored establishing another set of meetings as a burden and redundant; he said that such focused meetings can be very helpful, and he further recommended including 'select' members of the public and those with commercial interests. I applaud that approach if the group is kept small, and that frequent open meetings are included in the arrangement. Move quickly to form a **small** task force of persons who have expertise or interests in the matter and set them to work with a close deadline for producing the desired result. Take care that persons predisposed to a hard plan or activity are cautioned not to let that predisposition cloud their sense of reason. After they have met, concluded, and produced a draft, let that draft by subject to public scrutiny, especially from those who will be most impacted by activities relating to the lake and its environs.

Using those methods, I believe that a suitable document could be produced in less than a month or two, and could be put into practice without a great deal of difficulty and delay. Those with bona fide interests in the lake should be vitally interested in pushing such an effort forward with all speed. Additionally, if caution is called for, a smaller implementation program (test) could be part of the overall plan. Let the public see what can be accomplished, and they will be convinced of the value of the plan. That would also give the planning group an opportunity to fine-tune the plan. Any such plan would need to be subject to change as evidenced by results.

Extreme caution would have to be exercised to prevent the action group from becoming another, self-perpetuating body that would continue studies in order to enjoy meeting and pontificating. Make a plan; then dissolve the body of planners.

The next step is to allow the operations personnel/agencies put the plan into practice and do the necessary management. Appoint a 'watchdog committee' to keep an oversight of the work, and, if necessary, reconvene planning groups to make changes, but don't produce another bureaucracy to further obfuscate the lake's real or imagined problems.

NEW SPILLWAY/DRAINAGE/CONTROL STRUCTURE IN VICINITY OF OLD ONE

There is no doubt that the existing structure has far outlived its usefulness. I heartily agree with providing a new and better structure that is more responsive and capable of controlling lake levels

I am concerned that the new structure will allow for much higher levels than are currently experienced. That can only lead to an 'if it exists - use it' sort of condition. We do not need a higher lake. A higher lake will have severe economic impacts on adjacent lands, just as a much lower lake will be very harmful. What is needed is an effective new set of gates that can by manipulated easily and quickly by local authority to control the lake's level within set parameters that are not dangerous on either end.

I am told that those who currently operate the antiquated gates must call an office in Atlanta to obtain permission to open the gates during heavy downpours of rain. If true, and I don't doubt my source, we are truly in the realm of 'Big Brother' where no one is allowed to make decisions on the local level, but must defer to some higher authority. Local people know the lake, and local people need to make decisions, within parameters, to open or close gates, as needed to maintain the proper lake level. Safeguards must be in place to prevent some zealot from unilaterally draining the lake or flooding adjacent lands, but, in the normal scheme of things, we should appoint some responsible people, give them guidance; then stand back and let them do their duty. Doesn't seem to be extremely world-shaking advice, but under today's proclivities for supermanagement of almost every thing, it may be novel. Just do it!!

CONTROLLING EROSION AND HARMFUL BACTERIA AT THE SOURCE TO REDUCE TOXIC EXPOSURE AND SEDIMENTATION WITHIN THE WATERSHED AND LAKE

Other elements related to the simple solutions of dredging and biomass collection/composting include controlling erosion at the source, and not creating another 'lake' under the guise of a sedimentation basin.

Additionally, there must be a strong effort to reduce, if not eliminate, the presence of harmful bacteria; such as, *Escherichia coli* (E. coli), from the waters that drain into the lake. It is obvious that the major source of fecal materials is from poorly treated or untreated human waste that is allowed to flow into the natural surface and subsurface water systems. In these days and times it is unacceptable to let untreated human wastes flow into waters such as the lake. Those same contaminants pollute the wells of unsuspecting persons who happen to be in the soakage plane of inefficient human waste treatment systems.

I would say that the elimination of fecal bacteria in the water should be priority number one What say you?

SEDIMENTATION BASIN:

The proposed sedimentation basin does not appear to be an efficient solution to a problem that can be effectively and more permanently solved by attacking the sources. The pond, and that is what it is, would become a frequent nightmare of a task. The basin may fill with sediment fairly rapidly. As it fills it would become a nursery and harbor for noxious weeds (transported by wind or waterfowl). Since water flow would vary greatly, so would its surface elevation, that would lead to its becoming choked quickly with willows and other fast-growing and undesirable trees, shrubs, and weedy species. It would become another mosquito nursery, of stagnating water.

It would represent a significant increase in local water surface subject to evaporation, which, in turn, helps to concentrate problem materials suspended or dissolved in the water. The sedimentation basin would require relatively frequent draining and scraping out, and where would one put the materials scraped out? What would happen to the aquatic life? What would be the fate of the accumulated benthic population of the sedimentation basin?

Why create another man-made structure within the lake's area of influence? In my opinion, the proposed sedimentation basin is a 'band-aid' approach, albeit an expensive one, to a much larger problem. A more profitable and long-lasting solution would be to determine the source(s) of the offending sediment and take measures at those points to reduce the problems. Certainly, all intrusion of sediment cannot be stopped, but it seems possible, even probable, that the major amounts could be apprehended further up the water courses feeding into the lake, thus reducing the problem to a more manageable one.

The US Department of Agriculture Natural Resources Conservation Service (NRCS) in Southeast Missouri has an excellent record of reducing erosion from farm lands with the concomitant reduction of sediment and chemical run-off. If some of the large sums of money described as being necessary to save the lake could be redirected to improving erosion control on feeder streams, most of the sedimentation problem would vanish.

As a last resort, smaller ponding areas might be established on Reelfoot Creek and any other offending watercourse that would serve to catch sediment further up the stream. Those might be

more easily maintained and managed. In any case, they should be considered in the overall scheme.

HISTORY AND GEOMORPHOLOGY OF THE LAKE AND ITS ENVIRONS:

We are continually bombarded with myths regarding the formation of Reelfoot Lake. Certainly, the huge earthquakes of 1811-1812 had significant effects on the area, but, Reelfoot Lake did not magically and suddenly appear from high prairie or hill lands into the swampy lake we know today. Your study alludes to many aspects of the formation of the lake as we know it today, but if the data were gathered into one concise page or two it might help to dispel myths and to encourage deeper study of an exciting area. An outline of the probable pattern of events over a very long time would be helpful, especially if presented in a straightforward and interesting context.

It seems more likely (if you give credit to the landmark work of Dr. Roger T. Saucier regarding the Geomorphology and Quaternary geologic history of the Lower Mississippi Valley) that the Mississippi River, in its continuing response to gravity and available water, has swept over the entire region at least once, and more than likely many times. As the river made its broad loops and turns it also abandoned others; thus forming what are called "oxbow lakes". These are relatively common along the course of the river, and are one of the major bases for Reelfoot Lake.

I believe if your investigators had made deeper core drills within the lake area they would have found a great deal more evidence of the river's influence, and possibly evidence of much earlier earthquakes. It is extremely possible that there have been a succession of lakes in that area, and more detailed attention to the area may show more than one layer of downed trees, evidence of earlier eutrophication processes, and older point-bar locations.

We must transcend the romantic stories that abound – The river ran backwards for days!! The ground sank to dramatic depths!! The lake has deep areas that have yet to be fathomed!! There was volcanic activity!! All of these have been proven to be hyperbole. Actually, there is enough factual information available to give this giant evidence of the power of earthquakes an aura of its own without trying to embellish the real happenings.

I was surprised not to find reference to the failed rift in the center of the North American Plate, nor was there reference to the large graben that trends NE to SW with a width of almost sixty miles and an undetermined (as far as I know) length, or evidences of plutons in West Tennessee and Eastern Arkansas! All those are evidence of something very important about the upper Mississippi Embayment and, most importantly, the area affecting Reelfoot Lake.

Perhaps those discussions were considered immaterial to the overall study, but I feel that their inclusion would help readers to have a more informed view of the area. More information helps one to better visualize what has occurred and what may happen in the future.

It should be noted that the vegetation in and around the lake is representative of the swamp or marsh conditions that existed before the lake was deepened by the processes of a slight ridge being raised along the south rim of the current lake, and some subsidence within the lake itself. I would like to see a more straightforward treatment of the geology of the lake area. The huge masses of loess that comprise the highlands immediately east of the lake are part of the history of the lake and the source of a lot of the sedimentation.

Additionally, the effects of damming up of the historic drains from the lake should be included in the study to more clearly portray the more probable way the lake was formed and as it has been managed (and mismanaged) over the years following the earthquake period.

Another helpful adjunct to the study would be a series of colored contour maps showing the effects of 282, 283, 284, 285, 286, 287, and 288 feet of surface elevation in that area. actually one large map would suffice if different colors were chosen for the various elevations. In that area one foot contours are a must. The land has a remarkable amount of relief, but the variances are relatively small. It is not 'flat as a pancake', but the small variances in surface elevation can have far-reaching and dramatic effects.

SUGGESTED ADDITIONAL REFERENCES:

An inclusion of a more eclectic set of references to round out those I found in the document set might include:

Roger T. Saucier Dec 1994. Geomorphology and Quaternary Geologic History of the Lower Mississippi Valley, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi, in two volumes

Russell H. Caldwell, July 1989. Reelfoot Lake, revised edition, Copyright 1989 by Russell H. Caldwell.

Otto W. Nuttli May 1980 (second edition) w/foreword and appendices by David Stewart: The Effects of Earthquakes in the Central United States, pub. By The Center for Earthquake Studies, SE MO State Univ., Cape Girardeau, MO.

Edward T. Luther, 1985 (second printing), Our restless Earth, The Geologic Regions of Tennessee. Published in cooperation with The Tennessee Historical Association by the University of Tennessee Press, Knoxville.

Paul J. Vanderwood, 1969. Night Riders of Reelfoot Lake. Memphis State University Press, Memphis, TN

Myron L. Fuller 1912. Department of the Interior, United States Geological Survey, Bulletin 494. The New Madrid Earthquake. The Government Printing Office, Washington, DC

[NOTE: In the ensuing years, parts of the claims and observations made by Fuller and Nuttli have been called into question; however, much of their basic work is still valid and makes for a more complete knowledge of the lake and its history.]

DREDGING

Although this option has generally been dropped from further consideration; I feel that it should be reconsidered in a different light. I do not mean that we should move a very large Mississippi River dust pan or cutter-head dredge into the lake to root and tear away at the bottom and banks. That is patently an unacceptable solution, if for no other reason than there is not enough water to float such a behemoth in much of the lake. Although a big dredge could cut out its own channel and pump the offending sedimentation and debris onto the bank; the damage to the lake would be irreparable.

The dredging system that I envision is a very simple one. A system that would take years to clear large expanses of the bottom of the lake, but would be kind to the environment. It would consist of a small barge or flat-bottomed boat that would have a very shallow draft. The barge would be no more than 20-30 feet long and about 10-15 feet wide. Mounted on the barge would be a small suction pump that would be able to handle mud and light debris. At the front of the barge (or side) would be a boom-like device from which would be suspended a pipe system connected to the pump. The pipe would be about 6" diameter (larger would be better if the resulting system does not get too heavy for the light barge), movable by hand or light tackle, and would be rigid enough to enable it to be directed to the bottom. The very end of the suction pipe could have a short, flexible snout that would help to accommodate variations on the lake bottom and to reduce harm to the bottom.

The pump and pipe combination should be strong and large enough to be able to suck up the roots of curlyleaf and other noxious weeds/vegetation. The capability of the pump/pipe combination should allow the careful cleaning of the newest siltation/sedimentation on the lake bottom and on submerged logs without damaging the hard clean bottom needed for breeding by certain fish species. In fact, the goal would be to reestablish a hard clean bottom without damaging cover and feeding areas for aquatic life.

The pump and pipe combination should be strong enough for operations in deeper water, if that is deemed necessary. However, it may be more practicable to have a second dredge or other solution for the deeper water and for heavier accumulations of sediment.

The envisioned dredge/suction barge would be accompanied by either discharge pipes (for when the unit is close to a dumping site on shore) or by small barge-like equipment that would collect and hold the dredged material for transport to an on-shore dumping site. Alternatively, a barge or boat that would serve to transport large barrels or tanks of dredged material would suffice. The latter might be the better solution, as the smaller containers could be lifted off the barge and dumped using a small crane mounted on the bank. The smaller containers could also have relief holes that would allow most of the pumped water to run back into the lake near the dredging site.

In operation the dredge barge would resemble its larger cousins in that it could be equipped with spuds for holding it in place and for a rotational focus. It would also have long anchor lines on the front that would allow for moving the head of the barge back and forth as needed; then, as one area is cleaned, the lines would be used to pull the barge forward for another dredging sweep.

The whole setup would be accompanied by a small, shallow draft boat for moving the dredge and transporting barges. The boat would serve as the crew boat for moving workers from the bank to the work site and back. It would also serve as an emergency transport for injured personnel, etc.

A crew to operate the envisioned dredge and ancillary equipment would consist of about 5-6 persons who would be employed full-time. When not operating in the dredging mode, they would be collecting biomass (see discussion), clearing and maintaining circulation channels, and performing other duties related to cleaning and clearing the lake's waters and areas. Maintenance of equipment would be relatively minimal with the simple items outlined above, but there would be slack times between modes of operation for hauling the crew boat, barges, etc., and performing necessary repair and maintenance.

The results of the dredging operations would recover (over time) a large amount of rich sediment that could be mixed with the composted biomass and converted into desirable potting soil, soil amendments, fill dirt, and landscaping. The sale of such materials would help to defray the cost of operations.

BIOMASS COLLECTION/CONVERSION

From data extracted from the DSEIS, and from personal observations, the volume of biomass potentially available for collection from Reelfoot Lake is very large. Additionally, it seems that mechanical cutting/pulling/raking/collection of the aquatic weeds (especially curlyleaf and coontail) would be a viable option for disrupting the life cycle of the most noxious of the weeds. It would also seem that devising a simple collection process, using the dredging barges for transport, and establishing a place for allowing the collected biomass to compost on land would be ecologically desirable and would be supported even by the most avid groups ostensibly devoted to protecting the environment.

The very fact that this solution is not dramatic may be its nemesis. Everything in the study seems to be on a grand scale, and simple solutions applied over a long time period do not seem to find entrance into the plans. However, if one has been on the lake, attempting to fish, and has experienced how easy it is to pull up a huge wad of vegetation with the edge of a paddle or bow-facing oar; it is also easy to understand how simple the collection process could be.

A raking device or a couple of strong prong-like projections set on the front of a small, open top barge could be pushed into a mass of the offending vegetation. After the rake is loaded with the vegetation, a simple tilting mechanism would bring the impaled mass into the barge, where the biomass would be removed from the collecting mechanism. The rake could then be repositioned, and the process repeated until the barge was filled. Alternatively, a very small stiff-leg crane could be barge or boat mounted, and, equipped with a rudimentary grapple, would simply dip into the floating biomass and lift masses into a transporting barge or boat.

The collected biomass would then be transported to selected points on the lake bank, the mass unloaded by similar grapples and placed in piles or rows for composting. When composting is done correctly there is little objectionable odor, and the location of the composting sites would limit impact of the composting operations on the local area.

If there is doubt about composting as an option, I believe that an expert; such as, Mr. William Bricker of Augusta, GA's famous composting company, Kricket Krap™, would be glad to advise or consult regarding composting. He has used a large variety of materials to produce several products that are a commercial success. There is little doubt that an economic boon could exist in the marketing of a Reelfoot Lake compost or potting soil. At the least, local agriculturists could use the materials to enrich the lands in an environmentally friendly manner.

The biomass collection process can be accomplished with a few persons hired to perform those duties during the growing season for the target aquatic weeds. During the rest of the year they could be employed with vacuum dredging of selected areas within the lake's environs. Over time, these complementary processes would rejuvenate and extend the life of Reelfoot Lake for the enjoyment of yet more generations of people.

One further advantage of the environmentally safe and minimally invasive suggestion outlined above is that the equipment and crew represent a flexible operating group that can be easily moved to specific areas at will. The management group would be able to attack any heavy infestations of biomass or troublesome sedimentation as determined to be necessary; or, a grid system of clearing and cleaning could be used for normal operations. Coupled with enlightened use of the proposed spending plan, the dredging/biomass collection system would succeed.

STATE OF TENNESSEE

DON SUNDQUIST
GOVERNOR

August 9, 1999

Memphis District Corps of Engineers
ATTN: CEMVM-PM-E (Hite)
167 North Main Street, B-202
Memphis, TN 38103-1894

RE: Comments of the State of Tennessee on the Corps of Engineers Feasibility Report, Draft Environmental Impact Statement, and all associated Appendices for the Reelfoot Lake, Tennessee and Kentucky Feasibility Study

Ladies and Gentlemen:

I am responding on behalf of the Governor of the State of Tennessee as the lead point of contact for state NEPA reviews concerning the above referenced document. Enclosed are comments from specific state agencies. Please consider these comments as you would those in this letter.

Reelfoot Lake is a state and national treasure. As the only naturally formed lake in Tennessee, Reelfoot is home not only to a wide diversity of wildlife, including golden and bald eagles, but also provides unparalleled scenic vistas. It is one of the most abundant fishing and game preserves in the nation, providing year-round opportunities for sportsmen of all interests. With its shallow shores and striking cypress ecosystem, Reelfoot is also home to almost every species of wading bird in the southeast. Long a mecca for photographers, naturalists, and sportsmen, Reelfoot is a place of quiet beauty and startling abundance not found elsewhere in this region.

In recognition of this natural bounty, the State of Tennessee made Reelfoot a State Park in 1956, and gave it the additional designation of State Natural Area in1973. The State of Tennessee supports the Corps of Engineers' efforts to preserve and protect this critical ecosystem. We are committed to work in partnership with the Corps to ensure the continued health and vitality of Reelfoot Lake.

We have reviewed the project proposals described in the report and the DEIS. These proposals include a water level management regime with a water fluctuation component, construction of sediment retention dams, construction of a new spillway, upgraded circulation channels, restoration of Isom and Shelby Lakes, and development of waterfowl management areas.

We support the concepts outlined in these proposals. All proposals for alteration of the function and structure of Reelfoot Lake and its surrounding ecosystem must be supported by good data

State Capitol, Nashville, Tennessee 37243-0001
Telephone No. (615) 741-2001

and based upon sound science. Also, all adverse impacts must be carefully reviewed and analyzed in order to avoid or minimize such impacts to the extent possible.

To ensure the success of this project, the State requests that the Corps continue to work closely with all affected parties to allow ongoing dialogue in the planning and implementation phases. The use of the Partnership Agreement that the State enjoys with the Corps of Engineers will help ensure that appropriate review and consideration is given to all aspects of the proposed work.

Following are specific issues that the State of Tennessee requests that the Corps consider and address prior to issuing the final EIS.

1. **The Corps and the State should work in partnership to examine fully all direct and associated impacts of the proposed projects to Reelfoot Lake.**

Most of the proposed projects will require authorization from the Department of Environment and Conservation and the Tennessee Wildlife Resources Agency. The Corps should coordinate with these agencies very early in the process. A specific area that the State would like to examine further is impacts to water quality and pollutant loading.

Additional information is particularly critical to allow a thorough evaluation of impacts of the proposed lake level fluctuation. If selected as a final alternative, this component will present significant challenges. Clearly, it will require a more detailed examination of the data and information to ensure that dramatic releases of lake waters do not further degrade water quality downstream or cause irreparable environmental impacts.

Also, additional consideration will be necessary for streams designated by the State as being impaired. Pursuant to Section 303(d) of the Clean Water Act, the State is required to list streams that are not meeting water quality standards. Several streams in the Reelfoot Lake area, including Running Reelfoot Bayou, are 303(d) listed streams. These streams fail to meet water quality standards for such parameters as organic enrichment, nutrients, suspended solids, and flow alteration. By law, the State cannot authorize any activity that would further degrade water quality in these streams. The State is available to assist the Corps in avoiding impacts to these waters.

2. **Any proposed project should thoroughly examine impacts to rare and threatened habitat at Reelfoot Lake.**

Reelfoot Lake and its associated wetlands are designated as Outstanding National Resource Waters and as a Class 1 State Natural Area. The area provides habitat to a myriad of state and federally listed endangered and threatened species. The State has recorded 182 rare, threatened, and endangered species in this area. The Bewicks Wren, Swainsons Warbler, and the rapidly declining Least Bittern exist at Reelfoot Lake. Reelfoot Lake is also the only known breeding location for

Purple Gallinules and Common Morehens (shoreline-feeding water birds) in Tennessee.

Great care should be taken to ensure that the habitat of these species is maintained, and if possible, enhanced. The State is committed to providing any assistance necessary to the Corps to ensure protection of these critical areas.

The State strongly supports the Corps' efforts to preserve Reelfoot Lake. The survival of this unique ecosystem is vital to the citizens of Tennessee. Since the historic earthquake that forced the Mississippi River to flow backward and create this natural treasure, Reelfoot has drawn visitors from across the state and the nation to enjoy and admire its natural beauty. From the veteran photographer braving the winter cold to capture the image of a soaring bald eagle, to the first fish caught this spring by a young sportsman, Reelfoot has enriched the lives and welfare of the citizens of Tennessee and the people of this region. We must take action now to protect this precious area for generations yet to come.

We realize that any significant structural projects designed to promote the long-term health of the ecosystem may result in short-term adverse impacts. We believe that the preservation and protection of the lake outweighs such impacts, and trust that the Corps will bring to bear the latest available scientific data and management techniques to avoid or minimize these impacts.

The Corps has a unique opportunity to implement a project that can highlight its ability to cooperate and communicate with all affected parties. We are confident that the Corps will take this opportunity to fully explore the impacts of all alternatives to ensure the success of this important project.

Sincerely,

Justin P. Wilson
Deputy to the Governor for Policy

encl.

The following state agencies commented on the draft EIS:

Department of Environment and Conservation:
- Division of Water Pollution Control
- Division of State Parks
- Historical Commission and Archaeology
- Natural Heritage

Tennessee Wildlife Resources Agency

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION

July 28, 1999

District Engineer
U.S. Army Engineer District, Memphis
ATTN: Environmental and Economic Analysis Branch (CEMVM-PM-E)
167 North Main Street, B-202
Memphis, TN 38103-1894

Dear Sirs:

Thank you for the opportunity to review the *Draft Feasibility Report and Draft Environmental Impact Statement for the Reelfoot Lake, Tennessee and Kentucky Project*. As you may be aware, the Division of Water Pollution Control was an active participant in the planning and implementation of many of the studies that described the water quality conditions at Reelfoot Lake. We are pleased to continue an active role in this process and offer the following general and specific comments for your consideration.

1. Most of the potential restoration projects described in the document will require authorization from the Department of Environment and Conservation in the form of an Aquatic Resource Alteration Permit and/or §401 Certification. Included in these are a new spillway, digging of circulation channels, or creation of a dam on Reelfoot Creek. Authorization of these projects will be based on an analysis of the ability of the applicant to avoid water quality impacts. Off-site compensatory mitigation of water quality impacts may not be an option at Reelfoot Lake.

2. The Tennessee Water Quality Control Board has approved Outstanding National Resource Water status for Reelfoot Lake and associated wetlands. Understandably, this recent designation under Tennessee's Antidegradation Policy is not included as an issue in the draft document, but a discussion of the potential ramifications of this designation may be in order for the final version.

3. The need to improve water quality in Reelfoot Lake is well documented. In our opinion, the techniques best suited to bring about this improvement are: restoration of impacted or lost riparian wetlands; removal of hydrological modifications such as channelization and levees and restoration of natural flow regimes along tributary streams, implementation of best management practices in agriculturalized areas (including conversion of some farmed areas to permanent cover), and a more natural fluctuation of lake levels.

The extreme summer drawdown discussed in the draft is a well-established fisheries management technique. However, its value as a method to improve water quality is less well-established.

4. Running Reelfoot Bayou is listed on the 303(d) List as not meeting water quality standards for organic enrichment, nutrients, suspended solids, and flow alteration. The Division would be unable to authorize any activity that would add additional loadings of these pollutants to this stream. The potential impacts of dramatic water releases from Reelfoot Lake on downstream waters have not been quantified or adequately considered.

5. The recent history of constructed projects in the Reelfoot area has not been without problems. In order to be able to authorize projects such as dam or spillway construction, we would need strong assurance that the applicant has the means to prevent offsite impacts.

6. We support the statement in the draft that restoration projects should contain provisions for water quality monitoring in order to gage impacts and/or success.

Thank you again for the opportunity to participate in this process. The Division of Water Pollution Control is prepared to provide assistance as needed. If I can be of further assistance, I can be contacted at 615-532-0699.

Sincerely,

Gregory M. Denton

Gregory M. Denton, Manager
Planning and Standards Section

Division of Water Pollution Control • L & C Annex 6th Floor • 401 Church Street • Nashville, Tennessee 37243-1534

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
BUREAU OF STATE PARKS
401 Church Street
Nashville, Tennessee 37243-0446
615 532-0001

MEMORANDUM

TO: David Harbin

FROM: Walter Butler WB
Assistant Commissioner

RE: Comments on the Feasibility Report and Environmental Impact Statement (EIS) Regarding the Corps of Engineers' Reelfoot Lake Feasibility Study

DATE: August 6, 1999

The following are the Division of State Parks comments on the above referenced report and EIS:

1. The main concern is the overall impact that this project will have on State Parks and associated properties.
2. The proposed construction of the spillway may impact a Rangers residence.
3. Potential higher water levels may impact the Park campgrounds. The campgrounds are heavily visited with high occupancy rates.
4. There is little information in the report and EIS on the impacts to general recreation in the area.

Thank you for allowing us the opportunity to comment. If you have any questions I can be reached at 532-0022.

WB:jb

c: Roy Jensen
Steve Pardue, Park Manager

July 28, 1999

MEMORANDUM
[revised July 29,1999]

To: Mr. David L. Harbin, Attorney,
Environmental Policy Office, TDEC

From: Andrew N. Barrass, Ph. D., Environmental Review Coordinator
Division of Natural Heritage, TDEC

Subject: NEPA Review, DRAFT-Environmental Impact Statement, Reelfoot Lake and Feasibility Study for Spillway Re-construction, U.S. Army Corps of Engineers, Memphis District; Project review information for endangered species and critical or sensitive habitat

As I indicated in our discussion yesterday, we have reviewed our Departmental data bases and find recorded State and/or Federally listed species within or adjacent to the Reelfoot Lake projects sites. These species have very specific habitat needs, with some specific habitat-types only occurring in the project area. In total we have 188 rare, threatened, and endangered species records(of State and Federal concern) within the project area. The largest concentration of these records are within the Reelfoot Lake management area, please see Attachment 1

The results of our Departmental data bases review does not mean that a comprehensive biological survey of the project area has been completed. Several studies were completed nearly a decade ago. Because of the presence of State and/or Federally listed species near the project area (within a mile radius and/or a fifteen mile segment downstream), it is probable that those species will occur in the project area if suitable habitat exists. Therefore, we would *recommend* that a survey of the project site(s) be conducted prior to project implementation.

We have had little time to thoroughly review the DRAFT-Environmental Impact Statement, Reelfoot Lake and Feasibility Study for Spillway Re-construction (DEIS) and supporting documentation, since we only received our CD copy July 12th. The document appears to be very general in scope, possibly be due to the prolonged development time (since 19867) In addition, the technical components lack natural resource information. This leaves the review agencies at a loss to evaluate or understand the USCOEs approach to the proposed construction actions and preferred habitat restoration techniques. Like many of the more recent Federal actions outlined by DEISs, the project concept maybe generally accepted yet the construction techniques are questionable or not thoroughly documented.

Because of the highly erodable soils in this region the construction techniques, restoration actions, dredging projects, and spillway re-construction will pose many challenges to the contractors selected for this project There have been many advances in the development of bio-engineering techniques, native plant propagation, habitat restoration, and construction erosion control during the last few years The DEIS however, does not address these accepted practices.

In addition to these general comments, we also suggest the following more specific issues for consideration in the **Final-Environmental Impact Statement, Reelfoot Lake and Feasibility Study for Spillway Re-construction**:

1 The Reelfoot Lake property contains approximately 12,000? acres of forest (approximately 50% of the managed area). The land use alternatives should review the significance of protecting contiguous forest tracts, forest communities and sensitive plant or animal populations. As an example, there are many state listed rare plant species only found within the Reelfoot Lake management area These rare plant populations and associated communities should be further evaluated prior to dredging or canal re-construction.

2 The project area has a large number of rare, threatened or endangered bird species. This concentration of bird species records is associated with the variety of wetland habitats present in the management area As an example, the Bewicks Wren, Swainsons Warbler, and Least Bittern have rapidly declining populations according to the ***National Partners in Flight.*** Additionally, the project area is the only known location for breeding Purple Gallinules and Common Morehens (shoreline-feeding water birds) in Tennessee. Perhaps the Final-EIS should address the project benefits to these wetland species.

3 The managed property should have a thorough field survey for all plant and animal species in order to designate the proper protection actions for the species of State or Federal concern. Perhaps GIS mapping of habitat types could be a useful tool for evaluating appropriate land use options

4 Our Department has routinely opposed the disposition or development of public land that contributes to the fragmentation of forested lands and to the loss of wildlife habitat or recreational resources The land use alternatives (e g canal corridors selected to be re-dredged) should provide adequate buffers for the protection of sensitive species and aquatic habitat. We believe that the Final-EIS and construction plan should thoroughly explore the continued protection of high-quality habitat and conservation areas, including contiguous forest or sensitive wetland species

5 The land use alternatives reviewed should acknowledge existing conservation agreements with various land management agencies (e.g., Tennessee Wildlife Resources Agency), in order to maintain land use and conservation strategies (e.g., Natural Areas).

6. The land use alternatives should address the encroachment by adjacent properties of dissimilar land use(s).

7. The Final-Environmental Impact Statement should address current land use(s) and compare long term and cumulative impacts to ***changes*** in land use or land management strategies The DEIS has not defined the end product of the assumed restoration of Shelby Lake and Lake Isom

8. The proposed prolonged draw down that will be accomplished by the re-construction of the spillway could have a beneficial effect by reducing large populations of similar aquatic plants along the shoreline and encouraging additional native emergent species to invade the shoreline A potential hazard to this positive effect to littoral plant communities is that exotic plants too could encroach in the newly created space (e.g., Purple loosestrife).

9. The DEIS has not addressed the Executive Order on Invasive Species and how the USCOE will implement measures to control alien species and protect sensitive ecosystems.

10. A report prepared for our Department by the USGS, *Nonpoint-Source Pollutant Discharges of the Three Major Tributaries to Reelfoot Lake, West Tennessee, October 1987 Through September 1989*. (Lewis *et al*, 1991), discusses thoroughly pollutant loading to the Reelfoot Creek drainage. The hydraulic portion of the Final-EIS should include information from this report in the analysis of assumed water quality and nutrient loading from storm events In addition, assumed water quality conditions associated with a draw down could be influenced by nutrient loading data from this report.

As we discussed during our meeting, we believe that this proposed project is a great opportunity for the region and State. We applaud the Tennessee Wildlife Resources Agency for serving as the sponsor for this project. We look forward to the large scale habitat restoration and the continuing efforts to protect Reelfoot Lake.

Please let me know if we can assist the USCOE in furthering the EIS process. We appreciate the opportunity to assist you with your pre-project planning and review of the document Should you need any additional information regarding a specific species, species habitat requirements, special ecological sites or managed areas, etc. please contact me at 615/532-9695.

Attachments: (1)
(quad map listing)

cc:

Mr. Reginald G. Reeves, Director, DNH-TDEC
Mr. Dan Sherry, TWRA
Mr. Lee Barclay, Ph. D., U.S. Fish and Wildlife Service

TENNESSEE WILDLIFE RESOURCES AGENCY

ELLINGTON AGRICULTURAL CENTER
P.O. BOX 40747
NASHVILLE, TENNESSEE 37204

July 28, 1999

Mr. David L. Harbin
NEPA Coordinator
Department of Environment and Conservation
Office of Environmental Policy
L&C Tower, 20th Floor
401 Church Street
Nashville, TN 37243-1548

re: DEIS for the Reelfoot Lake Feasibility Study

Dear David:

The Tennessee Wildlife Resources Agency is a cooperating agency in support of the Corps' Feasibility Study for Reelfoot Lake. We are in agreement and full support of the basic findings and action alternatives selected in the document. In this comment letter, we do not analyze the Benefit and Cost Summaries presented with various action alternatives.

We would like to make the following specific comments:

- PAGE 10, REDUCED WATER LEVEL MANAGEMENT CAPABILITY:

  Where the word 'weir' occurs, the more correct term should be 'stop-log structure'.

- PAGE 23, HYDROLOGIC CHARACTERISTICS:

  The end of this section states the implication that future without project hydrologic conditions will be the same as existing condition which includes the Interim Water Level Management Plan presently in effect. TWRA cannot commit to continued implementation of the Interim Water Level Management Plan without the project.

- PAGE 25, USE OF HERBICIDES TO CONTROL AQUATIC VEGETATION:

  Although not aquatic vegetation in the same context as the examples stated in this section, water willow should be listed as one of the problem vegetative species in the lake.

- PAGE 25, IMPLEMENTATION OF WATER LEVEL MANAGEMENT PRACTICES

  There is some confusion regarding lake levels that have been held since 1991. Policy dictates that gates are not *opened* until lake levels reach 282.7 NGVD. Once opened, they are held at 282.2 NGVD except at such time when maximum drawdown might occur which would pull water 5.8 feet lower (276.4 NGVD).

- PAGE 26, IMPLEMENTATION OF WATER LEVEL MANAGEMENT PRACTICES

  In the first paragraph, the frequency of drawdowns should be corrected from " ..at least once every 10 years.." to "as needed after 5 years".

- PAGES 26 AND 28, WALNUT LOG SEDIMENT CONTROL:

  Contrary to statements in the DEIS, we believe that sediment deposition from Walnut Log ditch is a significant contributor to the filling of Bayou du Chein at its confluence and downstream. We agree with the DEIS not to include it as a feature of the subject project. It should be identified, however, as a significant problem that should be handled by a local sponsor.

- PAGE 27, DREDGING IN CRITICAL DEPOSITION AREAS:

  We do not necessarily agree with the statement that there is a *greater* need to prevent additional sediment from entering the lake than to remove existing lake sediment. We do agree that prevention of additional sediment is more practical.

- PAGE 29, ALTERNATIVE WATER SUPPLY TO REELFOOT LAKE:

  (a) and (b) - A more accurate statement as to why these features were eliminated would be due to cost and impracticability rather than lack of local sponsor support.
  (c) - This heading should more clearly be stated "North and South Fork Reelfoot Creek Reservoirs"

- PAGE 30, IMPLEMENTATION OF WATER LEVEL MANAGEMENT PRACTICES:

  TWRA probably will not continue water level management efforts if this project does not move forward.

- PAGE 31, CONSTRUCT ALTERNATIVE SPILLWAY:

  We suggest that the phrase "...In order to implement an efficient and effective periodic drawdown of the lake level..." be replaced by "In order to implement an efficient water level management program as described....".

- PAGE 34, ALTERNATIVE 1 - NO ACTION:

  Again, the Interim Plan will probably not continue if the project does not move forward.

- PAGE 35, ALTERNATIVE 2 - DYNAMIC WATER LEVEL FLUCTUATION WITH MAJOR PERIODIC DRAWDOWN:

  At the bottom of this page where real estate interests are mentioned, property should be included up to 285 m.s.l.

- PAGE 36, ALTERNATIVE 2 - DYNAMIC WATER LEVEL FLUCTUATION WITH MAJOR PERIODIC DRAWDOWN:

  At the top of the page, if real estate interests are adjusted to 285 m.s.l., acreage figures should be adjusted accordingly.

- PAGE 37, CONSTRUCT ALTERNATIVE SPILLWAY:

  The term 'drawdown' used many times in this section and elsewhere is sensitive to many readers and may unnecessarily send up red flags. Substituting terms like 'water level management' where possible might be better.

- PAGE 38, PLATE 1:

  Landowner Tom Hopkins has requested that we consider the ditch (and property boundary) immediately west of Alt. 6 rather than dissect his property with Alt. 6 Is this a reasonable request?

- PAGE 41, CONSTRUCT ALTERNATE SPILLWAY:

  In the second paragraph, line 6, we would prefer the word 'lower' to 'draw down'.

- PAGE 46, PLATE 6

  Donelson Ditch is identified for channel excavation. It has already recently been dredged and should not appear on this plate.

- PAGE 73, PARTNERING OPPORTUNITIES:

  At the bottom of the page, the USFWS lease will expire in year 2016, not 2001.

- PAGE 85, RECOMMENDATIONS:

  Terms such as 'acquisition' and 'willing sellers' may be inappropriate since willing sellers may be hard to come by. Options such as the purchase flowage easements should also be included.

We would appreciate you coordinating these comments with the Corps.

Sincerely,

Dan Sherry
Fish & Wildlife Environmentalist

DS/bjs
cc. Gary Cook
Jim Johnson
Gary T. Myers

DEPARTMENT OF ENVIRONMENT & CONSERVATION
Recreation Resources Division
10th Floor L&C Tower
401 Church St.
Nashville, TN 37243

July 29, 1999

District Engineer
U.S. Army Engineer District, Memphis
ATTN: Environmental and Economic Analysis Branch (CEMVM-PM-E)
167 North Main Street, B-202
Memphis, TN 38103-1894

Dear District Engineer:

Thank you for the opportunity to review the Reelfoot Lake Draft Feasibility Report and Draft Environmental Impact Statement (DEIS) for potential impacts on recreation resources. If the proposed improvements are implemented, our division anticipates that this project will have a tremendous quality of life benefit to the residents of the Reelfoot Lake region and the many visitors to the area. In addition, the project could provide substantial improvements to ensure the future recreation opportunities of the area for fishing, boating, eagle watches and other interpretive recreation activities.

Tennessee's *1995-1999 State Recreation Plan* clearly shows that lake access and related activities are a high priority for the Northwest Tennessee Planning Region (plan attached). The proposal to improve the long-term use of Reelfoot and Shelby Lakes will help meet the objectives of this state policy plan. Areas of special consideration that this project could improve include: boat access, fishing and waterfowl hunting. Furthermore, the proposed alternatives would provide an important resource for the State of Tennessee to ensure the long-term viability of Reelfoot Lake State Park and economic/tourism opportunities that are directly tied to the use of this lake. Alternatives 2b, 3b, 4b and 5b would all provide a positive impact for recreation.

The popularity of natural resource-based recreation areas is growing in Tennessee. I strongly support efforts to meet these growing demands and conserve our state's natural resources for our next generations to enjoy.

Sincerely,

Joyce H. Hoyle, CLP
Director

ROY HERRON
STATE SENATOR
P O BOX 8
DRESDEN, TENNESSEE 38225
(901) 364-5418
304 LEGISLATIVE PLAZA
NASHVILLE, TENNESSEE 37243-0224
(615) 741-6676

Senate Chamber
State of Tennessee

JOSEPHINE BINKLEY
LEGISLATIVE ASSISTANT

24TH SENATORIAL DISTRICT
Benton, Dyer, Henry, Lake, Obion
and Weakley Counties

August 5, 1999

Colonel Daniel W. Krueger
Commander Memphis District
U. S. Army Corp of Engineers
167 North Main Street, Room B 202
Memphis, TN 38103

Dear Colonel,

I attended the public meeting on July 20th at Ellington Hall on Reelfoot Lake. I appreciate the opportunity to share with you my views after listening to the presentations, public comments, discussed Reelfoot Lake issues with citizens I am privileged to represent as well as personnel from the TWRA. I also have studied the pounds of documents recently shared with me by the Corps.

It seems to me that there are some things about which there should be little argument. The proof seems overwhelming and the public benefit quite substantial.

Specifically, we all agree that the sedimentation drawdown of Reelfoot Creek should be completed as soon as possible. I am unaware of any good reason why this should not be done and it seems that action on this is most urgent.

Additionally, replacement of the current spillway is imperative. If the spillway is not replaced, instead of worrying about a "drawdown" we may all be worrying about a "blow-out."

On the other hand, the drawdown is vigorously opposed by many with good reason. Even proponents have to admit that such drawdowns may not be successful. Indeed, the potential for a substantial damage is clear. And after viewing photographs of and discussing with witnesses too the problems with the drawdown at Crockett Bottoms, it is clear that grave damage might be done.

I respectfully suggest that action to save the lake should be taken immediately

I respectfully submit that the least proven, most dangerous, and most questioned and questionable proposal of the drawdown should be tabled, at least until such time there is a greater certainty of it actually benefiting the lake.

I appreciate your consideration of views that I believe are held not only by myself but my many who care deeply about the lake and want to see it preserved for our children and generations unborn.

If you have questions about these thoughts or if I can be of help in seeking to preserve and extend the life of the lake, please, just let me know.

Respectfully,

Roy B. Herron

jb

COMMONWEALTH OF KENTUCKY
DEPARTMENT OF FISH AND WILDLIFE RESOURCES
C. THOMAS BENNETT, COMMISSIONER

July 1, 1999

Memphis District Corps of Engineers
ATTN: CEMVM-PM-E (Hite)
167 North Main Street, B-202
Memphis, TN 38103-1894

RE: Draft Feasibility Report and Draft Environmental Impact Statement, Reelfoot Lake Tennessee and Kentucky – Memphis District Corps of Engineers

Dear Sir

Members of my staff have reviewed the above-referenced documents. Accordingly, we offer the following comments and recommendations.

The Kentucky Department of Fish and Wildlife Resources (KDFWR) is concerned about the fish and wildlife resources of Reelfoot Lake, both for the present and the future. We agree with the various studies, that without some action, those resources will be seriously impacted, as will the citizens of Tennessee and Kentucky. However, measures must be taken to insure that the action taken is not at the expense of those citizens.

Our concern with the documents is they note under the Preferred Alternative (5B), dynamic water level management could impact agricultural land in Kentucky. However, the report notes that compensation will be required, but there is no commitment to make such compensation to Kentucky agricultural interests. Without such a commitment, KDFWR feels that both documents are flawed and the economic analysis may be incomplete.

Again, KDFWR supports the restoration of Reelfoot Lake and its associated environments, but such improvements should not be conducted detrimentally to the citizens who are adjacent to the project.

We appreciate the opportunity to comment. If anyone in the Memphis District Corps of Engineers would like to discuss our comments, please contact Mr. Wayne L. Davis of my staff at 502/564-7109.

Sincerely,

C. Tom Bennett
Commissioner

CTB/WLD/kh

Arnold L. Mitchell Bldg. #1 Game Farm Road Frankfort, Ky 40601

State of Tennessee
Department of Environment and Conservation
Policy office
20th Floor, L&C Tower
401 Church Street
Nashville, Tennessee 37243-0454

VIA FACIMILE AND REGULAR MAIL

July 7, 1999

Richard Hite
Planning, Programs, & Project Management Division
Environmental & Economic Analysis Branch
Memphis District Corps of Engineers
167 North Main Street B-202
Memphis TN 38103-1894

RE: Feasibility Report, Draft Environmental Impact Statement, and Associated Appendices for the Reelfoot Lake Feasibility Study

Dear Mr. Hite:

I am the designated State's lead contact, on behalf of Justin Wilson, Deputy to the Governor for Policy, for the review of the Feasibility Report, Draft Environmental Impact Statement, and Associated Appendices for the Reelfoot Lake Feasibility Study (the report and draft EIS). I have enclosed a complete list of Tennessee Agency Contacts for NEPA reviews. The Corp may have already provided a copy of the report and draft EIS to these state contacts. For the state contacts that have not received a copy of the report and draft EIS, please send a copy to them for their review and comment. I will be coordinating the State's response to the Corp regarding this review and comment by the State contacts. If you have any questions, please call me at (615) 532-0144.

Sincerely,

David L. Harbin

enclosure

6/22/99

Art Center Supply Stores Inc

Greetings Mr. Funderburk,

Thank you for sending the vast wealth of information on the proposed improvements on Reelfoot Lake. Looks like you have done extensive research for a project that will, ~~~~ no doubt, slow-down the death of a wonderful resource.

I will share the information you provided with some other interested parties.

Please keep me informed of any public meetings. Y'all deserve more support!

Thanks,

Tom Wilson

Midtown
1616 Union Avenue, Memphis TN 38104
(901) 276-0321 • Fax (901) 276-0270
Business Offices (901) 274-0152

East
5035 Park Avenue, Memphis TN 38117
(901) 682-9877

United States Department of the Interior

OFFICE OF THE SECRETARY
Washington, D.C. 20240

JUN 29 1999

ER 99/546

Mr. David L. Reece
Chief, Environmental and
Economic Analysis Branch
Department of the Army
Memphis District Corps of Engineers
167 North Main Street B-202
Memphis, Tennessee 38103-1894

Dear Mr. Reece:

This is in regard to the request for the Department of the Interior's comments on the Draft Feasibility Report and Draft Environmental Impact Statement for Reelfoot Lake, Lake and Obion Counties, Tennessee, and Fulton County, Kentucky.

This is to inform you that the Department will have comments, but will be unable to reply within the allotted time as we have just received your transmittal of sufficient copies to satisfy our intradepartmental needs. Please consider this letter as a request for an extension of time in which to comment.

Our comments should be available by August 13, 1999.

Sincerely,

Terence N. Martin

Terence N. Martin
Team Leader, Natural Resources
Management
Office of Environmental Policy
and Compliance

City of Dyersburg
TENNESSEE

Billy J. Taylor
Fire Chief

FIRE DEPARTMENT

July 23, 1999

Memphis District U.S. Army Corp. of Engineers
Public Affairs Office
167 N. Main St.
Room 202-B

To whom it may concern:

I would like to speak to the issue concerning the plan to restore Reelfoot Lake to it's natural environment and to say I regret not being in position to attend the meeting Tuesday night, July 20, 1999 at the Air Park.

I am very pleased that the various Federal and State agencies along with sportsmen, bird watchers, farmers, land owners, and business people acknowledge the deteriorating state of this beautiful lake and the need for "us all" to take proactive and immediate action in order to halt this deterioration. I realize there will be some pain, discomfort, and inconvenience upon us all, more on some than others. If we do not begin "now" to correct this problem, I am afraid the lake will continue to dry up and become stagnated along with the economy of the Tiptonville area and the many activities that flourish today. "Sacrifice today" means a future for the lake and our children and grandchildren along with the generations that follow.

I am not qualified to offer a solution, but I do know the Tennessee Wildlife Resource Agency, The Army Corp. of Engineers, etc., and their "qualified people" does in fact have the best interest of Reelfoot Lake at heart. The "great" leaders and elected officials of the past had a vision for the future, and the strength to act under pressure to make the hard decisions that made this country great. I would encourage anyone in a leadership position concerning this issue to do the same by supporting this restoration plan.

Respectfully submitted,

Billy J. Taylor

216 S. Church St. • Dyersburg, Tennessee 38024 • (901) 286-7615 • Fax (901)286-7670

Henry Sanger
311 Moulton St.
Hickman, KY 42050
July 23, 1999

US Army Corps of Engineers
Reelfoot Lake
Drift Feasibility Report

Thank you for the opportunity to comment on the Reelfoot Feasibility Report.

Being a Kentucky landowner, farmer and hunter, I have a vested interest in what will be done to the lake.

Solving the siltation problem on Reelfoot Creek on the east side of the lake should be your number one priority. Your report states that is about 85% of the siltation problem in the lake.

The report looked for sources of fresh water for flushing of the lake. If you cleaned out Upper Bayou De Chien channel to Hickman, Kentucky, that would get the lake a source of water.

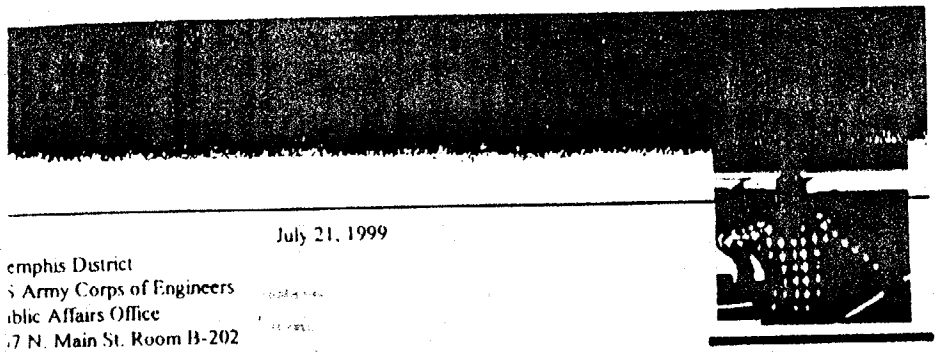
If the spillway is the next problem, get the easements to the elevation of the top of the structure 286.2 MSL before you start construction. Other Corps projects had to get the right to flood to the highest level in the event it ever happens. An alternative would be to redesign the spillway to overflow at the level 282.2 MSL of the old spillway. The new spillway, as designed, has a higher flow capacity than the current spillway. As a result, the outlet ditch will need to be reworked to handle the extra capacity.

The water level management plan, known as the "Interim Plan of Operation", and the proposed plan, known as the "Dynamic Water Level Fluctuation with Major Periodic Drawdown", should be looked at by all parties and both states that are affected. All parties should agree on the plan and be compensated for all damages before it goes into effect. The effects are wide spread with either plan. The lake level should be 282.2 MSL until a plan can be agreed upon by all parties in both states.

I hope we can work in the best interest of the lake and for all parties concerned.

Sincerely,

Henry Sanger



July 21, 1999

emphis District
S Army Corps of Engineers
iblic Affairs Office
7 N. Main St. Room B-202
emphis, Tenn. 38103-1894

ear Su

aving read the various proposals concerning Reelfoot Lake in the Library at iptonville I would like to state the following: I am against the drawdown for veral reasons, the main one being I do not see that it will accomplish anything. does nothing to remove the siltation in the lake, the best I can tell is that the WRA believes it will improve the number and quality of fish in the lake. The lake ready has some of the best fishing in the country, if it ain't broke don't fix it.

do see some merit in some of the other proposals, even some of them that have een called not feasible. It would definitely help the lake if the Mississippi River ould be used to furnish running water through the lake. This would serve more han one purpose, it would bring more oxygen to the water in the lake as well as ake it somewhat self cleaning. It would also help the lake if a small dredge were ut in the lake and just left there, it wouldnt have to be a big one a small one ould do, it could vacuum the muck from the bottom of the lake to be deposited lsewhere. This could be paid for by the user fee that is currently being charged n Reelfoot Lake.

What is going to be the impact on the people in the area, Lake County has a ather fragile economy as it is, if you take some of the taxes away from the county overnment it will probably not be able to function at any kind of reasonable level. Many people make their living either directly or indirectly from the lake, what are hese people supposed to do? We should be considered as part of the nvironment in this study. I am the manager of the sanitary sewer system around he lake and I can see a big impact on the economy if there is a draw down of the ake every 5 years or so.

very once in a while a portion of the lake will "turn over" and there will be a fish kill. When this happens dead fish float to the shore line and they stink pretty adly, I do not know what kind of a health problem they represent. The study hows the potential for a fish kill, I assume this would be of large proportions as he fish are having to live in a shrinking environment if there is a draw down.

K5OTT

221 Ashby Drive
Tiptonville, Tenn. 38079

Phone 901-253-8538
Fax 901-253-8126
E-mail k5ott@ecsis.net

What about the smell from that? What about the health problems from this?

Mr. Carey Calhoun spoke at the public meeting held last night and brought up a concern I hadn't thought about, what is this drawdown going to do to the water we all depend on for drinking etc.? Will it affect the supply of water in the aquifer? Will it affect the quality of the water in the aquifer. There are still people who depend on well water in this area, what is this going to do to them?

What about the wildlife? I am sure a drawdown is going to have a big impact upon the wildlife in the area, are the fur bearing animals going to be able to survive? Every year there are many ducks who winter on Reelfoot Lake. How is a drawdown going to affect them. You know it is really hard to think of all the things that will be affected by a drawdown of the Lake. I bet the public brought up some concerns you had not thought of before at the public meeting last nite, and you know what? That is probably just the tip of the iceberg, I bet there are many things we have not even thought of.

I Believe the siltation damn on Reelfoot Creek is a good idea, but doubt that it will ever come to pass, the landowners do not want to sell and the TWRA does not want to offer them enough money to make them willing sellers, I doubt seriously if congress would allow you to condemn the land. The same holds true for Shelby Lake and Lake Isom.

I am not smart enough to know all the things that could be done to help the lake but I am smart enough to know that a draw down is not the answer.

Sincerely Yours;

Ellis R. Fant

Ellis R. Fant

Joe D. Sanger
2690 State Route 125
Hickman, KY 42050
USA
Fax 270-236-3428
Home Phone 270-236-3427
Email jsanger@apex.net

July 27, 1999

Dear Sir or Ms .

I am submitting these written comments concerning the proposed plan of action for Reelfoot Lake My opposition to the plan is centered around several unfounded assumptions the plan makes

If you follow your plan of "dynamic fluctuation" and raise the water level of the lake, private property will be affected The higher water level is a major problem for local farmers especially when we receive a large rainfall Since I farm close to the lake I know the effect the higher water level produces We have had major crop damage in the past when the lake was high and we received a big rain I can only imagine what an even higher lake level will do. This type of flooding is not acceptable to agricultural interests

Another major concern of mine is the proposed new spillway which is phase one of the plan The elevation of the top of the proposed system is four feet higher than the present spillway Why would you build it higher unless you planned to raise the water to this level? Having the top of the new spillway at 282.2 feet is the only way the new spillway would be acceptable to me If you do build the new spillway at 286 feet, the Corp should get flood easement from private landowners up to that elevation before the contract is awarded as other federal projects have been required to do Also why would you build a higher capacity spillway if you don't increase the size of the outlet ditch to the river by the same increment. In my opinion, any flood control project should start downstream at the river and work up to the dam. Why did the Corp design such a high gate elevation yet has not told local interest its reasoning? Is it because the Corp knows agricultural land will be adversely affected?

Why is the silt retention basin on Reelfoot Creek in phase 3 of the plan? The EIS states than sediment is the biggest detriment to Reelfoot Lake. Why isn't this basin in phase 1? It looks like we need to address the issue of why Reelfoot Lake is deteriorating instead of measures that seem to be only masking the problem.

It is a shame that the proponents of this plan would perceive that the construction of the Mississippi Levee System is the chief cause of detriment to Reelfoot Lake. Maybe Reelfoot Lake formed by natural causes has a natural life process.

Due to the severe damages to private property owners as well as opposition from local sportsmen and business owners,it should be clear that the proposed plan is not what is needed and should be dropped

Sincerely

Joe Sanger

July 27, 1999

Memphis District
U.S. Army Corps of Engineers
Public Affairs Office
167 No. Main St., Room B-202
Memphis, TN 38103-1894

Attn: Mr. Roger Funderburk,
Project Manager
Reelfoot Lake, TN

By attending the public meeting of 7/20/99, I quickly learned major water fluctuations at Reelfoot will meet with difficulties. As well, no Federal action will incur like difficulties. The public record will confirm these assessments by the statements made by the Farm Corporations and their lobbyist as well as business owners around the lake. A living example of draw-down without permanent alternative water source can be viewed at Rives, TN. Crockett Lake, approximately five hundred (500) acres can only be classed as a total disaster.

Let's attempt to apply some common sense to the problems facing all parties concerned included, but not limited to, business owners, farm corporations, Lake and Obion Counties, the State of Tennessee, and the Federal Government. Facts are facts, and none of the above can financially afford to loose the financial machine known as Reelfoot Lake.

What has been, and is, the primary objective that has prompted some ten million dollars in studies? Am I correct in stating extending the life of the Lake has top priority? If I am correct, then why Shelby Lake restoration and Lake Isom restoration at this time? Neither will have effect on improving water quality in Reelfoot Lake. If these projects have the importance that some believe, then submit them on their own merits, but not attached to a project as important as the primary objective of increasing the life of Reelfoot Lake.

Let's briefly apply common logic to the proposed spillway. If anyone questions the need for a new bottom outlet spillway, they live in another world. That aside, let's

Original Message-----
From: Suzanne Keefe [mailto:keefes@ecsis.net]
Sent: Sunday, July 25, 1999 12:00 AM
To: mvm meetings@usace.army.mil
Subject: Reelfoot Lake Project

I would like to respond to the public meeting held at Reelfoot Lake on July 20, 1999. My name is Suzanne Keefe. My husband and I are residents of Lake County and are very concerned with the proposed Reelfoot Lake project. I have several concerns I would like to address. As a citizen of this county and a teacher with the Lake County School System, I am very concerned about the impact that a periodic drawdown would have on this community, my employment, and the future of my family. The tax base in Lake County is heavily supported by the tourist industry that Reelfoot Lake provides. A loss of this revenue would devestate our county, our schools, and the lives of our children. My husband and I were involved in the tourist industry here for twelve years as owners of a resort. We are presently ready to begin construction of a new 50 room motel on Reelfoot Lake. This will be the only totally new resort built on the lake in years. We have steadily watched the tourism industry, based on increased fishing activity, grow on the lake for the last several years and have decided to invest a great deal of money to attract more people to our area. As you can see the prospects of a drawdown and all that comes with it would devestate us personally.

My husband is a lifelong Lake County resident who is an avid sportsman at Reelfoot. We do not want to see the lake come to an early demise and are open to suggestions that are productive and will create a positive increase in the life of the lake. We agree with the siltation reserve and the new spillway, but are definitely opposed to a drawdown. We were very active in the fight against the drawdown in 1985. We witnessed first hand the growth of vegetation, fish kill, and loss of business that this can create. After reading the environmental impact study during the last drawdown and listening to your team last week, we are not convinced that a drawdown is the right step to save Reelfoot Lake. I'm not so sure that you are convinced that it is the answer either. I see no need to play with the livelihood a county when you are not sure what the outcome will be. Until someone can give us proof that this will work, I must remain opposed. A drawdown will not only turn Reelfoot Lake into a swamp, but it will pull Lake County and it's citizens down with it.

We greatly appreciate your concern by listening to the opinions of the people who will be most effected by this decision. Because no matter what happens, whether the lake is saved or if it turns into a stinking,rotted fish swamp, all of the members of your team will go to their own homes and not be directly effected.

Reelfoot Area Chamber of Commerce
Route #1, Box 1205
Tiptonville, TN 38079
901-253-8144

July 26, 1999

Memphis District
U.S. Army Corps of Engineers
ATTN: CEMVM-PM-E /Kite/
167 North Main Street, B-202
Memphis, TN 38103-1894

To Whom It May Concern:

The Reelfoot Area Chamber of Commerce has worked hard for Lake County and the Reelfoot Lake area. We are just beginning to gain some respect in the community after being involved with several successful projects. Let us also say, that the Corps of Engineers has been associated with some of these endeavors and we are very grateful.

Reelfoot Lake is one of our main priorities. We want to save Reelfoot. BUT we want someone to assure us that a drawdown would do that. They have not. We have more questions than answers. If the drawdown fails and the lake does not refill, we will be left to suffer the consequences.

We think that some of the proposed suggestions will help. The Chamber wishes that the $10,000,000 spent on the study had been used to better advantage. We suggest dredging of the lake, but they tell us it would be too expensive. Just think how far $10,000,000 would go toward the dredging of Reelfoot.

The Chamber implores you to find a better way. We hear a booming economy is going on in our country but somehow it has not found its way to Lake County. If you ruin Reelfoot with a drawdown, we will never recover.

Sincerely,

Marjorie Davis

Marjorie Davis
Executive Director

JEROME D. SHUMATE
1000 Robertson Street
Tiptonville, TN 38079

July 21, 1999

Col. Dan Krueger
Memphis District Corps of Engineers
167 North Main Street, B-202
Memphis, TN 38103-1894

Dear Col. Krueger:

Each morning we read the paper or listen to the news before leaving for work. A disaster or a tragedy usually happens somewhere in the world making the headlines. This morning was no exception with the finding of John F. Kennedy, Jr. after a plane crash.

After the meeting last night at Buford Ellington Assembly Hall on Reelfoot Lake, I hope there is some way to save Reelfoot Lake without destroying livelihood around the lake. If not, I fear that Reelfoot may some day make the news as it did in 1811 and 1812 when an act of God formed it. This time it will make the news by being a "mud hole" created by T.W.R.A., U.S. Fish and Wildlife, and U.S. Army Corps of Engineers.

Each of these organizations is well aware of the silt that enters Reelfoot from the hills on the east side of the lake. Why hasn't this problem been corrected before now? T.W.R.A. has purchased land on the west side of the lake for wildlife purposes. If they had been concerned about saving the lake, they could have used those funds to stop silt from entering the lake instead of generating more habitats for wildlife. That should tell you what they are interested in — wildlife, not people trying to survive

I feel like this project will go on despite the wishes of most of the people around the lake. If you continue with this catastrophe, I request that a board be formed consisting of five members who will have control of lake stages at Reelfoot. This board would consist of the following: One member from each of the three counties bordering Reelfoot Lake - Fulton county in Kentucky and Obion and Lake counties in Tennessee; one from T.W.R.A.; and one from U.S. Fish and Wildlife. If this project fails, T.W.R.A. and U.S. Fish and Wildlife will move on. Who must survive the destruction that occurs? -- the three counties trying to survive next to the "MUD HOLE."

Sincerely,

Jerome D. Shumate

MACIE M. ROBERSON
County Executive, Lake County
Box 1 • Court House
229 Church Street
Tiptonville, Tennessee 38079

TELEPHONE
901/253-7362

Col. Daniel W. Krueger
District Engineer Memphis, District
167 North Main Street, B-202
Memphis, Tennessee 38103-1894

Dear Col. Krueger,

It was good to see you at the public hearing concerning the Reelfoot Lake Study. I appreciate your listening to the concerns of the citizens. I have a concern that has been brought to my attention since this hearing. It has been mentioned that a possible recommendation to the spillway operation. It has been proposed that a member from Fulton County, Kentucky, one from Lake County, one from Obion County, a member from U.S. Fish and wildlife and a member from TWRA to control or operate the spillway gates. This would give representation to everyone effected by the water level of the lake.

Again thanks for all your concerns and all your help in the past.

Sincerely,

Macie Roberson
Lake Co. Executive

apply like logic to the location on the new spillway. Is the proposed location one that would allow greater water level fluctuation than the present outlet ditch? If so, is that any longer considered a realistic possibility? Is there some geological reason the new spillway cannot be located on the present Reelfoot Running Bayou on land presently owned by TWRA? The proposed spillway requires the construction of a new highway bridge. A check with the Tennessee Department of Transportation will undoubtedly confirm the immediate need for replacement of the present bridge over Reelfoot Running Bayou. Why two, if one will serve the purpose? If a draw down ever becomes a reality, there is an inexpensive and effective means to dredge the present Reelfoot Running Bayou Outlet ditch to any require depth with absolutely no negative effects on water quality or aquatic wildlife.

The proposed sediment basin on Reelfoot Creek faced some opposition but can probably become a reality. As I understand this project, the water from the basin will be released into the lake, as it should be. This released water quality should be equivalent to or exceed the quality of rain water.

In addressing the Problems and Opportunities section of the Feasibility Study, it is reasonable to agree that the major problems are identified as "Loss of Aquatic Habitat and Declining Water Quality." Without major progress in correcting these problems, there is no need to discuss the remaining problems or opportunities.

In reviewing the Feasibility Study highlights, I find no mention or recommendation to use the natural dredges God provides. One dredge is OXYGEN. A second dredge provided by God is WATER. Four of the twelve features eliminated from further study would have provided both "dredges" at the same time. One problem – All four alternative water supplies involved Kentucky. Let's fact facts; there has not been, nor will there be, any co-operation from that geographical area. Maybe an alternative would be to defy everyone and construct a levee East to West along the Tennessee-Kentucky line and let Tennessee handle its' water requirements and Kentucky handle its' water problems. At least, they have a pump station provided by taxpayers to minimize crop damage.

We in Tennessee aren't too proud to accept a second-hand pump station that cost approximately four million dollars to construct in the Memphis area that has never been used. We need the capacity of approximately six million gallons of water per day, which is rich in dissolved oxygen. Please assist us in achieving this goal, either through the available Mississippi River or ground water.

In reviewing the Corps of Engineer's Memphis District "River Watch" (June 1999) issue and the article on Reelfoot Lake; through my experience and in talking with many others, I am unable to confirm sport fishermen are catching Carp and Buffalo. Maybe the article is referring to fresh water Drum, referred to as White Perch by many from the Northern States.

In further review of this publication, would it be reasonable to suspect the three civilian members of the "River Commission" are from Missouri, Arkansas and Mississippi? Is this the route the citizens of Tennessee should take in order to save a national treasure?

The ideas and proposals, that I have touched on, offer cost savings as well as operating expense. The Hindside Plant has prevented approximately eighteen (18) million dollars in crop damage per year since being in service. The loss of Reelfoot Lake WILL result in the loss of approximately forty million per year to just two counties. Isn't it time we apply common sense to an investment that has a R.O.I. two plus times better than Hindside.

In closing, WE HAVE THE RESOURCES to assist in operating expenses known as the Reelfoot Lake Preservation Fee.

A Concerned Citizen,

W. E. Hickman

Cc: U. S. Senator, Bill Fisk
U. S. Congressman, John Tanner
State Senator, Roy Herron

United States Department of the Interior

FISH AND WILDLIFE SERVICE
446 Neal Street
Cookeville, TN 38501

July 26, 1999

Colonel Daniel W. Krueger
U.S. Army Corps of Engineers
ATTN: CEMVM-PM-E (Hite)
167 North Main Street, B-202
Memphis, Tennessee 38103-1894

Dear Colonel Krueger:

U.S. Fish and Wildlife Service (Service) personnel have reviewed the draft feasibility report, Draft Environmental Impact Statement (DEIS), and associated appendices for the Reelfoot Lake, Tennessee and Kentucky Feasibility Study. An impact assessment for threatened and endangered species in the project area is included in these documents.

The assessment is adequate and supports the conclusion that the proposed project is not likely to adversely affect the bald eagle (*Haliaeetus leucocephalus*) and the least tern (*Sterna antillarum*), with which the Service concurs. In view of this, we believe that the requirements of Section 7 of the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.) have been fulfilled and that no further consultation is needed at this time. However, obligations under Section 7 of the Endangered Species Act must be reconsidered if: (1) new information reveals that the proposed action may affect listed species in a manner or to an extent not previously considered, (2) the proposed action is subsequently modified to include activities which were not considered in this biological assessment, or (3) new species are listed or critical habitat designated that might be affected by the proposed action.

We have enclosed (Attachment) our revised Draft Fish and Wildlife Coordination Act Report on the Reelfoot Lake Project, Lake and Obion Counties, Tennessee and Fulton County, Kentucky. If you have questions or if we can be of further assistance, please contact Steve Alexander of my staff at 931/528-6481 (ext. 210) or steven_alexander@fws.gov.

Sincerely,

Lee A. Barclay, Ph.D.
Field Supervisor

200 Circle Drive
Rogersville, Tn
July 27, 1999

Memphis District
U.S. Army Corps of Engineers
Public Affairs Office
167 N. Main St., Room B-202
Memphis, Tn. 38103-1894

Dear Sirs:

I have recently read and studied the Reelfoot Lake Tennessee and Kentucky Feasibility Report and the Draft Environmental Report. I am writing to express my opposition to the plans.

I was born and reared in Lake Co., Tn. My brother and I jointly own farms in both Lake Co. and Obion Co. Our Lake County farm is bordered on the east by Isom Lake. The U.S. Fish and Wildlife, Dept. of Interior, now wants to acquire all of it for Isom Lake expansion. Part of this farm was condemned by the Federal Government and taken many years ago for Lake Isom.

TIMOTHY C. NAIFEH
ATTORNEY - AT - LAW
102 SOUTH COURT STREET
TIPTONVILLE, TN 38079

TELEPHONE
(901) 253-6886
FAX
(901) 253-6886

July 22, 1999

Memphis District
U. S. Army Corp of Engineers
Public Affairs Office
167 North Main Street
Room B 202
Memphis, TN 38103-1894

RE: Reelfoot Lake Project

To Whom It May Concern:

Please be advised that I am opposed to any implementation of a drawdown for Reelfoot Lake. I have hunted and fished Reelfoot Lake all my life and have personal experience that a drawdown will be ineffective. There have been several years in a row where the lake bed was dry where I hunted and after the water covered the ground the muck expanded and we had the same problem as always. The Crappie fishing in Reelfoot Lake is better than it ever has been and it appears to me that a drawdown will result in a major fish kill. From the meeting I had as County Attorney with the Corp it appears the options that are being suggested are an inexpensive way to attempt to save Reelfoot Lake. Obviously, the options that they are proposing which include a drawdown will have significant environmental impacts and the Corp and the State cannot confirm an environmental impact will not be major. We do not know what will happen to the waterfowl and/or other wildlife on Reelfoot Lake. It appears to me that if the Corp of Engineers and the State of Tennessee would like to save Reelfoot Lake it would be in their best interest to appropriate more money to reroute the river and make a sedimentation basin to catch any sediment coming from the river through Bayou De Chein coupled with dredging of Reelfoot Lake. Obviously, Reelfoot Creek is a major contributor up to eighty (80) percent of the siltation coming into Reelfoot Lake which has been ignored for an eternity. The drawdown of Reelfoot Lake as I understand it will in no way prevent siltation from coming into the lake. If I thought the drawdown would in effect save Reelfoot Lake I would be the

first one to wave the banner in favor of it. However, I do believe that your efforts of a drawdown will be a disaster and will in no way benefit the environment, human, animal and/or otherwise, nor can say within reasonable degree of certainty that this preferred alternative will work to save Reelfoot Lake. It was also stated that if the preferred alternative including a drawdown is implemented that it cannot be determined how long the life of the lake will be extended, if any.

Further, the economic impact for Lake County, motel owners, resort owners, and other businesses that depend on their livelihood of the lake will be drastic and may not recover. I would suggest that the money be appropriated to compensate the above in the event of a disastrous consequence. Further, the report suggested that in studies of other lakes the black crappie had little to no recovery in the short term. If the periodic drawdown is implemented the effect on the black crappie will be disastrous. Also, in the event of a drawdown the fur bearing animals who may go in search of water will become trapped in the muck and will most certainly die. Also, other animals may venture out into our backyards and homes and may spread such diseases as rabies and lyme disease among others. The health concerns have not been properly addressed and therefore any major drawdown of Reelfoot Lake should not be implemented.

If you have any questions, please do not hesitate to contact me.

Sincerely,

Timothy C. Naifeh
Attorney at Law

TCN:bca

TIMOTHY C. NAIFEH
ATTORNEY - AT - LAW
102 SOUTH COURT STREET
TIPTONVILLE, TN 38079

TELEPHONE
(901) 253-6665
FAX
(901) 253-6666

July 28, 1999

Memphis District
U. S. Army Corp of Engineers
Public Affairs Office
167 North Main Street
Room B-22
Memphis, TN 38103-1894

RE: Reelfoot Lake Project

To Whom It May Concern:

Please find enclosed a resolution with the Lake County Executive's signature and vote of the commissioners showing the Lake County Court Has gone on record opposing any Implementation of a project which includes a drawdown on Reelfoot Lake.

Sincerely,

Timothy C. Naifeh

Timothy C. Naifeh
Attorney-at-Law

TCN:bca
corpeng ltr

Enclosure Resolution on Drawdown

RESOLUTION ON DRAWDOWN FROM THE LAKE COUNTY COURT

WHEREAS, on this 26th day of July, 1999, the County Executive and the County Commissioners for Lake County hereby declares on the record by this resolution their opposition to any implementation of a project by the U.S. Army Corp of Engineers and the State of Tennessee of a drawdown of Reelfoot Lake.

FURTHER, IT IS HEREBY RESOLVED, that this County Court finds that any implementation of a project that includes a drawdown will have a major adverse and detrimental economic impact regarding income to residents, tax liability to residents and overall tax base for Lake County.

FURTHER, IT IS HEREBY RESOLVED, that this County Court finds that the implementation of any project that includes a drawdown will also have a substantial adverse impact on the environment and wildlife habitat.

FURTHER, IT IS HEREBY RESOLVED, that the County Court further finds that any implementation of a project including a drawdown will have a devastating impact on tourism for the Lake County area and its residents.

WHEREFORE, IT IS RESOLVED that this County Court hereby notifies the U.S. Army Corp of Engineers, the State of Tennessee and the Tennessee Wildlife Resource Agency that they are on record opposing any implementation of a project which includes a drawdown of Reelfoot Lake.

Passed this 26th day of July, 1999.

LAKE COUNTY COURT

11 Yeas 0 Nays

MACIE M. ROBERSON
LAKE COUNTY EXECUTIVE

ATTEST:

JoAnn Mills
JOANN MILLS
COUNTY COURT CLERK

ST: THIS A TRUE AND CORRECT COPY.
7-29-99
JoANN MILLS
County Clerk

Mrs. Charles P. House
Route One, Box 253
Ridgely, Tennessee 38080

July 28, 1999

Mr. William L. Kelly
U.S. Army Engineers Dist
167 N. Main Street
Memphis, Tn 38103

Dear Sir!

I attended the meeting held at Reelfoot Lake and I am very much opposed to plan. Not only would it effect Tourist Trade at Lake but would also alter the tax base in our small County making it necessary to join other counties and no longer exist.

My farm land in Obion County has been successfully farmed for three generations or more and I strongly believe that I have a right to continue as is.

As our neighboring Kentuckians stated: 'Which is more important to feed the people or feed the ducks!'

Sincerely
Mary F House

Mrs. Obion Co farms are bordered on the West side by Reelfoot Running Bayou. Due to the fact that proper Maintenance on the Bayou has been almost non-existant for many many Years, the West side of this Property is affected by Overflows at certain times of the Year. Excessive rains occasionally affect this situation also- as would a larger lake drawdown.

Our farms have been farmed for at least 80 years or more by my family members. My brother and I represent the 3rd Generation and our Children will represent the 4th Generation.

The plan the Corp has approved is opposed by all the local farmers, as well as the Area Merchants.

Please give my request some consideration. Thank you.

Sincerely
Lillian W. Currin

somewhat moot.

The noted design elements of the tentatively selected alternative will cause some unavoidable environmental losses, but should achieve positive results in the long-term.. This is especially true if the results of the sediment analysis do not indicate any extensive areas which are grossly contaminated. In this event excavation of soil in these areas would require special handling and disposal which can be problematic. Based in the current information available for Alternative 5b, a rating of EC-2 was assigned. That is, we have a degree of environmental concern about some of the elements of the proposal given the present lack of data. Nonetheless, we strongly support the overall project objectives as the value of this nationally recognized resource makes reversal of the present downward environmental trend essential. With this in mind, the additional information being collected for evaluation in the final document assumes added importance as it will serve as the directing force during construction of the project.

It is also important to note that this plan is just a start. An holistic approach is necessary to effect any long-term restoration of the lake's amenities. The underlying, off-site problems impacting the lake, viz., sediment inputs from agriculture and construction, are not being addressed by this proposal. Nonetheless, they must be corrected if a real solution is to be reached.

If we can be of further assistance, Dr. Gerald Miller (404-562-9626) of my staff will serve as initial point of contact.

Sincerely yours,

Heinz Mueller

Heinz J. Mueller, Chief
Office of Environmental Assessment

Commonwealth of Kentucky

STATE SENATE

P.O. BOX 790
MURRAY, KENTUCKY 42071
(270) 753-1562

STATE CAPITOL ANNEX
FRANKFORT, KENTUCKY 40601
(502) 564-8100

BOB JACKSON

WESTERN KENTUCKY CAUCUS, CHAIR
COMMITTEES
BANKING AND INSURANCE, VICE CHAIR
CAPITAL PROJECTS AND BOND OVERSIGHT
EDUCATION, CO-CHAIR
GOVERNMENT CONTRACT REVIEW
TOBACCO TASK FORCE
TRANSPORTATION

August 2, 1999

Mr. Jim Reeter
U.S. Army Corp of Engineers
Memphis District
Public Affairs Office
167 North Main Street Room B-202
Memphis, TN 38103-1894

Dear Mr. Reeter:

As the Kentucky State Senator representing Fulton County, I would like to express my concerns regarding your proposal to raise the water level at Reelfoot Lake. Many of my constituents are farmers who would be devastated by this plan. These are some of the reasons we object to your proposal, as well as what we feel would be beneficial to residents of Fulton County:

- Your presentation did not address the agricultural impact on Fulton County
- The Corp of Engineers gave no compelling reason to increase the water level.
- Historically, the mean sea level (msl) was set at 282.2, and we would like to see that maintained from March 16 - November 14. It was our understanding that the interim plan would only be operational until the feasibility study was completed and not as a matter of permanent record.
- My constituents in Fulton county would agree to 283 2 msl during the time frame of November 15 - March 15 for enhancement of water fowl and for aquatic or vegetative control.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA FEDERAL CENTER
61 FORSYTH STREET
ATLANTA, GEORGIA 30303-8960

AUG 0 2 1999

Memphis District, Corps of Engineers
B-202 Clifford Davis Federal Building
167 N. Mid-America Mall
Memphis, TN 38103
Attention: Mr. Richard Hite

Subject: Draft Environmental Impact Statement (DEIS) for Reelfoot Lake in Tennessee and Kentucky

Dear Sir:

Pursuant to Section 309 of the Clean Air Act and Section 102 (2)(C) of the National Environmental Policy Act (NEPA), EPA, Region 4 has reviewed the subject document, an evaluation of the consequences of various structural/operational measures designed to enhance the lake's fish and wildlife resources, recreation potential, and overall environmental health. Specific improvements include a water level management regime with a dynamic draw down component, a sediment retention dam, new spillway, upgraded circulation channels, restoration of amenities at Isom and Shelby Lakes, and development of waterfowl management areas.

Construction of the major elements of the recommended plan (Option 5b) will directly impact approximately 50 acres of forested and other jurisdictional wetland types. This habitat lies within the actual construction footprint of the noted measures as well as in areas where dredged material will be deposited. Additional wetlands will be indirectly affected by sedimentation and other project induced conditions. Given the dramatic conversion to other land uses of the historic wetlands in the project area, any additional alterations are to be avoided, if possible. Hence, the primary planning mandate for all parties was to minimize these losses. Overall, this has been done.

Given the physical geography of the watershed, there do not appear to be any practicable design options which would result in the same degree of environmental restoration without some wetland loss/alteration. There are also engineering and cost practicalities which must be taken into account in any attempt to improve the lake's poor water quality and excessive sediment loading. These realities coupled with the national

significance of the resource militate the objections we have had over similar flood plain manipulations, viz., Black Swamp on the Obion River. Nonetheless, it should not be construed that our general concurrence with this particular project serves as a precedent for further similar actions in less compelling circumstances.

Construction of the sediment basin will, in part, address several of the problem areas identified in the reconnaissance study. However, we would like to see more attention paid by state and federal natural resource conservation agencies in fostering soil conservation measures in the watershed. This attention would result in subsequent long-term improvements in erosion, water quality, etc. without the need for repeated cycles of ever more complicated structural features.

These land treatment measures would complement the gross retention provided by the sediment basin and aid in establishing an ethic among area land owners on the need to install/maintain measures which will lessen future sediment contamination in the Reelfoot system. Operation/maintenance of the basin is equally important in meeting these restoration goals. It must be made clear in the final document as to which agency(ies) will be responsible for managing this structure. Other potential water quality responsibilities must also be addressed. Namely, the results of the sediment analysis should be included in the final document. They will determine where/how any dredging/soil deposition will take place. This information must be reviewed for conformance with standards by appropriate state and federal regulatory agencies prior to any construction activities.

The periodic draw down may adversely affect selected fishing and agricultural interests. This is an unavoidable, but incremental outcome and should not be examined in isolation. In regard to the former, recent studies suggest that in the absence of some pronounced restoration efforts the lake's long-term fisheries prospects will trend downward. The anticipated long-term benefits of the proposal on fishery resources should rectify this situation and quickly subsume any transient losses.

An examination of existing production potential can be made of those agricultural parcels which will receive the small increment of additional innundation (.3 feet). While the overall significance of this extra flooding on crop yields is presently unknown, experience in other, similar situations would suggest that this is marginal land with limited productivity. It should also be noted that the status quo (cited as the no-action option in this document) water level management plan (U.S. Fish and Wildlife Service Integrated Dynamic Water Level Fluctuation) has provisions to revisit its draw down regime(s) as conditions warrant. Given the apparent downward trend of the lake's recreational and environmental potential, changes in management are likely in any event. This possibility would make the noted controversy about the selected alternative

U S ARMY CORPS of ENGINEERS
MEMPHIS DISTRICT

PUBLIC AFFAIRS OFFICE

167 N MAIN ST , ROOM B-202
MEMPHIS, TN 38103-1894

To Whom It May Concern

Subject REELFOOT LAKE DRAWDOWN

The Corps of Engineers completed the drawdown study requested by the Tennessee Wildlife Resources Agency (TWRA) The Corps of Engineers as well as the TWRA presented quite professionally their interpretations of the results of the study I realize that the Corps of Engineers and the TWRA are both concerned about the life expectancy of Reelfoot Lake and are desirous of extending the life of the lake The citizens of Lake County are also desirous of these results

However, I must question the feasibility of such a drastic proposal as having a drawdown without assurance that this action will prolong the life of the lake for a significant length of time. Lake County as well as Obion County and Fulton County, Kentucky will be adversely affected by a drawdown and the fluctuation the water level of the lake Lake County is especially dependent upon tourists' patronage of its restaurants, motels, and numerous other businesses around the lake Without this patronage, these restaurants, motels, and business could not survive The jobs available in Lake County are already extremely limited. Without these jobs, more people will be leaving Lake County, taking their patronage of other Lake County businesses as well as tax revenues with them

I submit that no other lake as small as Reelfoot Lake supports the livelihood of as many commercial fishermen proportionally Many acres of prime farmland will be affected by such a drawdown. I understand that the anticipated cost of the drawdown would be $35,000,000 00. Add that figure to the loss of tax revenues, business, and jobs and any prudent person can see that the cost far exceeds the benefits. Have provisions been made to fairly compensate the county and the people that will surely suffer? Reelfoot Lake is once again providing nesting sites for the bald eagle. Will the eagle find this interference of nature acceptable?

Once again, I question the feasibility of taking such a great chance at such an obvious cost when no one knows whether it will work I question this gamble with the lives and livelihood of the people who live near and love Reelfoot Lake

Respectfully,

Aaron Staulcup

AARON STAULCUP

AS/lb

James H. Vincent
1064 Bradley Road
Gallatin, Tennessee 37066
615-230-1627

July 29, 1999

District Engineer
U. S. Army Engineer District, Memphis
Attention: Environmental and Economic Analysis Branch (CEMVM-PM-E)
167 North Main Street, B 202
Memphis, Tennessee 38103-1894

Dear Sir:

Having read your proposed plans for the Reelfoot Lake Area and having discussed the same with several people at your office, I would like to offer an observation and a suggestion.

I agree that help is needed at Reelfoot. A new spillway is needed and the ditches need dredging. Dredging will have to be an on going project because the problem is with large outboard motors making a large wake and washing out the banks.

This should be the extent of the project on the Lake itself No draw down is necessary In fact it would be a disaster in many ways. How would you fill it up rapidly enough? How would you keep the area from growing up in weeds, willows etc. as so much of it did in the draw down several years ago. How can you justify ruining a great bald eagle wintering area?

If you build the spillway and hold the water two feet higher, then you will have done Reelfoot Lake and thousands of people a great favor. Anything more than this would be a great disservice.

Sincerely,

James H. Vincent

James H. Vincent

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-----Original Message-----
From: Candy Curlin [mailto:ccurlin@ecsis.net]
Sent: Thursday, July 29, 1999 7:15 PM
To: mvm meetings@usace.army.mil
Cc: dsundquist@mail.state.tn.us; Senator_Frist@Frist.senate.gov; cfreeman2@mail.state.tn.us; tourdev@mail.state.tn.us
Subject: REELFOOT LAKE

My husband and I own Sportsman's Resort on Reelfoot Lake. It is located on the North end of Reelfoot Lake next to the Airpark Inn. We were at the meeting this month and heard all the comments. It seems to me everyone has the same thought. We need to save Reelfoot ***but not by a DRAWDOWN***

In the past 15 years since we have bought Sportsmans we have struggled to make ends meet. My husband has worked outside jobs through the lean years. We started doing ***fishing packages*** 3 years ago and started working a couple of boat and sporting shows in St. Louis and Indiana costing us thousands of dollars to advertise the lake. We tell people what good fishing and hunting is on the lake and they come and spend their money here. I mentioned at a meeting last year the money we bring in to the state for T.W.R.A. as for as license money. (the figures or at the bottom) Not to mention what the county gets and they need every penny they can get.

We have a lot of equity built up in our business. We have done a lot of work in the 15 years since we have been here. So with that, we recently bought another (fishing camp) on the South end of Reelfoot formerly Rays Camp. We were going to build a new motel on the property site, buy more boats and motors, and do a lot more promoting Reelfoot Lake to fill the rooms. ***But now what do you do?*** We could survive the new spillway and the dredging of the ditches for better circulation even the new silt retention basins. ***But we could not survive a drawdown***. At the boat shows there are people who still bring up the drawdown of '85 and want to know if it ever filled back up.

They talk about the North end like it is alread dead. They took us off the creel check a couple of years ago.(I think now we are back on it) When they brought in the machine from Louisiana a couple of years ago and dredged out some of the ditches, fishing improved greatly. I asked them about bringing that back and they said it cost to much to rent. Why not buy one? I'd be all for trying to get money from the politians for something like that. You can have study after study but we live here, we are here everyday *We live and breathe from this lake. Don't slowly smother us and kill us with the DRAW DOWN*.

PLEASE, get money, get the machinery in here and do some physical work on the lake. Show us where the ***Reelfoot Perservation Permit*** money can go and show something for us collecting it all these years. **PLEASE NO DRAWDOWN**

THANK YOU,
BILL & CANDACE CURLIN
R.R. # 1 BOX 2335
TIPTONVILLE , TN 38079
901 253-6581
www.reelfootlake.com <http://www.reelfootlake.com>

THE JUNE TO FEB FIGURES OR WHAT WE WOULD LOSE WITH A DRAWDOWN. I AM JUST ONE MOTEL BUSINESS OUT OF 8 IN LAKE COUNTY AND 6 OR 7 IN SAMBURG. SO ADD THE FIGURES UP AND EVERYONE LOOSES

- LICENSE MONEY COLLECTED FOR 1998 18,553.00(ALL YEAR) 13,404.00 (JUNE-FEB)
- GROSS SALES 177,209.00 63,947.00
- STATE TAX 15,233 5,484.00
- COUNTY 1,758.00

-----Original Message-----
From: Marcia Perkins Mills [mailto:mpmills@USIT.NET]
Sent: Thursday, July 29, 1999 9:52 PM
To: mvm.meetings@usace.army.mil
Subject: REELFOOT LAKE

To Whom It May Concern:

I am president of the Reelfoot Area Chamber of Commerce and I serve on the board of the Tiptonville Main Street Association. My brother and I run a business that has been in our family for 46 years.

We are very concerned with the drawdown. It might not affect us directly, but it will affect many of our customers and friends who depend on the lake for their livelihood. We want to see Reelfoot saved, but we don't think that a drawdown is the answer. We hope you will reconsider your decision to do this.

Sincerely,
Marcia Perkins Mills