US Army Corps of Engineers
Little Rock District

Draft Environmental Assessment

Greers Ferry Lake

Draft Shoreline Management Plan White River and Tributaries

2020

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GREERS FERRY LAKE
SHORELINE MANAGEMENT
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1.0 INTRODUCTION

The 2020 *Greers Ferry Lake Shoreline Management Plan* is the required U.S. Army Corps of Engineers (USACE) approval document (Title 36, Section 327.30 and Engineer Regulation 1130-2-406) that protects and manages shorelines of USACE Civil Works water resource development projects under USACE jurisdiction in a manner that promotes safe and healthy public use of shorelines while maintaining environmental safeguards. The objectives of management actions in the 2020 *Greers Ferry Lake Shoreline Management Plan* are to balance permitted private shoreline uses and natural resource protection for general public use. USACE last updated the *Greers Ferry Lake Shoreline Management Plan* in 2004; and thus, the document is currently out-of-date.

The 2020 *Greers Ferry Lake Shoreline Management Plan*, once approved by the Southwestern Division Engineer, will become an appendix to the Operation Management Plan (OMP) for the lake. The objectives of the 2020 *Greers Ferry Lake Shoreline Management Plan* are to manage and protect the shoreline, to maintain optimal fish and wildlife habitat, natural environmental conditions, and to promote the safe and enjoyable use of the lake and shoreline for recreational purposes. Shoreline uses that interfere with authorized project purposes, public safety concerns, violate local norms, or result in significant environmental effects are not allowed.

Activities covered by the shoreline management plan, such as placing private floating facilities or modifying vegetation, on public lands require prior written approval, and/or a shoreline use permit from the Operations Project Manager (OPM) at Greers Ferry Lake.

With the draft 2020 *Greers Ferry Lake Shoreline Management Plan* revision, USACE is completing a Draft Environmental Assessment (EA) that evaluates existing conditions and potential impacts of proposed alternatives. The EA is prepared pursuant to the National Environmental Policy Act (NEPA), Council on Environmental Quality (CEQ) regulations (40 Code of Federal Regulations, 1500–1517), and USACE Policy and Procedures for Implementing NEPA as directed by ER 200-2-2 (1988).

2.0 PURPOSE AND NEED FOR ACTION

2.1 Purpose and Need

The 2020 *Shoreline Management Plan for Greers Ferry Lake* is the required U.S. Army Corps of Engineers (USACE) approval document (ER 1130-2-406) that protects and manages the shorelines of all Civil Works water resource development projects under USACE jurisdiction in a manner which will promote the safe and healthful use of these shorelines by the public while maintaining environmental safeguards to ensure a quality resource for use by the public.

The 2020 *Shoreline Management Plan for Greers Ferry Lake* main objectives are to manage and protect the shoreline; to establish and maintain acceptable fish and wildlife habitat, aesthetic quality, and natural environment conditions; and to promote the safe and healthful use of the lake and shoreline for recreational purposes.

- The original *Shoreline Management Plan for Greers Ferry Lake* (also known as the Lakeshore Management Plan) was approved in 1974.
- This plan was subsequently reviewed, updated with public involvement, and approved by the Division Engineer, Southwestern, in February 1976.
- This plan was reviewed again and updated with additional public involvement in 1982.
- Revision of 36 Code of Federal Regulations (CFR) 327. 30 in 1990 required the Little Rock District to convert its currently approved lakeshore management plans to *Shoreline Management Plan*s. The District's draft operating policy for shoreline management was made available for public review and comment in May 1991. This *Shoreline Management Plan for Greers Ferry Lake* became effective on April 16, 1993.
- Following public review of the April 1993 *Shoreline Management Plan for Greers Ferry Lake*, Supplement No. 1 was added and that version of the *Shoreline Management Plan for Greers Ferry Lake* became effective on November 21, 1994.
- The last review of the *Shoreline Management Plan for Greers Ferry Lake* began on January 26, 1999. That plan was approved by the Division Engineer, Southwestern, on March 14, 2000, and at a public workshop held in Heber Springs, Arkansas on March 16, 2000, the District Engineer presented the approved *Shoreline Management Plan for Greers Ferry Lake* to the public. However, an organization known as Save Greers Ferry Lake, Inc., filed suit in federal court claiming that the USACE had failed to comply with the National Environmental Policy Act (NEPA).
- In May 2000, the U.S. District Judge issued a temporary injunction that ruled the associated environmental assessment did not support an overall finding of no significant impact.
- Following the injunction, the USACE withdrew the 2000 *Shoreline Management Plan for Greers Ferry Lake*, reverted to the 1994 *Shoreline Management Plan for Greers Ferry Lake*, and publicly announced that it was going to conduct a full Environmental Impact Statement (EIS) to continue the process.

- The EIS was completed in April 2002. The final selection was a preferred alternative combination that conforms to existing laws and regulations and best balances public uses of shoreline for recreational opportunity, public safety, and environmental protection.
- Along with the completion of the EIS, a 2002 *Shoreline Management Plan for Greers Ferry Lake* was issued.
- A second suit was filed in federal court by Save Greers Ferry Lake, Inc. and Arkansas Nature Alliance. In September 2004 a summary judgment was filed by the United States District Court.
- An updated version of the *Shoreline Management Plan for Greers Ferry Lake* went into effect in December 2004.

The *Shoreline Management Plan for Greers Ferry Lake* will be reviewed at least once every five years, in accordance with regulations in place at the time of the review. Rezoning requests will not be accepted or considered in future reviews.

The Greers Ferry Project Office annually assesses the *Shoreline Management Plan for Greers Ferry Lake* in accordance with the "Annual Assessment of the *Shoreline Management Plans* (SMP) for Little Rock District Lakes". These assessments may serve as the Five-Year Review/Update providing there are no major issues or changes needed to the plan. The assessment will consider any revision to the Little Rock District's operating policy on shoreline management, changes in recreational use patterns on the project, amount of available Limited Development Area's (LDA), and other pertinent shoreline factors.

Considering the 2002 EIS (Case No.l 1:02CV00064 WRW, Section V. Conclusion, page 34), the maximum number of docks that will be allowed on Greers Ferry Lake is 506 (Alternative 6 Revised Preferred Alternative Maximum Potential of Dock was 521; USACE was enjoined from issuing permits to 15 docks that did not meet the established criteria, therefore reducing the potential maximum number of docks to 506).

2.2 Project History

Greers Ferry Lake is a major component of a comprehensive plan for water resource development in the White River Basin of Arkansas and Missouri. The project is located in the scenic Ozark Mountain region of north central Arkansas in Cleburne and Van Buren counties (Figure 2.1). The lake area extends in a westerly direction upstream from the dam approximately 50 miles into Cleburne and Van Buren Counties, Arkansas. The reservoir collects drainage from 1,146 square miles of an area upstream of the dam. Greers Ferry Lake is the last reservoir located in the five-reservoir system constructed in the White River Basin for flood control, hydropower generation, and other project purposes.

Greers Ferry Lake appears to be two bodies of water–one lying north of the other and connected in the middle by a quarter mile wide channel called the "Narrows". The surrounding terrain is rocky and rugged with vertical changes in elevation of more than 600 feet. The 306.3 miles of shoreline lie within Cleburne and Van Buren Counties and the perimeter of the lake is almost entirely wooded with a cover of mixed shortleaf pine and upland hardwoods.

Three major tributaries of the Little Red River comprise the water source for Greers Ferry Lake. These tributaries, Devils Fork, Middle Fork, and South Fork, are rapid flowing and provide excellent floating recreation above the impoundment.

The total area contained in the Greers Ferry project, including both land and water surface, consists of 41,194.5 acres. Of this total, 4,807 acres are in flowage easement (Note: a small difference in acreage figures exist throughout this document due to using GIS/survey plats data which is more accurate and based on new technology versus the deed language which was derived without the aid of technology). The region is characterized by narrow ridges between deeply cut valleys that are forested with deciduous trees and scattered pine and eastern red cedar. When the lake is at the top of the conservation pool (462.04 above mean sea level [amsl]), the water area comprises 31,207 acres and 306.3 miles of shoreline. The shoreline is irregular with topography ranging from steep bluffs to gentle slopes.

In 1937, the Chief of Engineers presented a report to Congress providing an overview of flood-control plans for the Ohio and Mississippi Valleys. The report stressed the need for construction of a system of flood control reservoirs in the White River Basin. In reviewing the Chief of Engineers' report, the House Committee on Flood Control recommended and Congress authorized a comprehensive study of the White River basin.

In 1954, Congress adopted the recommendations from the Chief's report authorizing the construction of Greers Ferry Lake. The Greers Ferry Lake project was originally authorized as one of the multiple-purpose reservoir projects in the White River Basin for control of floodwaters, generation of hydropower, and other purposes by Section 4 of the Flood Control Act of 1938 and as amended by the Flood Control Acts of 1941 and 1944. The inclusion of storage in the lake for municipal and industrial water supply was authorized by the Water Supply Act of 1958.

Construction of Greers Ferry Dam and appurtenant works was initiated in March 1959. The dam was completed in December 1962, and the powerhouse and switchyard were completed in July 1964. Greers Ferry Lake provides a wide variety of opportunities for the public to recreate on public lands and waters. Paved access roads wind through 16 public use areas with 1,148 campsites and approximately 27 public boat launching ramps. Three public use areas are currently leased to other sources: Eden Isle, Fairfield Bay, and Sandy Beach. There are nine commercial concessionaires with 4,061 wet boat slips. Additionally, there are four limited motel/resort leases.

2.3 Shoreline Allocation

2.3.1 General

In compliance with the Corps of Engineers' shoreline management regulation (36 CFR 327.30 ER 1130-2-406 and other applicable regulations), the Greers Ferry Lake shoreline has been classified into four allocations. These allocations are described below and are in agreement with the *Greers Ferry Lake Master Plan*, at the time of writing this document. These allocations extend from the water's edge to the project boundary for land-based uses and from the shoreline water ward for floating facility considerations. A map of the shoreline allocations, stored in Geographic Information System (GIS) format, is readily available for viewing at the Greers

Ferry Lake Office and will serve as the authoritative reference. Reduced or smaller scale maps may be developed for public dissemination. These maps will be for reference only, and will not serve as official authoritative reference. No changes will be made to the shoreline allocation layer except through the formal update process.

2.3.2 Shoreline Allocations

Limited Development Areas (LDA) (7.2% of Total Shoreline)
These areas are allocated for private activities, such as vegetative modification, and/or the mooring of privately owned floating facilities following the issuance of a permit in accordance with this *Shoreline Management Plan for Greers Ferry Lake* and current Federal Regulations. There are 22.0 miles of shoreline allocated as LDA. These areas are shown in red on the *Shoreline Management Plan for Greers Ferry Lake* allocation map.

Public Recreation Areas (PRA) (8.6% of Total Shoreline)
Public Recreation Areas were established with the intent of protecting the vista of the park or public use area by prohibiting the construction of private floating facilities and/or the modification of vegetation within the zoned area. Private floating facilities are not permitted within or adjacent to developed or future parks. Individuals or groups are not permitted to make any modifications of the landform or vegetative characteristics of lands under this allocation. These areas were also designated for park operations, such as swim beaches/launch ramps, and for commercial use including marinas/gas docks. Commercial boat docks and concessions are permitted in public recreation areas with a real estate instrument. There are 26.3 miles of shoreline allocated as Public Recreation Areas. These areas are shown in green on the *Shoreline Management Plan for Greers Ferry Lake* allocation map.

Protected Shoreline Areas (PSA) (83.4% of Total Shoreline)
PSA are those areas designated to maintain or restore aesthetic, fish and wildlife, historical, cultural, physical limitations, or other environmental values and includes areas with physical limitations such as bluffs. Other reaches of the shoreline were included under this allocation for physical protection reasons such as heavy siltation, rapid dewatering, erosion or exposure to high wind, wave, and current action. *Shoreline Use Permit*s for floating facilities will not be issued in this allocation. Vegetation modification and footpaths may be permitted in these areas, provided the request area is located inside the appropriate Master Plan land classification. Prior to issuance of the *Shoreline Use Permit*, the Operations Project Manager must determine that the requested land use will not adversely impact the environment or physical characteristics of the zoned area prior to issuing the *Shoreline Use Permit*. There are 255.7 miles of shoreline allocated as PSA. These areas do not have a designated color on the *Shoreline Management Plan for Greers Ferry Lake* allocation map.

Prohibited Access Areas (PAA) (0.8% of Total Shoreline)
These areas typically include hazardous zones near dams, spillways, hydroelectric power stations, and water intake structures. Public access is not allowed in these areas for health, safety, and security reasons. No *Shoreline Use Permit*s will be issued in PAA. Outgrants for public utilities may be considered in PAA. There are 2.4 miles of shoreline allocated as PAA. These areas are shown in blue on the *Shoreline Management Plan for Greers Ferry Lake* allocation map.

2.3.3 Flowage Easements

There are lands at Greers Ferry Lake where the Corps of Engineers' real estate interest is limited to the right to flood the privately owned property commonly referred to as flowage easements. These easements were acquired for the operation of the Greers Ferry Lake Project. In most instances, easements were acquired above the monumented Government boundary line up to elevation 491-foot with a few locations up to 498-foot elevation contour. The typical flowage easement grants the Government the perpetual right to occasionally overflow the easement area, if necessary, for the operation of the reservoir; and specifically provides that, "No structures for human habitation shall be constructed on the land […]"; and further provides that, "No other structures of any other type [including fill materials] shall be constructed or maintained on the land except as may be approved in writing by the representative of the United States in charge of the project." All flowage easement deeds should be checked for exact rights acquired prior to proceeding in any action on the easement.

Under *Title 36, Chapter III, Part 327, Code of Federal Regulations*, the Corps of Engineers has authority over all waters of the reservoir and all facilities thereon, regardless of ownership of the underlying land. Easement lands and other inundated private property are therefore classified into shoreline use allocations similar to fee-owned lands. Adjoining landowners who desire to place private floating facilities on waters over flowage easement lands or inundated private property must obtain a *Shoreline Use Permit* from the Operations Project Manager. There are currently 4,631 deeded acres of land affected by flowage easements.

Figure 2.1 Greers Ferry Lake and Surrounding Area

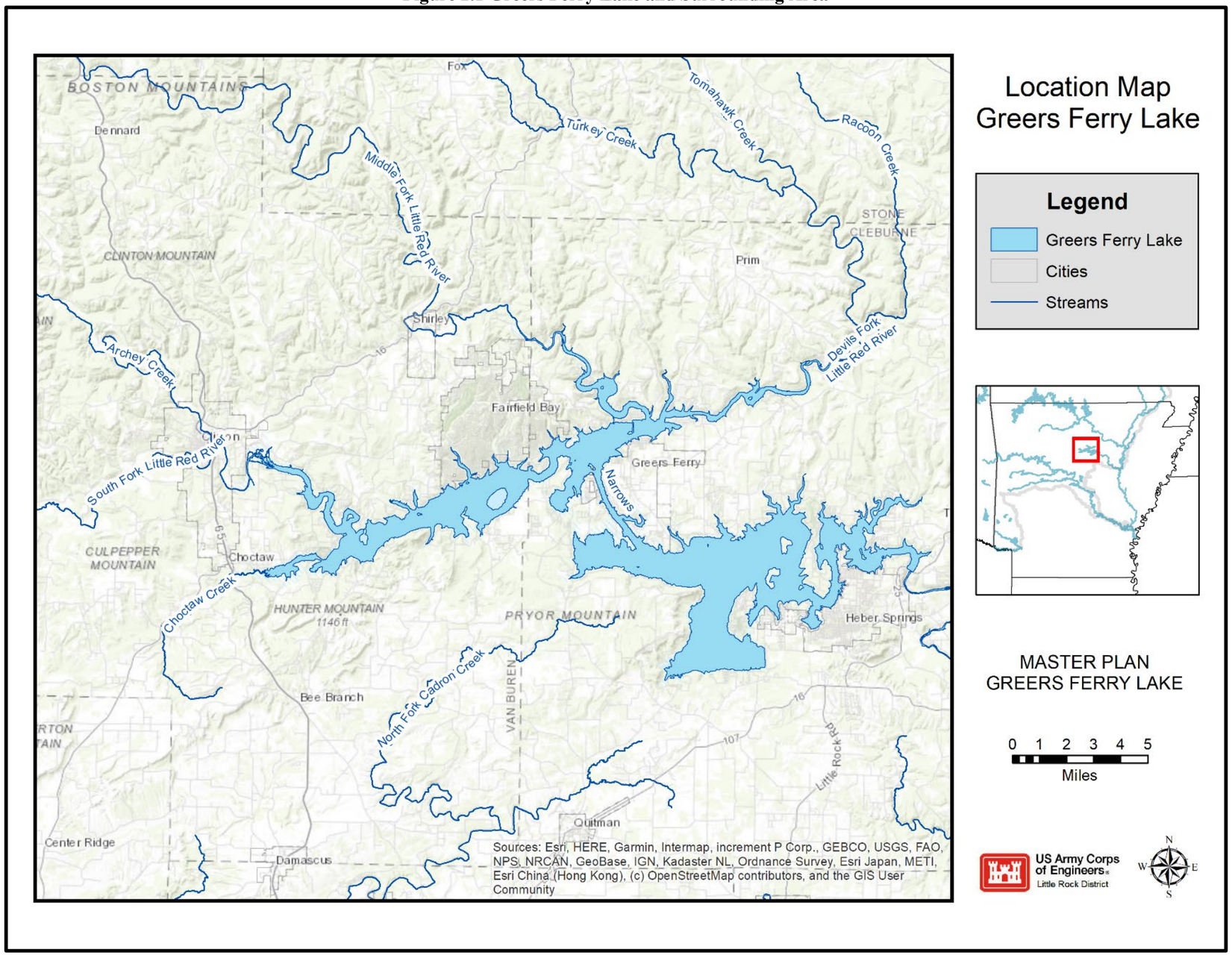


Table 2.1 Pertinent Data of Greers Ferry Dam and Lake

PERTINENT DATA OF THE DAM AND LAKE	
General Information	
Purpose	FC, P, Rec, F&W, W [1]
River	Little Red River
State	Arkansas
Drainage area, square miles	1,146
Dam	
Length in feet	1,704
Height, feet above streambed	243
Top of dam elevation, feet above mean sea level	503
Generators	
Main units, number	2
Rated capacity each unit, kilowatts	48,000
Station service units, number	1
Rated capacity each unit, kilowatts	500
Lake	
Nominal bottom of power drawdown elevation, feet above msl	435
Area, acres	23,740
Nominal top of conservation pool Elevation, feet above mean sea level	462.04
Area, acres	31,207
Length of shoreline, miles	306
Nominal top of flood-control pool Elevation, feet above mean sea level	491
Area, acres	39,762
Length of shoreline, miles	368
(1) *FC – flood control,* *P – power* *Rec-Recreation* *F&W-Fish and Wildlife* *W – water supply*	

3.0 ALTERNATIVES

3.1 Introduction

Alternatives evaluated in this EA are depicted in Table 3.1 and Figure 3.1. The alternatives include: Alternative 1 (No Action); Alternative 2 (Preferred); and Alternative 3 (Conservative). A complete set of maps for each alternative is located in Appendix C to this document.

The Preferred and Conservative Alternatives are compared to the No Action Alternative in order to evaluate potential positive and negative effects on the natural and human environment, based on the various shoreline allocations determined by each action alternative. All evaluated alternatives will be provided for public review after completion of the Draft EA. Public comments will be collected during the public comment period and considered in the development of the Final EA and the Final 2020 *Greers Ferry Lake Shoreline Management Plan*. Based on public comments received, the Final EA would compare all action alternatives to the Preferred Action or to a modified alternative that is developed, based on public preferences. The Final EA presents the Selected Alternative and provides the basis for the agency decision under NEPA.

These alternatives cover the range from increased shoreline protection to increased shoreline development and include analysis of the potential effects on the human, terrestrial, and aquatic environment from their implementation. A No Action Alternative examined leaving the lake as it currently exists in terms of developable areas and protected areas. Of the 306.3 miles of available land around the lake, 21.3% of this is allocated as LDA and PRA, with potential future development occurring. The No Action Alternative would leave PSA and PAA at 78.7% or 241.1 miles of land in "protected areas."

The action alternatives included a Preferred Alternative and a Conservative Alternative. The Preferred Alternative shifted the majority of the available shoreline acreage to PSA, with 83.5% of the shoreline in this category. A major shoreline allocation change was taking South Fork and Salt Creek PRA and reallocating them to PSA. This was done because both parks were never fully developed Corps parks (i.e. only primitive camping and boat launch ramps). Another shoreline allocation change was to decrease the PRA to fit within the Corps park boundary; these areas were reallocated to PSA. Potential effects from this alternative would be decreased vegetation removal and a reduction in soil erosion due to the retention of natural vegetation around most of the lakeshore. The Preferred alternative seeks to balance all components of lake usage, including the provision for growth and recreation potential, while protecting and preserving terrestrial and aquatic resources.

The Conservative Alternative further reduces the LDA to 3.0 miles, occupying only 1.0% of the shoreline, but increases PRA lands to 17.2%. PSA in this alternative constitute 80.3% of the shoreline, which also enhances shoreline vegetation preservation, reduces stormwater runoff quantity and velocity, which results in less in-lake sedimentation and

turbidity, and improves water quality. Considerations for future generations' lake use, to include recreation activities and viewing the lake as a limited natural resource, were taken into account in developing the Conservative Alternative.

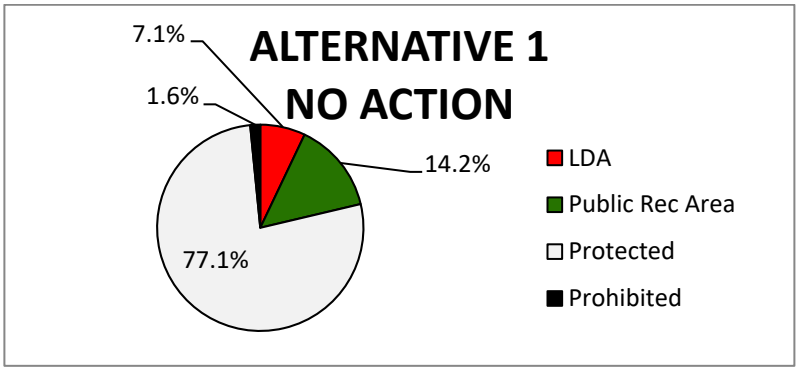
The action alternatives have the potential to improve health and safety issues, aesthetics, terrestrial and aquatic wildlife habitat. The decisions made in determining shoreline allocations were based on comments received during the Scoping phase, current/existing shoreline use activities on Federal lands, and the history of events and activities taken place at Greers Ferry Lake.

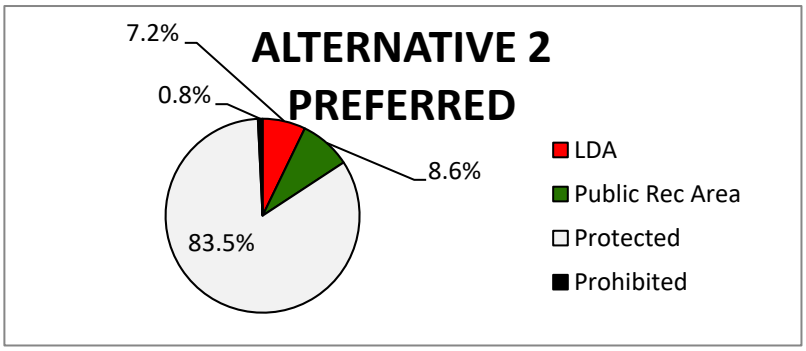
Table 3.1

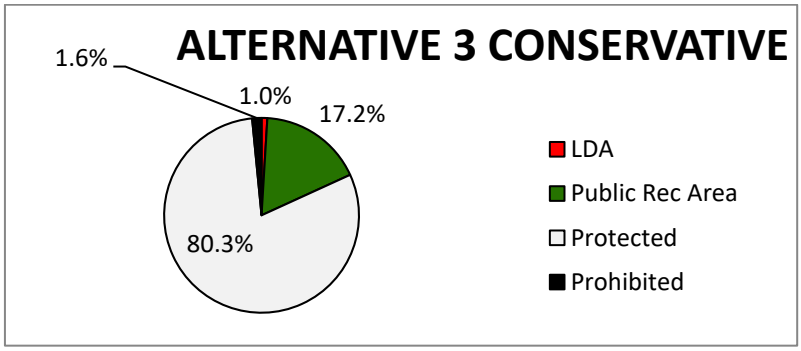
Changes in Miles of Shoreline (from 2004) Allocated to Limited Development Areas (LDA), Public Recreation Areas (PRA), Protected Shoreline Areas (PSA) and Prohibited Access Areas (PAA) for each Alternative

Alternative 1 (No Action)	Miles	Percent of Shoreline	Change in miles	Percent change in miles
Total Shoreline	306.3	100.0%	-	-
LDA	21.7	7.1%		
PRA	43.6	14.2%		
PSA	236.3	77.1%		
PAA	4.8	1.6%		
Alternative 2 (Preferred)	**Miles**	**Percent of Shoreline**	**Change in miles**	**Percent change in miles**
Total Shoreline	306.3	100.0%	-	-
LDA	22.0	7.2%	0.3	0.1%
PRA	26.3	8.6%	-17.3	-5.7%
PSA	255.7	83.5%	19.4	6.3%
PAA	2.4	0.8%	-2.4	-0.8%
Alternative 3 (Conservative)	**Miles**	**Percent of Shoreline**	**Change in miles**	**Percent change in miles**
Total Shoreline	306.3	100.0%	-	-
LDA	3.0	1.0%	-18.7	-6.1%
PRA	52.8	17.2%	9.2	3.0%
PSA	245.8	80.3%	9.6	3.1%
PAA	4.8	1.6%	0.0	0.0%

Figure 3.1 Pie Chart Depictions of Shoreline Percentages Allocated to Public Recreation Areas, Protect Shoreline Areas and Prohibited Access Areas for each Alternative







3.2 No Action (Alternative 1)

There are 306.3 miles of shoreline at Greers Ferry Lake. The No Action Alternative shoreline allocation, which is based on the 2004 Shoreline Management Plan, will retain 21.7 miles of Limited Development Area (LDA), representing 7.1% of the total shoreline miles. Public Recreation Areas (PRA) include 43.6 miles (14.2%), the Protected Shoreline Areas (PSA) include 236.3 miles (77.1%), while Prohibited Access Areas (PAA) comprise 4.8 miles or 1.6% of the total 306.3 miles of shoreline. Components of this alternative include:

- Legal parking access to shoreline is considered to be within 200 feet of facility location;
- There must be at least three parking spots for every four slips contiguous to the access easement;
- Docks will be spaced a minimum of 100 feet apart, with no crossover allowed and must be below property with two-thirds of the cove open;
- No swim decks allowed;
- New and replacement docks must use alternative power source;
- Walkways 40 feet in length and a maximum of six feet in width allowed;
- One to 20 slips per dock allowed, with maximum slip size 12 feet x 28 feet;
- Slip owner can be any US citizen with legal access within 200 feet of the dock;
- No new enclosed structures allowed;
- Existing vegetation modification permits are limited to 100 feet if it does not infringe on the existing 100 feet vegetative buffer implemented with the 2004 Greers Ferry Lake Shoreline Management Plan.
- Allow removal of non-flowering trees less than 2” in diameter at breast height with permit;
- Hazardous trees can be removed if they have the potential to fall on permitted path/underbrush areas or a structure, felled trees to remain on project lands;
- Vegetation removal for dock maintenance allowed for width of facility;
- Walking paths must be meandering with maximum six feet width;
- Ambulatory Assistance Vehicles (AAV) allowed on permitted paths, if eligible;
- Steps/stairs allowed in LDAs if slope >20%;
- Tramways allowed in LDAs;
- Easements allowed for access to docks.

3.3 Preferred (Alternative 2)

The Preferred Alternative shoreline allocation will increase the LDAs to 22.0 miles of shoreline, representing 7.2% of the total shoreline miles of the total 306.3 miles of shoreline. Public Recreation Areas are reduced to 26.3 miles (8.6%), the PSAs increased to 255.7 miles (83.5%), while PAAs will be decreased to 2.4 miles or 0.8% of the total 306.3 miles of shoreline. Components of this alternative include:

- Parking for new multiple owner docks required within 200 feet of the dock site on private property of a slip owner;
- Docks will be spaced a minimum of 100 feet apart, with no crossover allowed and must be below property with two-thirds of the cove open;
- No swim decks;

- New and replacement docks must use alternative power source;
- No deck overs allowed;
- Only single walkways 40 feet in length and a maximum of six feet in width allowed;
- Exterior walkway maximum six feet width, other walkways maximum four feet width, minimum width is three feet;
- One to 12 slips per dock allowed, with maximum slip size 12 feet x 28 feet;
- Slip owners must be adjacent landowners (for new docks only) and must have ownership of 75 contiguous feet of common boundary line within an LDA. One property is eligible for a two slip maximum;
- Only alternative power sources will be allowed for new and replacement docks;
- Existing vegetation modification limited to 100 feet if does not infringe on 100 feet vegetative buffer implemented with the 2004 Greers Ferry Lake Shoreline Management Plan.;
- Underbrushing across a vegetation break (i.e. road, etc.) is not allowed;
- Tree limbing is allowed up to six feet above ground surface along a permitted path only;
- Dead trees can be removed if they have the potential to fall on permitted path/underbrush areas or a structure, felled trees to remain on project lands;
- Vegetation removal for dock maintenance allowed for width of facility at 462 feet mean sea level and two foot swath for anchor cables;
- Walking paths must be meandering with maximum six feet width;
- AAV's allowed on permitted paths, if eligible;
- Steps/stairs allowed in LDAs if slope >20%;
- No new tramways allowed;
- No easements allowed.

3.4 Conservative (Alternative 3)

The Conservative Alternative shoreline allocation will reduce LDAs to 3.0 miles of shoreline, representing 1.0% of the total shoreline miles. PRA are increased to 63.6 miles (17.2%), the PSA is increased to 245.8 miles (80.3%), while PAA comprise 4.8 miles or 1.6% of the total 306.3 miles of shoreline. Components of this alternative include:

- New docks will not be allowed;
- Only alternative power sources will be allowed for replacement docks;
- No swim decks;
- No deck overs;
- No new vegetation modification permits allowed;
- Dead trees can be removed if they have the potential to fall on permitted path/underbrush areas or a structure, felled trees to remain on project lands;
- Walking paths must be meandering with maximum three feet width and only allowed at every other common boundary property line;
- No new AAV trails;
- No tramways allowed;
- No easements allowed.

4.0 AFFECTED ENVIRONMENT

4.1 Project Setting

The Greers Ferry Lake watershed is a portion of the Little Red River watershed as defined in U.S. Geological Survey Hydrologic Unit Code (HUC) 11010014. Construction of the Greers Ferry Dam split the Little Red River watershed in two: the northern portion drains to Greers Ferry Lake, and the remainder drains to the Little Red River below the dam. Figure 4.1 outlines the Little Red watershed and its contributing counties—Van Buren, Cleburne, Searcy, Stone, White, Independence, and Pope. The total area of the Little Red River watershed is 1,147,100 acres, with a total of 732,900 acres draining to the lake and 414,200 acres draining below the dam. Much of the water that flows into Greers Ferry Lake comes from Van Buren and Cleburne Counties; minor contributions come from Searcy, Stone, Independence, and Pope Counties. The portion of the Little Red watershed within White County drains below the dam. The primary towns in the Greers Ferry Lake watershed are Greers Ferry and Heber Springs, upstream of the Greers Ferry Dam on the lake, and the town of Clinton, Arkansas on the South Fork of the Little Red River. In addition, there are a number of large development areas, including the town of Greers Ferry, which sits immediately east of the northern end of the Narrows; the city of Fairfield Bay, which sits to the north of the upper portion of Greers Ferry Lake; Eden Isle, a developed peninsula on the Lower Lake west of Heber Springs; the city of Higden, which is immediately above the Narrows; and the city of Edgemont, east of Fairfield Bay. The remainder of the Greers Ferry Lake watershed consists primarily of forest and agricultural areas.

Greers Ferry Lake is a main-stem reservoir created by the damming of the Little Red River. At conservation pool elevation (462.04 feet mean sea level [msl]), the reservoir covers a total area of 31,207 acres, with inundation extending up the Little Red River's three primary branches, the South Fork, the Middle Fork, and the Devils Fork. At flood pool elevation,487 feet msl, the reservoir covers a total area of 39,762 acres. The Narrows are approximately 3 miles in length and less than 0.5 mile wide. The area of the lake north of the Narrows, termed the Upper Lake for this report, covers 12,900 acres and receives the bulk of the watershed drainage. The Upper Lake, which is long and narrow, runs in an east-west direction for approximately 25 miles. The average width of the Upper Lake is 0.66 mile. The area of the lake south of the Narrows, the Lower Lake, covers 18,200 acres and ends at Greers Ferry Dam. It consists of a large open area on the western side with three primary embayments, Salt Creek, Cove Creek, and Sulphur Creek. The Narrows connects to the Lower Lake on its western side near the Salt Creek embayment. The Lower Lake consists of an open area on its western side and then becomes thinner moving east. This area flows past the town of Heber Springs, winding north and south until it reaches the dam. High, rocky bluffs and peninsulas characterize this section of the lake.

The landscape surrounding Greers Ferry Lake and its watershed is largely rural and in private ownership. Forests and pasture dominate the land uses (77 percent and 12 percent, respectively). Urban areas account for less than three percent of the land use in the Greers Ferry watershed (CAST 2006). Similar land uses are found in areas west and north of Greers Ferry Lake.

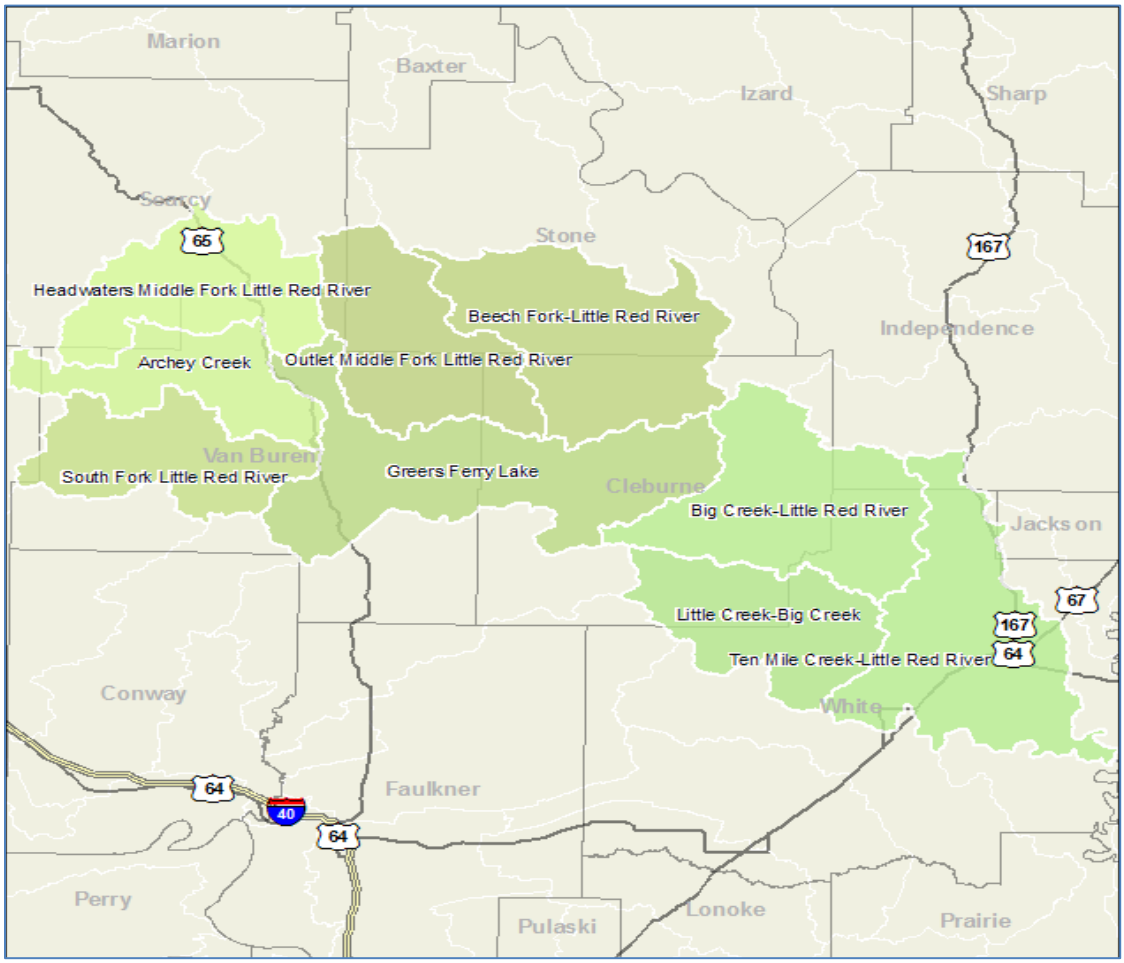


Figure 4.1: Little Red River Watershed

4.2 Climate and Climate Change

The climate in the Greers Ferry Lake area is classified as "humid subtropical" and is characterized by relatively high temperatures and evenly distributed precipitation throughout the year. The average annual temperature in Heber Springs, Arkansas is 59.3°F. While the warmest month, on average, is July with an average temperature of 79.7°F. Daytime summer temperatures can exceed 90°F on occasion. January is the coolest month, with an average temperature of 37.3°F. Daily lows between 20ºF to 25ºF is not uncommon.

The study area receives approximately 51 inches of rain. November and August typically recording the most and least rain, respectively. The months in late spring and late fall to early winter are generally the wettest. Summer precipitation primarily occurs during rainstorms, where locally high rainfall amounts can occur over a short period of time. During the fall, winter, and early spring, precipitation events are usually less intense and of longer duration. The area averages approximately 2 inches of snow per year, most of which occurs in February (Weatherbase 2017).

Climate change is an area of concern due to the potential for effects on many aspects of the environment, especially those related to water resources. The U.S. Global Change Research Program (USGCRP) summarized information regarding climate change and its potential effects in regional assessments in a report, "Global Climate Change Impacts in the United States" (2009). In the Midwest, which extends from Minnesota to Missouri, extreme events such as heat waves, droughts and heavy rainfall events are projected to occur more frequently. Should these events become significant enough to impact the operation of Greers Ferry Lake, the *Greers Ferry Lake Master Plan* and associated documents (i.e. Operations Management Plan and Shoreline Management Plan) would be reviewed and revised, if necessary.

4.3 Topography, Geology, Soils, and Minerals

4.3.1 General Geology and Topography

Greers Ferry dam, reservoir, auxiliary dikes and appurtenances are situated along the southwestern margin of the Boston Mountains; a deeply dissected physiographic section of the southern portion of Ozark Plateaus province. While several anticlines and synclines, post-Atokan folds and monoclines have been found in the area, the overall structure of the Boston Mountains is a homocline with a dip typically less than one degree. Fold structures trend to the northeast with gentle slopes and dips ranging from five to ten degrees, and faulting is characteristic of the younger post-Pennsylvanian folds, giving a horst and graben offset to the Morrowan rocks.

Topographically, the surrounding area of the reservoir consists of flat-topped mountains with elevations of 600 to 1,000 feet msl and a bench and bluff topography resulting from erosion by high gradient streams and by wind-sapping. Bench widths average 30 feet, while and the extensive reach of the bluffs can be traced laterally in some areas for more than 10 miles. Dominant lithologic features are fine to medium grained, dark to light gray sandstone and carboniferous, sandy to clayey shale. Valleys are primarily composed of alluvial fills consisting of sand and silt, and streams tend to flow directly over bedrock due to erosive forces that have cut through the alluvium along the valley floor and exposed the underlying rock. To the southwest, approximately 2.25 miles from the dam, Round Mountain peaks at elevation 918' msl and is the highest relief in the surrounding area. At the actual dam site, the bed elevation of the Little Red River and the high points of the left and right abutments are 258' msl, 533' msl and 427' msl respectively. The flood plain is about 500 feet wide and the stream channel is approximately 250 feet in width.

4.3.2 Site Geology

The dam is located on the northern limb of the Heber Springs anticline, midway from its axis and the axis of the Fairbanks syncline to the north. Bedrock surrounding the dam site consists primarily of sedimentary shale and sandstone from the lower Pennsylvanian (Morrowan) aged Bloyd and Hale formations. In the immediate area of the dam, bedrock is comprised of both the Dye Shale Member of the Bloyd Formation and the Prairie Grove Member of the Hale Formation (Arkansas Geological Survey (AGS) nomenclature)[1]. The abutments and valley walls in the vicinity of the dam belong to the Dye Shale Member, while the Prairie Grove Member

outcrops at the base of the valley below the Dye Shale Member and provides the bedrock foundation for the stilling basing and spillway section. Additionally, instead of the one degree dip typical of the Boston Mountains, the vicinity of the dam has a regional dip of four degrees in a northerly upstream direction, and jointing is a prominent structural feature with two major nearly vertical joint systems. The presence of these joints, due to the tendency of rock to break along joints instead of steps or ledges, coupled with weathering along these joints which extended deeper than anticipated, resulted in a lowering of the foundation grade as much as 15 feet in some places. The dam's left abutment consists of steep vertical cliffs with outcrops of both shale and sandstone. In contrast, the slope of the right abutment is a gentle grade, and the shale and sandstone outcrop patterns are less pronounced than those of the left abutment.

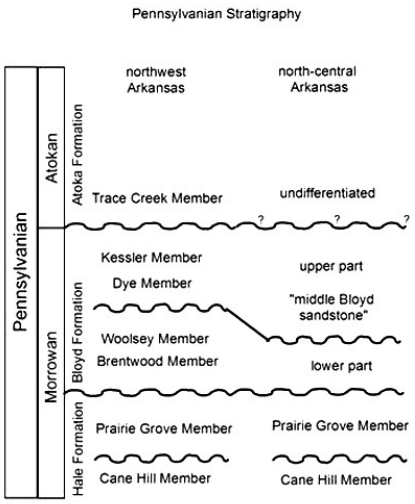


Figure 4.2 Geologic Column

The Dye Shale Member is primarily shale with some siltstone and thinly to massively bedded sandstone. The shale ranges in grain size from clay to silt, gray to black in color, and weathers tan to orange. The sandstone layers are thin to massively bedded, fossiliferous, cross-bedded, very fine to medium grained, and vary in color ranging from orange to tan. The Prairie Grove Member contains a variable sequence of sandstone, siltstone, and shale. The sandstone is coarse grained, ranges in color from orange to light gray, weathers orange to brown, and is medium to very thick, to massively bedded. The Bloyd and Hale formations provide good foundation rock except in sections where joint systems in combination with severe weathering have occurred.

Overburden in the immediate vicinity of the abutments consists of residual clay (with some silt) coupled with weathered sandstone fragments and boulders. Depths range from a few feet to 25 feet with the maximum depths found along the valley floor where half of the lower valley floor is covered by an alluvial terrace of sand and silt. All overburden was removed prior to emplacement of concrete structures, and all of the foundation rock on which concrete was placed was of the Bloyd and Hale Formations.

4.3.3 Soils

Soils in the Greers Ferry Lake study area are derived from in-place weathering of underlying rock strata, except in the active floodplain of the lake, where soils consist of alluvial silts and sands. Soils formed from overburden on sandstone parent material consist of sandy silt and fragments of sandstone and are up to 5 feet thick. Soils formed from shale bedrock are primarily clayey with few rock fragments and range from 4 to 20 feet, depending on active weathering depth. The following are the four predominant soil associations that make up two-thirds of the soils occurring in the Greers Ferry Lake study area (NRCS 2017):

Enders-Steprock Association. Moderately deep to deep soils found on moderate to steep slopes. This association is well drained and consists of gravelly to stony loamy soils that formed in the residuum of shale or interbedded sandstone. The soils are acidic because of the absence of limestone in the underlying bedrock.

Steprock-Mountainburg Association. Moderately deep soils found on gently sloping to moderately steep slopes. This association contains stony and gravelly loamy soils that formed in colluvium or residuum of sandstone or interbedded sandstone, siltstone, and shale.

Steprock-Linker Association. Moderately deep and well-drained soils found on gently sloping to moderately steep slopes. This association contains loamy and gravelly loamy soils that formed in residuum of sandstone or interbedded sandstone, siltstone, and shale.

Steprock-Mountainburg-Rock Outcrop Association. Moderately deep and shallow soils found on steep to very steep slopes. This association contains stony and loamy soils formed in colluvium or residuum of sandstone, interbedded sandstone, siltstone, and shale, or rock outcrop.

A soil survey by the Natural Resource Conservation Service (NRCS) shows there are six out of the eight possible general classifications (Classes I through Class VIII) occurring in the reservoir area. The erosion hazards and limitations for use increase as the class number increases. Class I has few limitations, whereas Class VIII has many. The soil class data for project lands is provided in Table 4.1. This data is compiled by the NRCS and is a standard component of natural resources inventories on USACE lands. This, and other inventory data, is recorded in the USACE Operations and Maintenance Business Information Link (OMBIL).

Table 4.1 Soil Classifications

Soil Class	Acreage
Class I	0%
Class II	0.45%
Class III	1.04%
Class IV	8.63%
Class V	2.33%
Class VI	6.25%
Class VII	3.99%
Class VIII	0%

A general description of the soils at Greers Ferry Lake and the land capability classes are described below.

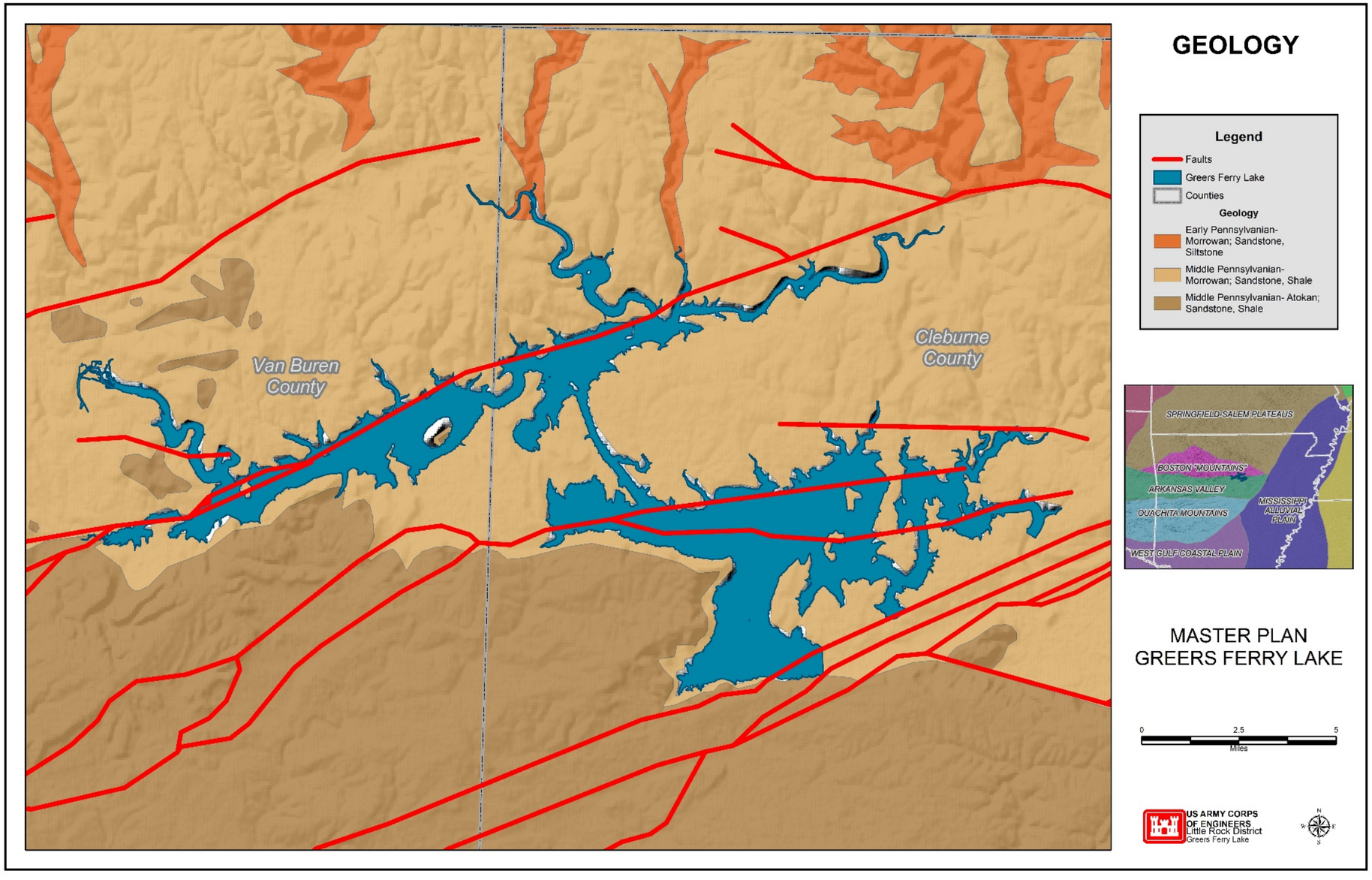
- *Class I* soils have slight limitations that restrict their use.
- *Class II* soils have moderate limitations that reduce the choice of plants or require moderate conservation practices.
- *Class III* soils have severe limitations that reduce the choice of plants or require special conservation practices, or both.
- *Class IV* soils have very severe limitations that restrict the choice of plants or require very careful management, or both.
- *Class V* soils have little or no hazard of erosion but have other limitations, impractical to remove, that limit their use mainly to pasture, range, forestland, or wildlife food and cover.
- *Class VI* soils have severe limitations that make them generally unsuited to cultivation and that limit their use mainly to pasture, range, forestland, or wildlife food and cover.
- *Class VII* soils have very severe limitations that make them unsuited to cultivation and that restrict their use mainly to grazing, forestland, or wildlife.
- *Class VIII* soils and miscellaneous areas have limitations that preclude their use for commercial plant production and limit their use to recreation, wildlife, or water supply or for aesthetic purposes.

Detailed information on all soil types surrounding Greers Ferry Lake is available on websites maintained by the NRCS, U.S. Department of Agriculture.

4.3.4 Minerals

According to the Arkansas Geological Survey website, Cleburne and Van Buren counties have 64 sand and gravel pits, shale, and crushed and dimension stone quarries that are either active, intermittent, abandoned or reclaimed (AGS 2017). Three abandoned coal mines are reported in the two counties, with only one in the Greers Ferry watershed. One phosphate rock mine is reported in Van Buren County near Leslie, but not within the Greers Ferry Lake watershed. The Arkansas Department of Environmental Quality monitors all sites to ensure there are no impacts to the surrounding environment.

Natural Gas and impacts to the Fayetteville Shale: To date, no drilling activity has taken place on USACE lands or under Greers Ferry Lake. Mineral rights for the Federal Government are managed by the Bureau of Land Management



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3 **Figure 4.3 Geology of Greers Ferry Lake Watershed**

4.4 Aquatic Environment

4.4.1 Hydrology and Groundwater

The Western Interior Plains Confining Unit (WIP) is a group of formations that occurs in the Boston Mountain Plateau and a portion of the Arkansas River Valley, including the area surrounding Greers Ferry Lake. These formations are comprised primarily of fractured shale, sandstone, and siltstone rocks of Mississippian and Pennsylvanian age that are characterized by low porosity, permeability, and yields. While there are no formally recognized aquifers, there are numerous shallow, undifferentiated, and saturated rocks of limited extent that are used for domestic and small community supply (Kresse, et al. 2014).

For this system, recharge occurs as precipitation that infiltrates the ground in upland areas and percolates to the water table. Groundwater flow paths are defined by small-scale topographic features where flow occurs from elevated areas to valley floors terminating in small stream systems. Groundwater storage in these aquifers is limited primarily to fractures and faults. Typical well yields range from 1 to 5 gallons per minute (gpm), and thicker sandstone units in the eastern part of the WIP system commonly yield 5 to 10 gpm. It is not uncommon for wells in the WIP system to go dry during pumping, especially during dry periods. Water levels in the WIP confining system range from near land surface to approximately 50 feet below ground surface. Seasonal fluctuations are about 10 feet, with drawdowns from pumping increasing fluctuations to as much as 45 feet (Kresse, et al. 2014).

Wells in the WIP confining unit are generally inadequate for public supply, thus are limited to domestic, small community, and non-irrigation agricultural supply, owing to poor well yields and limited groundwater resources. Since domestic and water supply systems producing less than 50,000 gallons per day are not required to report groundwater use, there is no way to accurately quantify the number of domestic and livestock wells in use in the WIP. As of 2010, water use from 13 wells completed in the Atoka Formation of the WIP confining unit was reported. These wells were primarily used for public supply at parks, schools, stores, and some commercial business (ANRC 2014). Most municipalities in the area around Greers Ferry Lake utilize the lake as their primary water source. The quality of groundwater in the WIP is highly variable but meets most secondary drinking water standards and is considered suitable for domestic and livestock uses.

4.4.2 Water Quality

The Greers Ferry watershed is relatively pristine, with 77 percent of its area (above the dam) in forest. The upper part of the lake generally has higher levels of nutrients, total suspended solids, fecal coliform bacteria, and other parameters where the three primary tributaries enter the lake. Potential pollutant loads to Greers Ferry Lake come from various sources, including the following:

- Watershed runoff entering the lake through the three major tributaries of the Little Red River—the South Fork, the Middle Fork, and the Devils Fork.
- Watershed runoff draining directly to the lake and its smaller tributaries. These loads reflect the immediate Upper and Lower Lake watersheds (adjacent land uses and marina development).

- Permitted point source discharges to the tributaries and Greers Ferry Lake (10 National Pollutant Discharge Elimination System (NPDES) permits located in upstream tributaries and/or lake).
- Septic systems within the immediate Upper and Lower Lake watersheds.
- Boating activities on the lake (fueling and illegal discharge of human waste).

The three major tributaries contribute more than 80 percent of the pollutant loading to the lake as the result of land use practices in the watershed. The Arkansas 2016 Integrated Water Quality Monitoring and Assessment Report identifies five miles of the South Fork of the Little Red River at the upper end of Greers Ferry Lake as having elevated levels of mercury, thus was placed under a fish consumption advisory (Arkansas Department of Environmental Quality 2016). The report also lists a total of 20.6 miles of the Middle Fork Little Red River not meeting established criteria for primary contact and aquatic life due to pathogen indicators (bacteria). A 2018 report is currently drafted, under review by the Environmental Protection Agency (EPA), but has not been finalized as of the drafting of this document.

Water quality in Greers Ferry Lake is considered satisfactory for the designated uses of the reservoir. These uses include hydroelectric power generation, water supply, water-based recreation, and flood control. Greers Ferry Lake is not listed as impaired under the Clean Water Act Section 303(d) listing program for any parameters (ADEQ 2016).

4.4.3 Fish Species and Habitat

The Arkansas Department of Environmental Quality classifies Greers Ferry Lake as a Type "A" water body (larger lakes of several thousand acres in size; watersheds dominated by upland forest; average depth 30 to 60 feet; low primary production/trophic status if in natural unpolluted condition). Low trophic status is mainly due to temperature stratification, which is natural and occurs in many deep reservoirs.

Sport fishing is an important pastime for lake residents and visitors. The Arkansas Game and Fish Commission (AGFC) manages the lake for both warm water and cool water species. Native and introduced sport fish popular with area anglers include *Micropterus* (black bass), *Centrarchidae* (sunfish), *Ostariophysi* (catfish), *Sander vitreus* (walleye), and *Morone chrysops* (white), and *Morone saxatilis* x *Morone chrysops* (hybrid striped bass). Hybrid striped bass and walleye are stocked in the reservoir and provide a "put and take" fishery. A highly productive and very popular trout fishery has been established in the Little Red River below Greers Ferry Dam by AGFC because of the available discharge of cold, oxygenated water from the dam. Table 4.2 lists fish species documented as occurring in Greers Ferry Lake and its tributaries.

Table 4.2: Fish Species Reported from the Greers Ferry Lake Watershed

Common Name	Scientific Name	Common Name	Scientific Name
Arkansas saddled darter	*Etheostoma euzonum*	Longear sunfish	*Lepomis megalotis*
Banded darter	*Etheostoma zonale*	Longnose darter	*Percina nasuta*
Bigeye shiner	*Notropis boops*	Longnose gar	*Lepisosteus osseus*
Bigmouth buffalo	*Ictiobus cyprinellus*	Northern hogsucker	*Hypentelium nigricans*
Black buffalo	*Ictiobus niger*	Northern studfish	*Fundulus catenatus*
Black crappie	*Pomoxis nigromaculatus*	Ozark madtom	*Noturus albater*
Black redhorse	*Moxostoma duquesnei*	Rainbow darter	*Etheostoma caeruleum*
Blackside darter	*Percina maculata*	Rainbow trout (i) (Little Red River below Greers Ferry Dam)	*Oncorhynchus mykiss*
Brown trout (i) (Little Red River below Greers Ferry Dam)	*Salmo trutta*	Brook trout (i) (Little Red River below Greers Ferry Dam)	*Salvelinus fontinalis*
Hybrid striped bass (i)	*Morone chrysops × saxatilis*	Redear sunfish	*Lepomis microlophus*
Blacktail shiner	*Cyprinella venustus*	Redfin darter	*Etheostoma whipplei*
Blue catfish	*Ictalurus furcatus*	Redfin shiner	*Lythrurus umbratilis*
Bluegill	*Lepomis macrochirus*	River redhorse	*Moxostoma carinatum*
Bluntnose minnow	*Pimephales notatus*	Shadow bass	*Ambloplites ariommus*
Brindled madtom	*Noturus miurus*	Shorthead redhorse	*Moxostoma macrolepidotum*
Brook silverside	*Labidesthes sicculus*	Slender madtom	*Noturus exilis*
Bullhead minnow	*Pimephales vigilax*	Slim minnow	*Pimephales tenellus*
Central stoneroller	*Campostoma anomalum*	Smallmouth buffalo	*Ictiobus bubalus*
Channel catfish	*Ictalurus punctatus*	Smallmouth bass	*Micropterus dolomieui*
Chestnut lamprey	*Icthyomyzon castaneus*	Speckled darter	*Etheostoma stigmaeum*
Common carp	*Cyprinus carpio*	Spotted bass	*Micropterus punctulatus*
Creek chub	*Semotilus atromaculatus*	Spotted gar	*Lepisosteus oculatus*
Creek chubsucker	*Erimyzon oblongus*	Spotted sucker	*Minytrema melanops*
Cypress darter	*Etheostoma proeliare*	Spotted sunfish	*Lepomis punctatus*
Duskystripe shiner	*Luxilus pilsbryi*	Steelcolor shiner	*Cyprinella whipplei*
Flathead catfish	*Pylodictus olivarus*	Stippled darter	*Etheostoma punctulatum*
Freckled madtom	*Noturus nocturnus*	Streamline chub	*Hybopis dissimilis*
Freshwater drum	*Aplodinotus grunniens*	Striped shiner	*Luxilus chrysocephalus*
Gizzard shad	*Dorosoma cepedianum*	Threadfish shad	*Dorosoma petenense*
Golden redhorse	*Moxostoma erythrurum*	Walleye (i)	*Stizostedion vitreum*
Golden shiner	*Notemigonus crysoleucas*	Warmouth	*Lepomis gulosus*
Goldfish	*Carassius auratus*	Wedgespot shiner	*Notropis greenei*
Green sunfish	*Lepomis cyanellus*	White bass	*Morone chrysops*
Greenside darter	*Etheostoma blennoides*	White crappie	*Pomoxis annularis*
Hornyhead chub	*Nocomis biguttatus*	Whitetail shiner	*Cyprinella galactuara*
Largemouth bass	*Micropterus salmoides*	Yellow bullhead	*Ameiurus natalis*

Largescale stoneroller	*Campostoma oligolepis*	Yellowcheek darter	*Etheostoma moorei*
Logperch	*Percina caproides*		

(i) = introduced sport fish.

Aquatic habitats in Greers Ferry Lake include littoral (shoreline), deep-water, and pelagic (open water) areas. Shoreline habitat, while limited, consists of:

- Shallow sloping mud flats,
- Moderately sloping gravel and cobble banks,
- Sheer vertical limestone cliffs,
- Standing timber (permanently flooded); and
- Vegetated shorelines.

Standing timber is present in many coves and occurs to a lesser extent along shorelines and points. Shoreline vegetation is mostly *Salix nigra* (black willows), which are abundant in some shallow coves and are tolerant of prolonged inundation. Shoreline habitat is important for many fish species throughout the year, particularly during spawning and post spawning periods. State fisheries biologists have stated that the best spawns on Greers Ferry Lake take place during high water years when terrestrial vegetation is flooded for an extended period (AGFC, personal communication). Flooded vegetation provides cover to help young fish avoid predators. In addition, flooded vegetation provides needed food sources for young fish. Most recently, spring high water conditions in 2008, 2009, and 2011 proved suitable for spawning conditions, and AGFC biologists documented good populations of young black bass as a result.

Natural structures in deep water habitats of the lake are limited to submerged trees, brush, rock piles, as well as variations in topography. Since the impoundment of Greers Ferry Lake in 1964, the few remaining submerged native forests have largely decomposed and provide little structure and forage habitat for fish. In response, the AGFC and USACE, in cooperation with other partners, enhance aquatic habitat by sinking structures throughout the lake for fish cover. As is the case in many reservoirs, water levels at Greers Ferry Lake change due to flood risk management and hydropower generation, and in some years, lake levels are lower than desired for spawning conditions. To compensate for poor spawning years, AGFC constructed the Greers Ferry Nursery Pond. This nursery pond allows biologists to augment native and introduced sport and forage fish populations by providing ideal spawning and rearing habitat. For example, in 2016, AGFC stocked the pond with more than 400,000 threadfin shad, allowing them to grow to suitable forage size, then released them in the lake. The nursery pond is also used to rear largemouth bass, crappie, and other sport fish species.

Construction of the Greers Ferry Lake dam changed the environment in tail-water areas of the Little Red River downstream of the dam. Specifically, water releases from the dam are too cold to support native smallmouth bass and sunfish in tail-water areas. In response, AGFC began stocking rainbow trout to create a recreational fishery in this new cold water habitat. In the mid-1980s, they added brown trout stockings to increase diversity of trout species available to anglers. Today, the Little Red River below the dam offers excellent trout fishing that supports a thriving tourism industry.

4.5 Terrestrial Resources

4.5.1 Wildlife

The rural landscape surrounding Greers Ferry Lake provides ample habitat for several common species of birds and mammals. Neotropical migrant songbirds are frequently seen during the summer near the lake, where they use a variety of habitats for nesting and brood-rearing. The diversity of bird species lends itself well to bird watching in the area. Hunting is popular in this general area. Important game species include deer, squirrel, turkey, dove, rabbit, and fur bearers. The rugged topography, with resultant pattern of small farms and extensive forest areas, provides excellent habitat for forest and upland game. Table 4.3 provides a partial list of common bird and mammal species known to occur around Greers Ferry Lake.

Table 4.3: Common Wildlife Species in the Vicinity of Greers Ferry Lake

Common Name	**Scientific Name**	**Common Name**	**Scientific Name**
Birds			
American kestrel	*Falco sparverius*	Lesser scaup	*Aythya affinis*
Barred owl	*Strix varia*	Mallard	*Anas platyrhynchos*
Black vulture	*Coragyps atratus*	Ring-neck duck	*Aythya collaris*
Blue jay	*Cyanocitta cristata*	Wood duck	*Aix sponsa*
Bobwhite quail	*Colinus virginianus*	Prothonotary warbler	*Protonotaria citrea*
Canada goose	*Branta canadensis*	Red-headed woodpecker	*Melanerpes erythrocephalus*
Cardinal	*Cardinalis*	Mockingbird	*Mimus polyglottos*
Common yellowthroat	*Geothlypis trichas*	Mourning dove	*Zenaida macroura*
Eastern phoebe	*Sayornis phoebe*	Robin	*Turdus migratorius*
Eastern wood-pewee	*Contopus virens*	Turkey vulture	*Cathartes aura*
Great horned owl	*Bubo virginianus*	Red-tailed hawk	*Buteo jamaicensis*
		Eastern wild turkey	*Meleagris gallopavo*
Kentucky warbler	*Geothlypis formosa*	Worm-eating warbler	*Helmitheros vermivorum*
Mammals			
Black bear	*Ursus americanus*	Opossum	*Didelphis virginiana*
Eastern gray squirrel	*Sciurus carolinensis*	Raccoon	*Procyon lotor*
White-tailed deer	*Odocoileus virginianus*	Nine-banded armadillo	*Dasypus novemcinctus*
Coyote	*Canis latrans*	Red fox	*Vulpes*
Little brown bat	*Myotis lucifugus*	Gray fox	*Urocyon cinereoargenteus*
Eastern cottontail	*Sylvilagus floridanus*	Eastern chipmunk	*Tamias striatus*
Woodchuck	*Marmota monax*	Beaver	*Castor canadensis*
Striped skunk	*Mephitis*	Bobcat	*Felis rufus*

4.5.2 Vegetation

Vegetation around Greers Ferry Lake can be broadly classified as humid temperate mixed forest. Shortleaf pine-oak-hickory forests are prominent on the mountainous, rocky slopes surrounding the lake. The species composition of these communities varies according to slope and prior disturbance. Drier, south-facing slopes feature post oak (*Quercus stellata*), pignut hickory (*Carya glabra*), and red cedar (*Juniperus virginiana*). North-facing slopes have white oak (*Quercus alba*) and northern red oak (*Quercus rubra*) and other species that favor more mesic soils. Southern red oak (*Quercus falcata*) chinquapin oak (*Quercus muehlenbergii*), and shortleaf pine (*Pinus echinata*) are also important components of this community. A maple-sycamore-gum association is found on the lower benches and stream valleys.

Shoreline areas and lake headwater tributaries have a sycamore (*Platanus occidentalis*) dominant forest community. Tree species tolerant of disturbance and periodic flooding compete well in areas adjacent to shorelines. Green ash (*Fraxinus pennsylvanica*), black willow, sweetgum (*Liquidambar styraciflua*), and river birch (*Betula nigra*) are often associated with the sycamore vegetative community.

Typical understory vegetation associated with the upland hardwood and shortleaf pine forests includes downy serviceberry (*Amelanchier arborea)*, which is found in common association with the white, red and chinquapin oaks and upland hickories. Pawpaw (*Asimina triloba*) is a typical understory tree commonly found in stands of oak, maple, and hickory in most areas. Hawthorn (*Crataegus* spp) is widely adaptable and can be found in the wet forest flood plains to the exposed, rocky slopes. Sassafras (*Sassafras albidum*) is similar to the hawthorn in that it has a diverse growth range, but will mostly be found in the areas with rich, moist soil. Southern wax myrtle or bayberry (*Myrica cerifera*) is a common semi-evergreen shrub found mostly along the stream banks and marsh areas. Buttonbush (*Cephalanthus occidentalis*) is common along the shoreline and in the limited wetlands adjacent to the lake.

Invasive species

In accordance with Executive Order (EO) 13112, an invasive species means an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health. Invasive species can be microbes, plants, or animals that are non-native to an ecosystem. In contrast, exotic species, as defined by EO 11987, include all plants and animals not naturally occurring, either presently or historically, in any ecosystem of the United States. Invasive species can take over and out compete native species by consuming their food, taking over their territory, and altering the ecosystem in ways that harm native species. Invasive species can be accidentally transported or they can be deliberately introduced because they are thought to be helpful in some way. Invasive species cost local, state, and federal agencies billions of dollars every year.

The Greers Ferry Lake Project is not protected from the spread of invasive species. Locally the project office works with its partners, AGFC, University of Arkansas Extension Services and United States Department of Agriculture, to help stop the spread of some of the most unwanted species. These would include feral hogs, zebra mussels, sericea lespedeza, privets, Japanese honeysuckle, tall fescue, and the emerald ash borer. USACE Park Rangers post signage in all

the recreation areas to communicate the dangers of spreading invasive species on project lands and waters. Rangers also place emerald ash borer traps on project lands to monitor any infestations of these species.

4.5.3 Wetlands

Wetlands are complex habitats that are transitional from dry land to open water, and they have soil, water, and plant components. Wetlands are defined as those areas inundated or saturated by surface or ground water at a frequency and duration to support a prevalence of vegetation typically adapted for life in saturated soil conditions. Many common species of waterfowl, fish, birds, mammals, and amphibians also live in wetlands during certain stages of their lives.

The steep shoreline surrounding Greers Ferry Lake limits the transitional environment between shoreline (littoral) and open water (limnetic) habitat, thus restricting wetland formation or sustenance. While some lacustrine littoral wetlands do occur in isolated pockets along the shoreline, the majority of Greers Ferry Lake is classified as a lacustrine limnetic wetland (deep water lake habitat). Limited palustrine (inland) wetland communities are also located adjacent to lake tributaries, particularly at the mouths of major tributaries on the west side of the lake.

4.6 Threatened and Endangered Species

Pursuant to the Fish and Wildlife Coordination Act (16 United States Code 661-667e), the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d), and the Endangered Species Act (87 Stat. 884, as amended 16 U.S.C. 1531 et seq.), the Little Rock District consulted the Arkansas Ecological Services Field Office of the U.S. Fish and Wildlife Service (USFWS) on July 29, 2015 and obtained a list of potential threatened and endangered species in the Greers Ferry Lake Project area (Table 4.4). The Little Rock District also consulted the USFWS Information for Planning and Consultation (IPaC) website to obtain a list of species.

Table 4.4: Federally Listed Species for the Greers Ferry Lake Project Area

Common Name	Scientific Name	Status
Gray bat	*Myotis grisescens*	Endangered
Northern long-eared bat	*Myotis septentrionalis*	Threatened
Indiana bat	*Myotis sodalis*	Endangered
Yellowcheek darter	*Etheostoma moorei*	Endangered
Pink mucket pearly mussel	*Lampsilis abrupta*	Endangered
Rabbitsfoot	*Theliderma cylindrica*	Threatened
Speckled Pocketbook mussel	*Lampsilis streckeri*	Endangered
Bald Eagle	*Haliaeetus leucocephalus*	Protected

Source: U.S. Fish and Wildlife Service IPAC website and Arkansas Ecological Service Office database.

Gray Bat

The gray bat is 3 to 4 inches in length and weighs 7 to 16 grams (0.25 to 0.50 ounces). Its fur is gray, but may have a slight reddish cast in the summer. The gray bat is the only *Myotis* with the wing membrane attached to the ankle instead of the base of the toe, and the only bat in its range with dorsal (back) hair that is uniform in color from base to tip.

Gray bats roost almost exclusively in limestone karst caves throughout the year. Colonies occupy a home range that often contains several roosting caves scattered along as much as 43 miles of river or lake shoreline. Individuals forage up to 12 miles from their roosts. Winter roosts are in deep vertical caves with domed halls where temperatures range from 42 to 51 degrees. The species selects hibernation sites where there are multiple entrances and good air flow. Summer cave temperatures range from 57 to 75 degrees, trap warm air, provide restricted rooms or domed ceilings, and are nearly always located within a mile of a river or reservoir. Maternity caves often have a stream flowing through them. There are occasional reports of gray bats roosting in storm sewers, mines, and buildings. Forested areas along the banks of streams and lakes provide important protection for adults and young. Young often feed and take shelter in forest areas near the entrance to cave roosts. They do not feed in areas along rivers or reservoirs where the forest has been cleared. Gray bats are likely to forage near lake tributary streams and wooded lake shores, but its use of specific lakeshore habitats is unknown. (USFWS 2017)

Northern Long-eared Bat

The northern long-eared bat is a medium-sized bat about 3 to 3.7 inches in length with a wingspan of 9 to 10 inches. As its name suggests, this bat is distinguished by its long ears, particularly as compared to other bats in its genus. Northern long-eared bats arrive at the hibernacula in August or September, enter hibernation in October and November, and leave in March or April. During summer, bats typically roost individually or in colonies underneath bark or in cavities or crevices of both live trees and snags, or in caves and mines, switching roosts every 2 to 3 days. They are not partial to certain roost trees, but often select trees that retain bark and form suitable cavities, such as black oak, northern red oak, silver maple, black locust, American beech, sugar maple, sourwood, and shortleaf pine. Bats have also been observed roosting in buildings, barns, park pavilions, sheds, cabins, under eaves of buildings, behind window shutters, and in human made bat houses. Bats roost more often on upper and middle

slopes, and migrate between 35 to 55 miles between summer roosts and winter hibernaculum. They commonly overwinter in caves and abandoned mines, which have large passages and entrances and relatively constant cool temperatures, high humidity, and little or no air currents. They have been found hibernating in abandoned railroad tunnels, storm sewer entrances, hydro-electric dam facilities, old aqueducts, and dry wells. Bats may use the same hibernaculum site for multiple years. The bat has a diverse diet of insects such as moths, flies, leafhoppers, caddisflies, and beetles. Northern long-eared bats are likely to forage near lake tributary streams and wooded lake shores, but its use of specific lakeshore habitats is unknown.

Indiana Bat

Indiana bats (*Myotis sodalis*) are small, weighing only one-quarter of an ounce, with a wingspan of 9 to 11 inches. Their fur is dark-brown to black. Indiana bats live in forested wetlands and riparian habitats such as hardwood and mixed forest woodlands. In the summer and fall, colonies roost in dead or dying trees, or in tree cavities exposed to direct sunlight on wooded or semi-wooded areas near the hibernacula. Roost tree species include elm, oak, beech, hickory, maple, ash, sassafras, birch, sycamore, locust, cottonwood, and pine, especially when these trees have exfoliating bark. Indiana bats use the same roost sites in successive summers. Indiana bats hibernate in the coldest (40 to 46 degrees) parts of limestone caves with pools and shallow passageways.

The bats typically prey on flying insects, and forage along river and lake shorelines, in the crowns of trees in floodplains, and in upland forest. They forage in riparian areas, upland forests, and above ponds and fields. The foraging habitat for an Indiana bat includes an airspace 6 to100 feet above a stream and a linear distance of 0.5 mile. As with other bat species, Indiana bats are likely to forage near lake tributary streams and wooded lake shores, but its use of specific lakeshore habitats is unknown.

Yellowcheek Darter

The yellowcheek darter is a small and laterally-compressed fish that attains a maximum standard length of about 2.5 in, and has a moderately sharp snout, deep body, and deep caudal peduncle. The back and sides are grayish brown, often with darker brown saddles and lateral bars. Breeding males are brightly colored with a bright blue or brilliant turquoise throat and breast and a light-green belly, while breeding females possess orange and red-orange spots but are not brightly colored. The yellowcheek darter inhabits high-gradient headwater tributaries with clear water, permanent flow, moderate to strong riffles, and gravel, cobble, and boulder substrates (Robison and Buchanan 1988). Prey items consumed by the yellowcheek darter include blackfly larvae, stoneflies, mayflies and other aquatic insects. The yellowcheek darter only occurs in the upper Little Red River drainage above Greers Ferry Lake in Cleburne, Searcy, Stone, and Van Buren counties, Arkansas. Remaining populations occur in the South Fork, Middle Fork, Archey Fork, and Devils Fork (including Turkey and Beech Fork segments) tributaries of the Little Red River. Major threats to the yellowcheek darter are similar to threats to the speckled pocketbook mussel. Both species are extremely vulnerable to natural disasters or man-made disturbances within their very small range. The USFWS has designated the entire range of the yellowcheek

darter (approximately 102 stream miles) as critical habitat. According to the USFWS IPaC website, Greers Ferry Lake is outside the critical habitat zone for this species.

Pink Mucket Pearly Mussel

The USFWS recovery plan for the pink mucket indicates its range is primarily in the Ohio, Tennessee and Cumberland River drainages, with occasional records from the Mississippi River drainage. A status review of mussels in Arkansas by Harris, et.al. (2009) reveals most pink mucket pearly mussel populations occur in the Ouachita Mountain ecoregion of west Arkansas. Three live pearly mussels were found at two sites in the White River. It is not known to occur in any Little Red River tributaries above Greers Ferry Lake.

The pink mucket is a yellow-brown mussel with a rounded, thick and inflated smooth shell. This mussel can grow to an adult length of 3 to 5 inches and can live up to 50 years. The pink mucket is found in mud and sand and in shallow riffles and shoals swept free of silt in major rivers and tributaries. As with other mussels, pink mucket are sensitive to water quality and sediment. The pink mucket was also one of the mussels in Arkansas that was commercially harvested for use in the button and pearl industry.

Rabbitsfoot Mussel

The Rabbitsfoot mussel can reach up to 6 inches in length. It is primarily an inhabitant of medium to large streams and rivers. It is widely distributed occurring in 13 of 15 states within its historical range. The majority of stable and reproducing populations left within its historical range occur in Arkansas. It usually occurs in shallow areas along the bank and adjacent shoals. Specimens may also occupy deep water runs. Bottom substrates generally include gravel with sand. This species seldom burrows but lies on its side instead. It uses shiners, or minnow species, as its host fish.

A small, stable population of rabbitsfoot mussels exists in the lower section of the Middle Fork Little Red River above Greers Ferry Lake. The USFWS designated 14.5 miles of the Middle Fork Little Red River as critical habitat for the rabbitsfoot mussel. This designated habitat begins at the confluence of Little Tick Creek north of Shirley, Arkansas, downstream to Greers Ferry Lake where inundation begins. Primary threats to the species are hazardous material spills within the Middle Fork Little Red River watershed, channelization projects, and turbidity and pollution from gravel mining, and poor land use practices.

Speckled Pocketbook Mussel

The speckled pocketbook is a medium-sized (appx.3 inches in length) freshwater mussel with a thin, dark-yellow or brown shell with chevron-like spots, and chain-like rays. The speckled pocketbook only occurs in the Little Red River watershed in north central Arkansas. The current known range includes the Middle Fork of the Little Red River from the influence of Greers Ferry Reservoir upstream to the confluence of Little Red Creek (approximately 62 river miles [rm]), the South Fork Little Red River from Arkansas Highway 95 upstream to near the western boundary of Gulf Mountain Wildlife Management Area and the Ozark National Forest

(approximately 14 rm), the Archey Fork Little Red River from approximately one river mile upstream of U.S. Highway 65 upstream to the confluence with Castleberry Creek (approximately 16 rm), lower Turkey Fork (approximately 2 rm), Beech Fork Little Red River (approximately 11 rm), and Big Creek (approximately 10 rm) (USFWS 2007).

Threats to this species include poor land use practices including unrestricted cattle access to streams, eroding stream banks, gravel mining, and activities associated with exploration and development of natural gas reserves in the Fayetteville Shale formation. Other threats include dewatering or decreased base flows, habitat fragmentation, increased sedimentation, pollution runoff, and chemical spills (USFWS 2007). Recovery strategies include protection of existing populations, and restoration of historic habitat and reestablishment of individuals in restored habitat. Without restoration, the species is vulnerable to extinction from a natural disaster or man-made impact on the one short stretch of river it inhabits (USFWS, 1991).

Bald Eagle

The Bald Eagle is one of America's great conservation success stories. On June 28, 2007 the Department of Interior removed the bald eagle from the Federal List of Endangered and Threatened Species. The number of nesting pairs in the lower 48 United States increased 10-fold, from less than 450 in the early 1960s, to more than 4,500 adult bald eagle nesting pairs in the 1990s. In the Southeast, for example, there were about 980 breeding pairs in 1993, up from about 400 in 1981. Bald eagles have established active nesting sites and are a common occurrence around Greers Ferry Lake. While no longer a listed species, the bald eagle remains a protected species under the Bald and Golden Eagle Protection Act (BGEPA) and Migratory Bird Treaty Act (MBTA).

Species of Conservation Concern

The Arkansas Natural Heritage Commission database lists 55 Species of Conservation Concern occurring within 5 miles of USACE boundary surrounding Greers Ferry Lake (Table 4.5). These species are native plants and animals that are at-risk due to declining population trends, threats to their habitats, restricted distribution, and or other factors. While the listing as a Species of Concern is based on Arkansas's status ranking, and is not a statutory or regulatory designation under federal, state or local law, they were taken into consideration during evaluation of alternative impacts to biological resources. All species below have been recorded within a five-mile radius.

Table 4.5: Species of Conservation Concern in the Vicinity of Greers Ferry Lake

Scientific Name	Common Name	Federal Status	State Status	Global Rank	State Rank
Animals-Invertebrates					
Alasmidonta marginata	elktoe	-	INV	G4	S3
Cicindela hirticollis	beach-dune tiger	-	INV	G5	S2S3
Cyprogenia aberti	Ozark fanshell	-	INV	G2G3Q	S3
Fusconaia ozarkensis	Ozark pigtoe	-	INV	G3G4	S3
Lampsilis streckeri	speckled	LE	SE	G1Q	S1
Pleurobema rubrum	pyramid pigtoe	-	INV	G2G3	S2
Pleurobema sintoxia	round pigtoe	-	INV	G4G5	S3
Ptychobranchus occidentalis	Ouachita kidneyshell	-	INV	G3G4	S3
Theliderma cylindrica	rabbitsfoot	LT	SE	G3G4T3	S3
Simpsonaias ambigua	salamander mussel	-	INV	G3	S1
Toxolasma lividum	purple lilliput	-	INV	G3Q	S3
Toxolasma parvum	lilliput	-	INV	G5	S3
Uniomerus tetralasmus	pondhorn	-	INV	G5	S2
Venustaconcha pleasii	bleedingtooth	-	INV	G3G4	S3
Villosa iris	rainbow	-	INV	G5Q	S3
Villosa lienosa	little spectaclecase	-	INV	G5	S3
Animals-Vertebrates					
Accipiter striatus	sharp-shinned hawk	-	INV	G5	S3
Cyprinella spiloptera	spotfin shiner	-	INV	G5	S1?
Etheostoma autumnale	autumn darter	-	INV	G4	S3
Etheostoma moorei	yellowcheek darter	LE	SE	G1	S1
Haliaeetus leucocephalus	bald eagle	-	INV	G5	S3B,S4N
Lithobates areolatus	crawfish frog	-	INV	G4	S2
Myotis lucifugus	little brown bat	-	INV	G3	S1
Myotis septentrionalis	northern long-eared bat	LT	SE	G1G2	S1S2
Ophisaurus attenuates	slender glass lizard	-	INV	G5	S3
Percina nasuta	longnose darter	-	INV	G3	S3
Scaphiopus hurterii	Hurter's spadefoot	-	INV	G5	S2
Plants-Vascular					
Asplenium pinnatifidum	lobed spleenwort	-	INV	G4	S3
Callirhoe bushii	Bush's poppy-mallow	-	INV	G3	S3
Carex careyana	Carey's sedge	-	INV	G4G5	S3
Carex hirtifolia	hairy sedge	-	INV	G5	S3
Carex normalis	spreading oval sedge	-	INV	G5	S1
Carex radiata	eastern star sedge	-	INV	G5	S1
Carex sparganioides	bur-reed sedge	-	INV	G5	S3
Caulophyllum thalictroides	blue cohosh	-	INV	G5	S2

	Claytonia arkansana	Ozark spring-beauty	-	INV	G1G3Q	S2
	Cuscuta coryli	hazel dodder	-	INV	G5?	SU
	Diphasiastrum digitatum	southern running-	-	INV	G5	S1S2
	Dryopteris x leedsii	Leed's wood fern	-	INV	GNA	S1
	Eriocaulon koernickianum	small-head	-	SE	G2	S2
	Heuchera villosa var.	Arkansas alumroot	-	INV	G5T3Q	S3
	Isoetes engelmannii	Engelmann's	-	INV	G4	S1
	Nemastylis nuttallii	Nuttall's pleat-leaf	-	INV	G4	S2
	Paronychia virginica	yellow nailwort	-	INV	G4	S2
	Philadelphus hirsutus	hairy mock orange	-	INV	G5	S2S3
	Primula frenchii	French's shooting-	-	ST	G3	S2
	Selaginella arenicola ssp.	Riddell's spike-moss	-	INV	G4T4	S3
	Silene ovata	ovate-leaf catchfly	-	ST	G3	S3
	Solidago ptarmicoides	white flat-top	-	INV	G5	S1S2
	Symphyotrichum sericeum	silvery aster	-	INV	G5	S2
	Tradescantia ozarkana	Ozark spiderwort	-	INV	G3	S3
	Trichomanes boschianum	Appalachian filmy fern	-	ST	G4	S2S3
	Utricularia subulata	Zigzag bladderwort	-	INV	G5	S2
	Viola canadensis var. canadensis	Canadian white violet	-	INV	G5T5	S2
	Special Elements-Natural Communities					
✓	✓ Central Interior Highlands & Appalachian Sinkhole & Depressional		-	INV	GNR	SNR
	Special Elements-Other					
	✓ Geological feature		-	INV	GNR	SNR

- These elements have been recorded within approximately 100 feet of the Greers Ferry Lake Corps Fee line Boundary

* - These elements have been recorded within a one-mile radius of the Greers Lake Ferry Corps Fee Line Boundary

FEDERAL STATUS CODES

LE = Listed Endangered; the U.S. Fish and Wildlife Service has listed this species as endangered under the Endangered Species Act.

STATE STATUS CODES

INV = Inventory Element; The Arkansas Natural Heritage Commission is currently conducting active inventory work on these elements. Available data suggests these elements are of conservation concern. These elements may include outstanding examples of Natural Communities, colonial bird nesting sites, outstanding scenic and geologic features as well as plants and animals, which, according to current information, may be rare, peripheral, or of an undetermined status in the state. The ANHC is gathering detailed location information on these elements.

GLOBAL RANKS

G3 = Vulnerable globally. At moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors.
G4 = Apparently secure globally. Uncommon but not rare; some cause for long-term concern due to declines or other factors.
G5 = Secure globally. Common, widespread and abundant.

T-RANKS= T subranks are given to global ranks when a subspecies, variety, or race is considered at the state level. The subrank is made up of a "T" plus a number or letter (1, 2, 3, 4, 5, H, U, X) with the same ranking rules as a full species.

STATE RANKS

S1 = Critically imperiled in the state due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors making it vulnerable to extirpation.
S2 = Imperiled in the state due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it vulnerable to extirpation.
S3 = Vulnerable in the state due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation.

GENERAL RANKING NOTES

Q = A "Q" in the global rank indicates the element's taxonomic classification as a species is a matter of conjecture among scientists.

4.7 Archaeological and Historic Resources

4.7.1 Cultural Resources

Cultural resources consist of artifacts, archaeological sites, buildings, structures, objects (BSO's) and districts. Archaeological sites may be prehistoric or historic in age, or a combination of both, while districts may be only prehistoric, or historic in age. Historic properties are cultural resources eligible for listing to the National Register of Historic Places (NRHP).

Cultural History

Prehistoric

The general location of Greers Ferry Lake is rich with prehistoric and historic occupation. Prehistoric Native American occupation, prior to European settlement, can be documented chronologically through five periods (Rodriguez et al. 2017):

- Paleo-Indian Period – 13,000 – 8,000 B.C.
- Archaic Period – 7,500 – 600 B.C.
- Woodland Period – 600 B.C. - A.D. 900
- Mississippian Period – A.D. 900 – 1541
- Protohistoric Period – A.D. 1541 – 1686

Historic

Historic use of the area can be divided into six general periods:

1. European Exploration: Although intense European colonization did not begin in Arkansas until the end of the seventeenth century, a protohistoric period was initiated by the arrival of the De Soto expedition in 1541. The De Soto expedition landed in Florida in 1539 and explored the lands bordering the Gulf of Mexico. During the next four years, the expedition traveled over parts of present-day Florida, Georgia, South Carolina, North Carolina, Tennessee, Alabama, Mississippi, Louisiana, Arkansas, and Texas. After this initial, brief Spanish contact, 140 years passed before Europeans returned to the region. Although the Spanish claimed the territory explored by De Soto, they did not attempt colonization until they were threatened by French expeditions in the seventeenth century. In 1684, the French attempted to establish a colony at the mouth of the Mississippi River. In 1686 the French established a trading post called *Aux Arcs* or the *Poste de Akansea* (afterward Arkansas Post). During the period when the French occupied Louisiana (1686-1763), the only immigration to the general area was undertaken by the French traveling from Canada or Louisiana. The Spanish Colonial Period lasted from 1763 to 1803 when the Louisiana territory was then transferred to the United States (Weinstein 2017).

2. Territorial Period: The territorial period lasted from 1803 to 1836. The newly arrived American administration brought many changes to Louisiana. The portion of the Louisiana territory that comprised the present state of Arkansas became part of the Missouri territory in 1812 when Louisiana became a state. The settlement at Arkansas Post was matched by similar communities at Little Rock, Washington, Helena, Ecore a Fabre (now Camden), Cadron (near present Conway), and Hopefield (near West Memphis). To help safeguard the southwestern frontier, a detachment of U.S. troops built Fort Smith on the Arkansas River at a place called Belle Point. Arkansas became a separate territory in 1819 after Missouri had applied for and been granted statehood. It was not until the introduction of the steamboats to the Mississippi River and its tributaries and the construction of federally funded military or post roads that the Arkansas Territory began to open up. The passage of the Indian Removal Act of 1830, gave the executive branch the authority to negotiate land-exchange treaties with native nations. Within the decade, the act was to lead to the removal of approximately 60, 000 Indians to the "Indian Territory" located within the western portions of the Arkansas Territory and the exchange of nearly 100 million acres of land for 68 million dollars and 32 million acres with the Arkansas Territory (Weinstein 2017).

3. Early Statehood Period: Arkansas Territory achieved statehood on 15 June 1836. Between this date and the outbreak of the Civil War, the population increased by nearly 860 percent. The antebellum identity of Arkansas was based on four major themes: the rural nature of the population, the agricultural economy, the system of slave labor, and a Southern political orientation. The landscape of antebellum Arkansas was dominated by two major agricultural units-the small, self-sufficient farm and the plantation. The third major component of Arkansas's prewar identity was slavery, which provided the chief source of labor for the large farms and plantations (Weinstein 2017).

4. The Civil War: The Civil War period was from 1861 to 1865. Arkansas seceded from the Union on 6 May 1861. The act of session had not been a foregone conclusion. The state had a strong Unionist following and at the convention held on 4 March 1861 the Unionists had won. Once fighting had begun at Fort Sumter, however, the secessionists were able to secure Arkansas' withdrawal from the Union. The war created much disunity in the state. One of the most important battles in Arkansas took place at Pea Ridge in northwestern Arkansas on 6 March 1862. The beginning of 1863 saw the capture of Confederate fortifications at Arkansas Post and the fall of Little Rock nine months later. By the end of the war, Confederate forces held on only in the southwestern corner of the state (Weinstein 2017).

5. Reconstruction and the Late Nineteenth Century: During reconstruction there was a labor shortage and as a result planters used sharecropping in an attempt to overcome this as well as a wage system. Regardless of the labor system employed following the Civil War, many African American laborers, though no longer held in legal bondage, found their economic circumstances little improved. With the end of reconstruction and a return to a normal relationship with the nation, Arkansans discovered that the rest of America had changed. The last quarter of the nineteenth century reflects Arkansas' attempt to catch up with mainstream America (Weinstein 2017).

6. Flood Control and River Development: The aftermath of the devastation of the Flood of 1927 was to bring national attention to the problem of flooding in the Mississippi River and its tributaries including the Arkansas River. The Flood Act of 1928 was based on the plans of Chief of Engineers, Major General Edgar Jadwin, and included plans for flood control on the Mississippi from the Ohio River to the Head of Passes below New Orleans. The Jadwin Plan called for the raising and strengthening levees and the creation of spillways, but it did not call for the creation of flood control reservoirs. The Flood Control Act of 1936 authorized the building of more than 300 flood control reservoirs with many of these being multipurpose in nature. Various subsequent flood control acts lead to the development of several dams and reservoirs in the Little Rock District including Clearwater, Blue Mountain, Bull Shoals, and Greers Ferry. The passage of the Rivers and Harbors Act on 24 July 1946 authorized the creation of the McClellan-Kerr Arkansas River Navigation System (MKARNS) at the time known as the Arkansas-Verdigris Waterway. Construction of the navigation system began in 1958 and was completed as far as Little Rock by January 1969 and to Tulsa by December 1970 (Weinstein 2017).

7. Regulatory Considerations: Cultural resources affected by federally funded or federally-permitted projects are subject to the requirements of Section 106 of the National Historic Preservation Act (NHPA) (16 U.S.C. Sections 470 through 470x-6) and its implementing regulations (36 CFR 800). Section 106 of the NHPA and its implementing regulations require federal agencies to take into account the impact of federal undertakings on significant cultural resources (historic properties). Historic properties are cultural resources that have been determined eligible for the National Register of Historic Places (NRHP). The Section 106 process is carried out by the federal agency in consultation with the State Historic Preservation Officer (SHPO) and appropriate Tribal Historic Preservation Officer's (THPO). The Section 106 process consists of identifying cultural

resources through records searches and field surveys, evaluating cultural resources to determine if they are historic properties using NRHP eligibility criteria (the federal agency makes the determination with concurrence from SHPO), assessing whether the effects of the undertaking on historic properties will be adverse, and consulting with the SHPO regarding these effects and any actions that might be taken to treat or mitigate them.

The NRHP eligibility criteria (36 CFR 60.4) state that: the quality of significance in American history, architecture, archaeology, and culture is present in districts, sites, BSO's of state and local importance that possess aspects of integrity of location, design, setting, materials, workmanship, feeling, association, and that:

A. Are associated with events that have made a significant contribution to the broad patterns of our history;
B. Are associated with the lives of persons significant in our past;
C. Embody the distinctive characteristics of a type, period, region, or method of construction, or that represent the work of a master, or that possesses high artistic values, or that represent a significant and distinguishable entity whose component may lack individual distinction; or
D. Have yielded, or may be likely to yield, information important in prehistory or history.

In addition, BSO's must be at least 50 years old, except in exceptional circumstances (Criteria Consideration G).
Section 101(d)(6)(A) of the NHPA, as amended, provides for properties of traditional religious and cultural importance to Native Americans (traditional cultural properties) to be determined eligible for inclusion in the NRHP.

Cultural Resource Investigations at Greers Ferry Lake

A review of the Arkansas Archeological Survey's (AAS) Automated Management of Archeological Sites Data in Arkansas (AMASDA) Database and other sources revealed several prior terrestrial cultural resources surveys and test investigations within the Greers Ferry Lake fee area (Coble 1994; Jones 1979; Klinger 2009; Klinger and Smith 1992; McCurkan 1983; McGimsey 1959; Wilks 2011). Although the review identified previous surveys within or transecting the fee area, it is important to note that the majority of the Greers Ferry Lake fee area has not be culturally surveyed, or what has been surveyed previously is of such an age that the methodology used during these surveys no longer follows current accepted standards. Currently, 186 known archaeological sites have been identified within the fee area with approximately 73 of these known sites currently inundated by the lake, while 113 sites have been identified elsewhere in the fee area. The majority of known sites have never been evaluated for NRHP eligibility and consulted on with the SHPO and the appropriate Tribal Historic Preservation Officer's (THPO). Until such NRHP evaluations and consultations occur, known sites that are unevaluated should be considered eligible and avoided.

Buildings, Structures, Objects (BSO) Inventories at Greers Ferry Lake

A review of the Arkansas Historic Preservation Program (AHPP) National Register and Survey Database revealed several BSO's recorded, evaluated and listed on the NRHP within the Greers Ferry Lake fee area. Currently, no comprehensive inventory and NRHP evaluation of all the BSO's within the Greers Ferry Lake fee area has ever been completed. Until it is determined which BSOs are eligible and which ones are not, effects to all BSOs require consideration on a case by case basis.

4.8 Air Quality

The U.S. Environmental Protection Agency (EPA) has the primary responsibility for regulating air quality nationwide. The Clean Air Act (42 U.S.C. 7401 *et seq*.), as amended, requires the EPA to set National Ambient Air Quality Standards (NAAQS) for wide-spread pollutants from numerous and diverse sources considered harmful to public health and the environment. The Clean Air Act (CAA) established two types of national air quality standards classified as either "primary" or "secondary." Primary standards set limits to protect public health, including the health of at-risk populations such as people with pre-existing heart or lung diseases (such as asthmatics), children, and older adults. Secondary standards set limits to protect public welfare, including protection against visibility impairment, damage to animals, crops, vegetation, and buildings.

EPA has set NAAQS for six principal pollutants, which are called "criteria" pollutants. These criteria pollutants include carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), particulate matter less than 10 microns (PM_{10}), particulate matter less than 2.5 microns ($PM_{2.5}$), sulfur dioxide (SO_2) and lead (Pb). If the concentration of one or more criteria pollutants in a geographic area is found to exceed the regulated "threshold" level for one or more of the NAAQS, the area may be classified as a non-attainment area. Areas with concentrations of criteria pollutants that are below the levels established by the NAAQS are considered either attainment or unclassifiable areas.

According to the Arkansas Department of Environmental Quality (ADEQ), the entire state of Arkansas is in compliance with all EPA ambient air quality standards. Only ozone concentrations occasionally approach the limit of the standard. The Conformity Rule of the Clean Air Act of 1977 (CAA), as amended, states that all Federal actions must conform to appropriate State Implementation Plans (SIPs). This rule took effect on January 31, 1994, and at present applies only to Federal actions in non-attainment areas (those not meeting the National Ambient Air Quality Standards for the criteria pollutants in the CAA). The state of Arkansas, including the Greers Ferry Lake area, is considered an attainment area and is therefore exempt from the Conformity Rule of the CAA.

The study area is located within the Northwest Arkansas Intrastate Air Quality Control Region (40 CFR §81.140). The area is classified as being in attainment for all NAAQS. The Current Air Data Air Quality Index Summary Report for Harrison, Arkansas (located north of Greers Ferry Lake and has similar land uses) reported 336 good days and 28 moderate days of air quality in 2018. "Good days" are number of days in the year having an Air Quality Index (AQI) value of 0 through 50. "Moderate days" are number of days in the year having an AQI value of 51 through 100.

Greers Ferry Lake is located in the Ozark Mountains, remote from heavy smoke-producing industry or large mining operations. The air is very clean and smog is virtually unknown in this region. Pollution sources in the vicinity of the lake include automobile emissions and local industries. Automobile traffic in the region is typical of rural areas and is not considered to be a significant source of pollutants. Automobile traffic in the project area is much greater during the summer recreational season, and minor degradation of air quality may occur during this period.

4.9 Socio-Economic Resources

Set in bucolic and rural setting, Greers Ferry Lake is a popular water recreation venue nestled in the foothills of the Ozarks in north central Arkansas. The lake is surrounded by an abundance of rock outcropping, trees, and wildlife, and has deep clean water ideal for swimming, fishing, boating, water skiing, and scuba diving. Adjacent to the lake are the communities of Clinton, Fairfield Bay, Greers Ferry, and Heber Springs that offer various amenities such as restaurants, motels, condominiums and other rental properties. There are several noted golf courses located around the lake that are part of the Arkansas Golf Trail. Given its beauty and popularity, the lake an important economic engine for nearby local communities.

Information contained in this section presents socioeconomic data and trends in the study area including economic and demographic indicators including those related to environmental justice as defined by NEPA, transportation, and recreation levels and trends. For the purposes of analyzing socioeconomics, the study includes counties within 75 to 100 miles of the Greers Ferry Lake. The radius is reasonable given that 75 percent of visitors to the lake came from these counties according to a previous carrying capacity recreational study (USACE 2001).[2] Twenty one percent originated from within 100 to 150 miles, and only 6 percent came from distances greater than 200 miles. Although the data are based on a 2001 study, it is unlikely that origins of visitors have changed significantly.

The study area includes 23 of Arkansas's 75 counties including those part of the Little Rock - Conway Metropolitan Statistical Area (population 734,600), which hosts the state capital and is a major source of visitors to the lake. Information from the U.S. Census Bureau, the U.S. Bureau of Economic Analysis, the USACE Little Rock District, the 2016 American Community Survey and several other sources served as key data sources for the socioeconomic portion of this study.

Population

Table 4.6 displays historical and projected population by each county in the study area, the study area as a whole, the State of Arkansas, and the U.S. Today, there are roughly 1.3 million people in the study area. Since 1980, the area's population has grown by 32 percent (approximately 312,000), and projections prepared by the University of Arkansas will grow by about the same amount over the next 50 years at an annual growth rate 0.65 percent. Overall, the population growth rate in the study area is lower than the state as a whole given that 11 of the 23 counties (primarily rural) are expected to lose population over the long-term as people migrate to urban areas for job opportunities.

Table 4.6
Historical and Projected Population Levels and Trends in the Greers Ferry Project Area

County or Region	Historical			Projected					
	1980	2016	CAGR*	2020	2030	2040	2050	2060	CAGR
County									
Baxter	27,409	41,355	1.15%	40,296	39,340	38,407	37,496	36,607	(0.24%)
Cleburne	16,909	25,183	1.11%	24,959	23,933	22,971	22,049	21,142	(0.41%)
Conway	19,505	20,916	0.19%	21,655	22,248	22,857	23,482	24,125	0.27%
Faulkner	46,192	115,514	2.58%	128,027	140,505	154,199	169,228	185,721	0.93%
Garland	70,531	95,184	0.84%	99,211	102,232	105,345	108,554	111,860	0.30%
Grant	13,008	17,829	0.88%	18,306	18,695	19,092	19,497	19,910	0.21%
Hot Spring	26,819	31,364	0.44%	34,510	35,990	37,571	39,183	40,864	0.42%
Independence	30,147	37,504	0.61%	38,561	40,905	43,391	46,028	48,825	0.59%
Izard	10,768	13,686	0.67%	12,481	11,294	10,229	9,256	8,375	(0.99%)
Jackson	21,646	17,135	(0.65%)	16,984	16,139	15,337	14,574	13,849	(0.51%)
Jefferson	90,718	69,115	(0.75%)	65,710	56,387	48,388	41,481	35,596	(1.52%)
Lawrence	18,447	16,525	(0.31%)	17,018	17,018	17,018	17,018	17,018	0.00%
Lonoke	34,518	72,898	2.10%	75,887	83,952	92,874	102,642	113,550	1.01%
Pope	38,964	63,835	1.38%	66,039	71,325	77,111	83,366	90,039	0.78%
Prairie	10,140	8,170	(0.60%)	7,723	6,884	6,130	5,464	4,866	(1.15%)
Pulaski	340,598	386,191	0.35%	409,626	438,011	467,895	499,818	533,919	0.66%
Saline	53,156	119,323	2.27%	132,720	163,898	202,602	250,446	309,279	2.14%
Searcy	8,847	7,938	(0.30%)	7,856	7,616	7,383	7,165	6,947	(0.31%)
Sharp	14,607	17,393	0.49%	16,581	15,947	15,352	14,765	14,200	(0.39%)
Stone	9,022	12,537	0.92%	13,386	14,618	15,963	17,431	19,034	0.88%
Van Buren	13,357	16,506	0.59%	16,075	14,928	13,863	12,874	11,956	(0.74%)
White	50,835	79,016	1.23%	78,433	77,886	77,420	76,957	76,420	(0.06%)
Woodruff	11,222	6,734	(1.41%)	6,425	5,603	4,885	4,260	3,715	(1.36%)
Regions									
Study Area	977,365	1,291,851	0.78%	1,348,469	1,425,353	1,516,284	1,623,034	1,747,817	0.65%
Arkansas	2,286,358	3,004,279	0.76%	3,072,430	3,271,344	3,521,402	3,832,115	4,214,071	0.79%
U.S. (1000s)	226,534	323,128	0.99%	332,555	354,840	373,121	388,335	403,697	0.49%

*CAGR: Compound Annual Growth Rate (red parenthesis indicate negative values).
Sources: Historical population from the U.S. Census, projected population from the U.S. Census (national level), and the University of Arkansas at Little Rock, Arkansas Economic Development Institute: Demographic Research.

Economy

Collectively, counties in the study area accounted for 42 percent ($16 billion) of the state's annual private payroll ($39 billion), and 0.27 percent of the national total ($6.3 trillion). Pulaski County (Little Rock) accounts for than one half the study areas private employment and payroll (Tables 4.7 and 4.8). The distribution of payroll and employment by industry in study area counties tends to follow national and state patterns. Finance and health care comprise about 30 percent of payroll, wholesale and retail trade make up 16 percent, and manufacturing accounts for 13 percent.

In terms of the number of positions, construction, retail trade and food and accommodation services employ 30 percent of the labor force, but also have relatively low wages and salaries. Average annual wages for accommodation and food services is $14,500, and the mean salary for retail trade workers is $25,260 per year. Construction workers earn an average wage (including benefits) of $46,000 per annum. Employees at utilities are relatively scarce (143 jobs statewide), and have the highest mean salaries of $93,320 per year, which is almost double the average across all industries ($43,000). Information services and mining workers (primarily gas extraction in the Fayetteville Shale production area) earn salaries totaling about $65,000 per year.

At the household level, key income indicators (per capita income and median household income) vary with lower values characteristic of rural counties and higher values characteristic of urban counties (Table 4.9). Both mean ($54,752) and median annual household ($40,821) income are lower than state averages ($42,336 and $58,850 respectively), and both metrics are lower than national level figures. Mean household income is significantly higher than median values, which reflects an asymmetric distribution for incomes across that is skewed toward higher earning households. The percent of families living below the federal poverty line is also slightly higher than the state (19.1 versus 17.2 percent), and significantly higher than the national threshold of 14.2 percent.

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Table 4.7
Annual Payroll and Number of Private Sector Establishments in the Greers Ferry Study Area (2016)

Counties	Number of establishments	Paid Employees	Annual Payroll ($millions)
Baxter	1,037	13,082	$438.4
Cleburne	574	5,795	$172.3
Conway	420	4,899	$175.9
Faulkner	2,501	35,107	$1,289.4
Garland	2,697	32,412	$1,031.5
Grant	260	3,432	$112.3
Hot Spring	486	6,085	$205.7
Independence	788	14,708	$521.8
Izard	215	1,964	$58.0
Jackson	331	3,770	$128.1
Jefferson	1,361	20,836	$741.3
Lawrence	273	3,000	$85.5
Lonoke	1,020	10,989	$327.2
Pope	1,594	23,454	$829.3
Prairie	154	973	$24.5
Pulaski	12,051	204,670	$9,139.0
Saline	1,866	20,438	$626.6
Searcy	113	1,070	$21.9
Sharp	305	2,579	$60.3
Stone	226	1,949	$48.3
Van Buren	331	3,810	$149.9
White	1,533	22,915	$742.1
Woodruff	133	1,207	$49.0
Study Area	**30,269**	**431,967**	**$16,647.4**
Arkansas	**65,175**	**10,003,113**	**$39,451.2**
U.S.	**7,663,938**	**124,085,947**	**$6,253,488.3**

Source: U.S. Census Bureau, 2016 County Business Patterns

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Table 4.8
Annual Payroll and Number of Private Sector Establishments by Industry in the Greers Ferry Study Area (2016)

Industry	Number of establishments	Paid Employees	Annual Payroll ($millions)
Accommodation and food services	2,574	47,739	$692.19
Administrative, support, waste management and remediation services	1,281	22,828	$556.34
Agriculture, forestry, fishing and hunting	134	1,015	$35.28
Arts, entertainment, and recreation	380	5,076	$99.01
Construction	2,539	21,018	$966.33
Educational services	319	6,672	$167.13
Finance and insurance	2,138	20,747	$1,349.30
Health care and social assistance	3,714	86,221	$3,763.09
Industries not classified	54	61	$0.97
Information	464	13,335	$881.37
Management of companies and enterprises	188	4,693	$295.75
Manufacturing	1,058	48,414	$2,174.34
Mining, quarrying, and oil and gas extraction	158	3,139	$198.58
Other services (except public administration)	3,192	21,200	$550.90
Professional, scientific, and technical services	3,025	18,141	$960.19
Real estate and rental and leasing	1,397	6,076	$224.23
Retail trade	5,074	66,702	$1,685.13
Transportation and warehousing	935	16,643	$729.36
Utilities	143	2,800	$261.30
Wholesale trade	1,502	19,447	$1,056.67
Total	**30,269**	**431,967**	**$16,647.43**

Source: U.S. Census Bureau, 2016 County Business Patterns

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Table 4.9
Income Statistics for the Greers Ferry Study Area (2016)

Region	Median Household Income	Mean Household Income	Per capita income	Percent of Persons Below Poverty Line
County				
Baxter	$47,559	$62,764	$23,068	13.8%
Cleburne	$53,669	$60,621	$21,896	15.5%
Conway	$38,266	$63,984	$24,809	21.5%
Faulkner	$50,872	$65,609	$24,602	16.1%
Garland	$40,011	$57,619	$24,696	20.6%
Grant	$49,159	$62,971	$49,195	13.0%
Hot Spring	$42,589	$54,251	$22,035	17.0%
Independence	$37,592	$55,132	$18,964	19.2%
Izard	$35,188	$44,942	$18,316	22.0%
Jackson	$31,245	$47,747	$19,691	27.1%
Jefferson	$36,377	$50,068	$18,010	25.5%
Lawrence	$33,381	$44,204	$24,501	23.6%
Lonoke	$56,156	$65,129	$20,192	12.1%
Pope	$40,354	$54,891	$21,035	19.6%
Prairie	$37,500	$45,960	$37,500	19.8%
Pulaski	$47,101	$68,381	$26,963	18.0%
Saline	$57,632	$69,829	$20,618	8.5%
Searcy	$35,542	$47,713	$19,404	20.7%
Sharp	$31,068	$45,090	$19,616	22.2%
Stone	$30,486	$46,825	$19,883	23.6%
Van Buren	$34,576	$46,633	$22,510	18.5%
White	$42,179	$58,434	$18,382	17.7%
Woodruff	$30,383	$40,506	$30,593	24.1%
Region				
Study Area	$40,821	$54,752	$23,760	19.1%
Arkansas	$42,336	$58,850	$23,401	17.2%
U.S.	$59,039	$72,641	$28,829	14.2%

Source: U.S. Census Bureau, 2016 County Business Patterns

Demographics and Environmental Justice

Executive Order 12898, entitled "Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations," addresses potential disproportionate human health and environmental impacts that a project may have on minority or low-income communities. Thus, environmental effects of a proposed plan or action on minority and low-income communities or Native American populations must be disclosed, and agencies must evaluate projects to ensure that they do not disproportionally impact any such community. If such impacts are identified, appropriate mitigation measures must be implemented.

To determine whether a project has a disproportionate effect on potential environmental justice communities (i.e., minority or low income population), the demographics of an affected population within the vicinity of Greer Ferry Lake must be considered in the context of the overall region. Guidance from the CEQ states that "minority populations should be identified where either: (1) the minority population of the affected areas exceeds 50 percent, or (b) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis (CEQ 1997)."

Table 4.10 displays U.S. Census data summarizing racial, ethnic and poverty characteristics of areas adjacent to construction sites (loops and compressor stations). The purpose is to analyze whether the demographics of the affected area differ in the context of the broader region; and if so, do differences meet CEQ criteria for an Environmental Justice community. Based on the analysis, it does not appear that minority or low income populations in the study area are disproportionately affected.

Table 4.10 also displays the number of children adjacent to Project areas. The purpose of the data is to assess whether the project disproportionally affects the health or safety risks to children as specified by Executive Order 13045, Protection of Children from Environmental Health Risks and Safety Risks (1997). Overall, it does not appear that any children would be disproportionally affected.

Table 4.10
Distribution of Racial Groups and Proportion of Children under the Age of 17 in the Study Area

	White	Black or African American	Hispanic or Latino	Two or more races	Native Hawaiian Pacific Islander	Asian	American Indian or Alaskan Native	Children under 17 Years of Age
County								
Baxter	95.3%	0.1%	2.1%	1.4%	0.0%	0.6%	0.5%	22.8%
Cleburne	95.1%	0.5%	2.4%	1.1%	0.0%	0.6%	0.4%	19.2%
Conway	81.7%	11.9%	3.8%	2.1%	0.0%	0.1%	0.5%	22.9%
Faulkner	82.0%	10.7%	3.8%	2.0%	0.1%	1.2%	0.4%	23.4%
Garland	83.1%	8.1%	5.2%	2.1%	0.0%	0.7%	0.7%	20.6%
Grant	93.5%	4.2%	0.8%	1.2%	0.0%	0.2%	0.3%	23.0%
Hot Spring	83.8%	10.4%	3.2%	2.1%	0.0%	0.2%	0.4%	20.8%
Independence	89.7%	1.6%	6.2%	1.8%	0.0%	0.9%	0.4%	24.0%
Izard	96.8%	0.1%	1.8%	1.1%	0.0%	0.2%	0.2%	18.1%
Jackson	79.5%	15.0%	2.5%	2.7%	0.0%	0.1%	0.2%	20.2%
Jefferson	40.0%	55.9%	1.8%	1.3%	0.0%	0.9%	0.1%	20.9%
Lawrence	96.8%	0.2%	0.9%	1.3%	0.0%	0.1%	0.7%	22.9%
Lonoke	87.0%	5.7%	4.1%	2.1%	0.1%	0.8%	0.5%	22.0%
Pope	85.5%	2.4%	8.5%	3.0%	0.0%	1.0%	0.4%	25.9%
Prairie	85.5%	13.0%	0.4%	0.7%	0.0%	0.0%	0.3%	22.9%
Pulaski	53.6%	35.8%	6.0%	2.5%	0.0%	2.2%	0.3%	21.3%
Saline	86.7%	5.9%	4.3%	1.9%	0.1%	1.0%	0.3%	24.8%
Searcy	94.0%	0.1%	1.4%	2.5%	0.0%	1.2%	1.3%	22.3%
Sharp	94.2%	0.1%	2.1%	2.8%	0.0%	0.6%	0.6%	21.1%
Stone	95.2%	0.0%	1.7%	2.5%	0.0%	0.2%	0.4%	19.7%
Van Buren	93.8%	0.5%	2.9%	3.0%	0.0%	0.2%	0.4%	20.1%
White	88.7%	4.1%	4.2%	2.4%	0.0%	0.7%	0.2%	23.7%
Woodruff	69.1%	26.8%	0.6%	1.8%	0.1%	1.5%	0.1%	20.9%
Region								
Study Area	**74.4%**	**17.7%**	**4.5%**	**2.2%**	**0.0%**	**1.2%**	**0.4%**	**21.9%**
Arkansas	**72.9%**	**15.7%**	**7.3%**	**2.0%**	**0.3%**	**1.6%**	**1.0%**	**23.6%**
U.S.	**61.2%**	**13.1%**	**17.6%**	**2.6%**	**0.2%**	**5.3%**	**1.3%**	**22.8%**

Source: U.S Census

Recreation

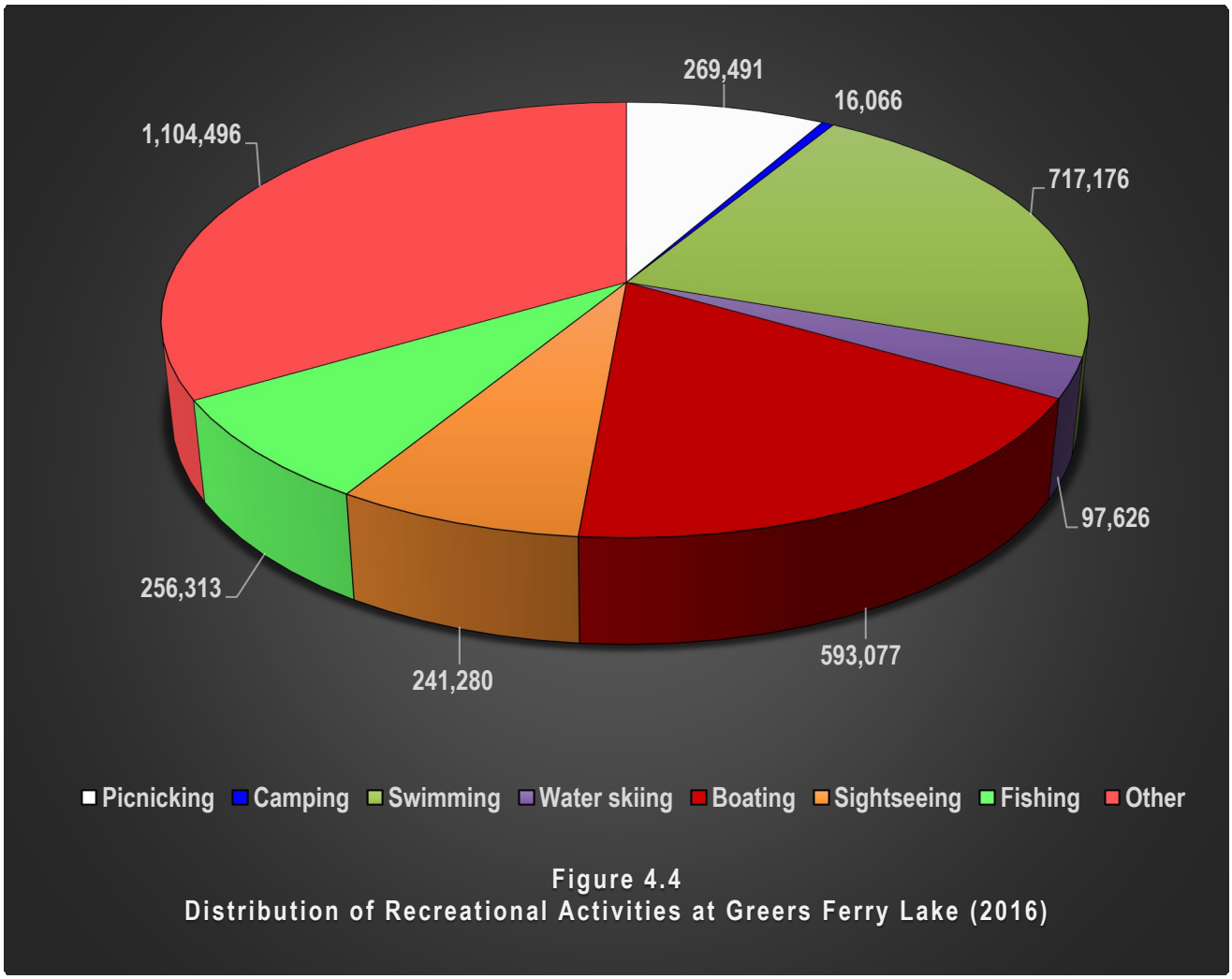
Greers Ferry Lake has a variety of recreational facilities (Table 4.11). Paved access roads wind through 18 recreation sites with 1,159 campsites. Other facilities include 11 swimming areas, 4 hiking trails, 27 boat launching ramps, sanitary dump stations, and picnic shelters. There are also numerous marinas providing year-around service and 4,061 boat slips, and stores selling grocery items, fuel, boat rental and storage, fishing guides and other supplies and related services. Figure 4.4 summarizes the types of recreation activities at the lake. Accounting for almost one half of reported activities, water sports (swimming, boating, skiing and fishing) are very popular at Greers Ferry. In addition to water sports, people engage in many land based sports such as, picnicking, hiking and sightseeing.

Table 4.11
Recreation Facilities at Greers Ferry Lake, Arkansas

Facilities	Number of sites
Recreation sites	18
Picnic sites	105
Camping sites	1,159
Playgrounds	10
Swimming areas	11
Trails	4
Trail miles	5.1
Boat ramps	27
Marina slips	4,061

Source: U.S. Army Corps of Engineers, Little Rock District

Figure 4.4 Distribution of Recreational Activities at Greers Ferry Lake (2016)



Source: U.S. Army Corps of Engineers, Value to the Nation: Recreation Fast Facts. 2016

In communities adjacent to Greers Ferry Lake, tourism and recreation are an important part of local economies. Based on 2017 data, 944,111 people visited the lake (visitor days) and spent $246.8 million in local economies within 30 miles of the lake. Within 30 miles of the lake, this spending had the following estimated outcomes (2017 Arkansas Tourism Economic Impact Report):

- Resulted in $19 million in sales revenue for local businesses;
- Supported 1,955 jobs;
- Generated $35 million in labor income (wages, salaries and benefits).

Table 4.12 displays historical data regarding annual visitation to Greers Ferry from 1972 to 2012 and 2014 to 2016. The distinctions in periods are necessary given that USACE changed the way it counts the number of visitors after 2012. Before 2012, a recreation "visit" to a USACE project was defined as entry by one person to a USACE project for recreation for any length of time – 15

minutes to 14 days. After 2012, USACE began to measure a visits in terms of "person days" where one visit reflected one person spending at least one day at a given project. In 1972, about 3.6 million people visited the lake, and by 2012, the number of visitors doubled to 7.4 million. The overall trend in positive; however, there is considerable variation in available data for consecutive years (1999 through 2012).[3]

Historical trends in recreation at the lake are important in the context of master planning. If recreation has and is expected to increase sharply in the future, the lake may reach a recreational carrying capacity, particularly during high demand seasons; and if so, recreational amenities may have to increase to accommodate demands. The remainder of this section is devoted to developing estimates of future recreation demands for the project.

Analysts can use a variety of techniques to project future values of a data set, some more complicated than others. For example, one can extrapolate trends based on historical growth rates, or develop more complicated statistical and mathematical models. Extrapolation solely on a growth rate or some measure of trend based on a beginning data point and a terminating value can be misleading if there is a lot of variation in interceding years. In other words, if the data plot in a smooth upward sloping line, using end and beginning data points to estimate growth rates is adequate (e.g., population growth); otherwise, care must be taken when selecting the period for estimating a growth rate, which is generally subjective, and the use of compound growth rates to extrapolate time series data for prediction can under or over predict future values. For example, using 1972 recreation visits as a base and 2012 as a terminus yields a rate of 1.8 percent per year. Using a 1984 as the start year results in a value of 1.2 percent, and applying 2002 as the base would shows negative growth (-0.7 percent).

[3] Centralized electronic for visitation data for USACE projects is available through the USACE OMBIL web application from 2000 through 2016.

Table 4.12
Annual Number of Trips per Person to Greers Ferry Lake Arkansas (2000 through 2012) and Annual Number of Visitor Days (2014 through 2016)*

Year	No. of visitors
1972	3,598,700
1979	4,548,000
1984	5,265,000
1989	4,420,700
1994	5,438,000
1999	5,646,800
2000	6,020,100
2001	6,720,421
2002	7,967,464
2003	7,594,327
2004	6,497,354
2005	6,833,030
2006	7,529,575
2007	7,461,133
2008	6,612,294
2009	7,341,244
2010	7,283,258
2011	6,193,155
2012	7,391,579
Annual average (2000 through 2012)	**6,020,100**
2014	1,950,229
2015	1,873,041
2016	1,917,652
Annual average (2014 through 2016)	**1,913,641**

* Before 2012, a recreation "visit" to a USACE project was defined as the entry by one person to a USACE project for recreation for any length of time be it 15 minutes or 14 days. After 2012, the USACE began to measure a visits in terms of "person days" where one visit reflected one person spending at least one day at a given project.

Visitation projection for this study involved two steps: 1) estimating marginal annual changes in visitation at the lake as they relate to selected driver variables, and 2) incorporate risk and uncertainty to develop a stochastic range of potential future levels of visitation.

Predicted marginal changes in annual visitation were estimated using a basic linear regression of economic and demographic variables at the state level. Table 4.13 shows historical trends for annual lake visitation, while Table 4.14 contains a correlation matrix for annual lake visitation (1999 through 2012) and population, median household income, gross domestic product (GDP), and per capita income. Monetary measures are in constant dollars to remove trends associated with price inflation (i.e., they are in real terms), and the period of analysis is limited to 1999 through 2012 given that these are the only consistent time-series data readily available in electronic format. As expected, most variables positively correlate with visitation, but not as strong as expected. The lack of strong correlation is due to the high inter-annual variation in recreation levels at the lake. Interestingly, household income is negatively correlated with visitation in some years, due to the likelihood of individuals forgoing longer trips and opting for local or regional destinations.

Table 4.13
Historical Trends in Greers Ferry Lake Visitation, Arkansas State Population and Economic Variables
(1999 through 2012)

Year	Visits	Real Median Household Income	Real State Gross Domestic Product	Real Per Capita Income	Population
1999	5,646,800	42,788	84,533	26,914	2,651,860
2000	6,020,100	41,404	85,271	27,402	2,678,588
2001	6,720,421	45,195	85,283	28,147	2,691,571
2002	7,967,464	43,224	87,979	28,223	2,705,927
2003	7,594,327	41,761	91,767	29,077	2,724,816
2004	6,497,354	44,452	96,064	29,878	2,749,686
2005	6,833,030	45,053	99,144	30,228	2,781,097
2006	7,529,575	44,113	101,028	30,935	2,821,761
2007	7,461,133	47,224	100,287	31,887	2,848,650
2008	6,612,294	44,129	100,485	32,116	2,874,554
2009	7,341,244	40,873	98,020	31,374	2,896,843
2010	7,283,258	42,478	101,309	31,286	2,922,280
2011	6,193,155	44,064	103,312	32,447	2,938,506
2012	7,391,579	40,788	103,170	34,076	2,949,828

Source: Recreation visitation from USACE Operations and Maintenance Business database. State population from U.S. Census and economic data from the Federal Reserve Bank of St. Louis

Table 4.14
Correlation Matrix for Visitation Arkansas State Population and Economic Variables
(1999 through 2012)

Variable	Visits	Real Median Household Income	Real State Gross Domestic Product	*Real Per Capita Income*	*Population*
Visitation to Greers Ferry Lake	1.00	-	-	-	-
Real Median Household Income	-0.03	1.00	-	-	-
Real State Gross Domestic Product	0.32	0.13	1.00	-	-
Real Per Capita Income	0.34	0.03	0.94	1.00	-
Population	0.29	-0.08	0.92	0.95	1.00

With the exception of median household income, variables considered for the regression model are highly correlated with each other. For instance, Gross Domestic Product and per capita income tend to move lock step with population increases (correlation coefficients of 0.92 and 0.95). Thus, given potential problems with multicollinearity and resultant inflated standard errors used to calculate t-statistics, the regression only includes the population index as the independent variable. Using population as the sole driver for projected recreation has the added advantage in that University of Arkansas at Little Rock demographers develop and publish county and state population projections for Arkansas over a 50-year period, and the projections are accurate. Another adjustment involved normalizing or indexing regression variables to a base on 100 as shown in Figure 4.5. Indexing is particularly useful for dealing with variables in different scales of measurement including pre-2012 and post 2012 recreation visitation counts.

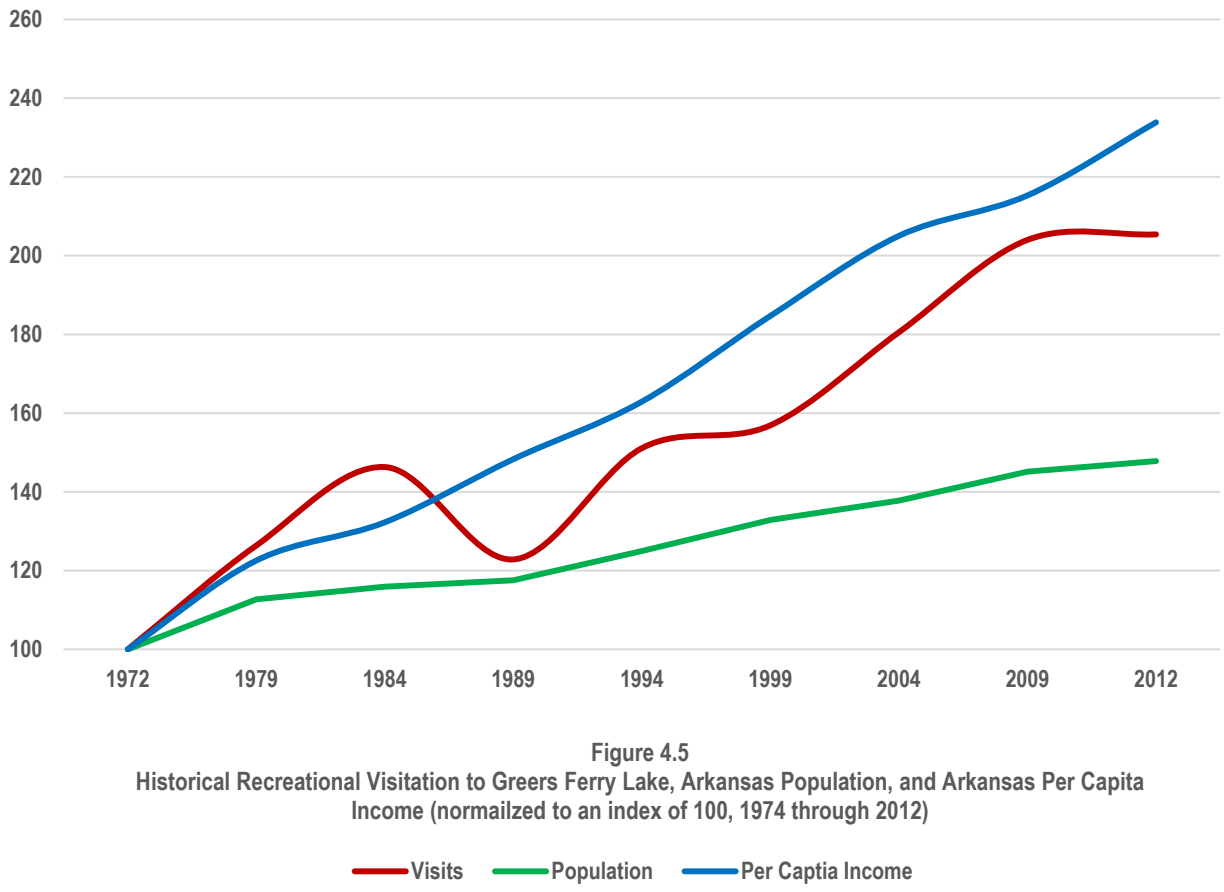


Figure 4.5
Historical Recreational Visitation to Greers Ferry Lake, Arkansas Population, and Arkansas Per Capita Income (normailzed to an index of 100, 1974 through 2012)

1

2

Table 4.15
Regression Results for Visitation and Population Index

Regression Statistics	
Multiple R	97.1%
R Square	94.3%
Adjusted R Square	93.5%
Standard Error	9.25
Observations	9

Analysis of Variance	Degrees of Freedom	Sum of Squares	F-stat	Significance F
Regression	1	9,967	116	0.001%
Residual	7	599		
Total	8	10,566		

Variable	Coefficients	Standard Error	t-stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-122.84	25.92	-4.74	0.21%	-184.13	-61.56	-184.13	-61.56
Population Index	2.20	0.20	10.79	0.001%	1.71	2.68	1.71	2.68

Annual variability is based on dispersion of historical data from 1999 through 2000. Using deviation historical values as a gauge for future variability is useful because it inherently captures all factors affecting uncertainty that are time consuming and costly to identify, or in some cases, impossible or difficult to measure identify. To model uncertainty in projections, probability distributions were fitted to data for percent variation in annual visitation. Goodness of fit statistical tests including the Chi-square, Anderson-Darling, Bayesian (BIC), Akaike (AIC), and Kolmogorov-Smirnov indicated a Beta frequency distribution (similar to a Gaussian distribution "bell" curve distribution), is best suited based on historical data (Figure 4.6). Variation for annual visitation captured by the Beta distribution was applied to predicted ranges of population growth from the University of Arkansas at Little Rock to develop a stochastic range of projections.

Table 4.16 and Figure 4.7 display the stochastic range of study projections over a 30-year period of analysis (2017 through 2047). Base year estimates range from 1.65 million to 2.21 million, and end year figures range from 2.24 million (95 percent exceedance) to 3.33 million (5 percent exceedance) with a midpoint 2.75 million. From a planning perspective, this range allows lake managers to plan capacity expansion for recreation facilities based on the level of risk they are willing to accept. For example, they may be comfortable in assuming that the midpoint is acceptable, or may conclude a greater level of certainty is best (i.e., 25 or 5 percent exceedance).

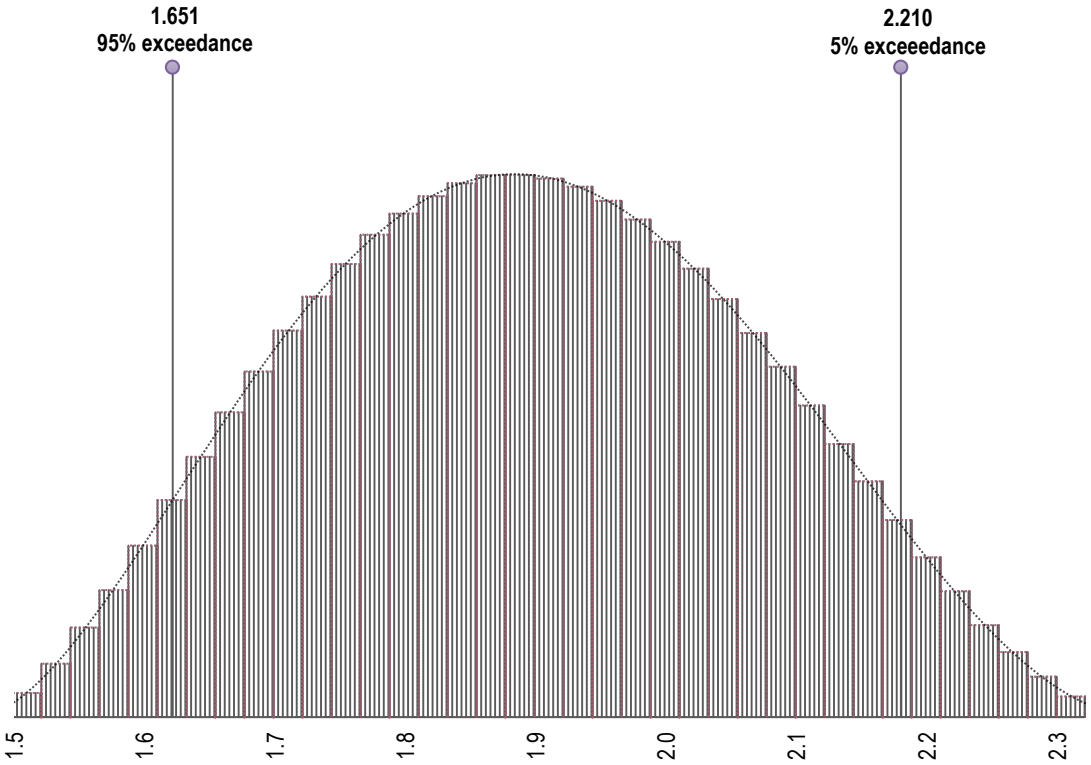


Figure 4.6
Simulation Results based on Beta Frequency Distribution for Variation in Historical Annual Visitation to Greers Ferry Lake (FY 1999-2013, millions of visitors)

1

Table 4.16
Projected Visitation to Greers Ferry Lake (person days, 2017 through 2047)

Year	95% Exceedance	75% Exceedance	50% Exceedance	25% Exceedance	5% Exceedance
2017	1,651,000	1,798,000	1,923,000	2,051,000	2,210,000
2018	1,668,000	1,818,000	1,946,000	2,077,000	2,240,000
2019	1,685,000	1,838,000	1,969,000	2,104,000	2,271,000
2020	1,703,000	1,858,000	1,993,000	2,132,000	2,302,000
2021	1,720,000	1,879,000	2,017,000	2,160,000	2,334,000
2022	1,738,000	1,900,000	2,041,000	2,188,000	2,366,000
2023	1,756,000	1,921,000	2,066,000	2,216,000	2,398,000
2024	1,774,000	1,942,000	2,091,000	2,245,000	2,431,000
2025	1,792,000	1,963,000	2,116,000	2,274,000	2,464,000
2026	1,810,000	1,985,000	2,142,000	2,304,000	2,498,000
2027	1,829,000	2,007,000	2,167,000	2,334,000	2,532,000
2028	1,848,000	2,029,000	2,193,000	2,364,000	2,567,000
2029	1,867,000	2,052,000	2,220,000	2,395,000	2,602,000
2030	1,886,000	2,075,000	2,247,000	2,426,000	2,638,000
2031	1,905,000	2,097,000	2,274,000	2,458,000	2,674,000
2032	1,925,000	2,121,000	2,301,000	2,490,000	2,711,000
2033	1,945,000	2,144,000	2,329,000	2,522,000	2,748,000
2034	1,965,000	2,168,000	2,357,000	2,555,000	2,785,000
2035	1,985,000	2,192,000	2,385,000	2,589,000	2,824,000
2036	2,005,000	2,216,000	2,414,000	2,622,000	2,862,000
2037	2,026,000	2,241,000	2,443,000	2,656,000	2,902,000
2038	2,047,000	2,265,000	2,472,000	2,691,000	2,941,000
2039	2,068,000	2,290,000	2,502,000	2,726,000	2,982,000
2040	2,089,000	2,316,000	2,532,000	2,762,000	3,023,000
2041	2,110,000	2,341,000	2,563,000	2,798,000	3,064,000
2042	2,132,000	2,367,000	2,594,000	2,834,000	3,106,000
2043	2,154,000	2,393,000	2,625,000	2,871,000	3,149,000
2044	2,176,000	2,420,000	2,657,000	2,908,000	3,192,000
2045	2,198,000	2,447,000	2,689,000	2,946,000	3,236,000
2046	2,221,000	2,474,000	2,721,000	2,985,000	3,280,000
2047	2,244,000	2,501,000	2,754,000	3,024,000	3,325,000

Source: U.S. Army Corps of Engineers, Regional Planning and Environmental Center, Little Rock District

2

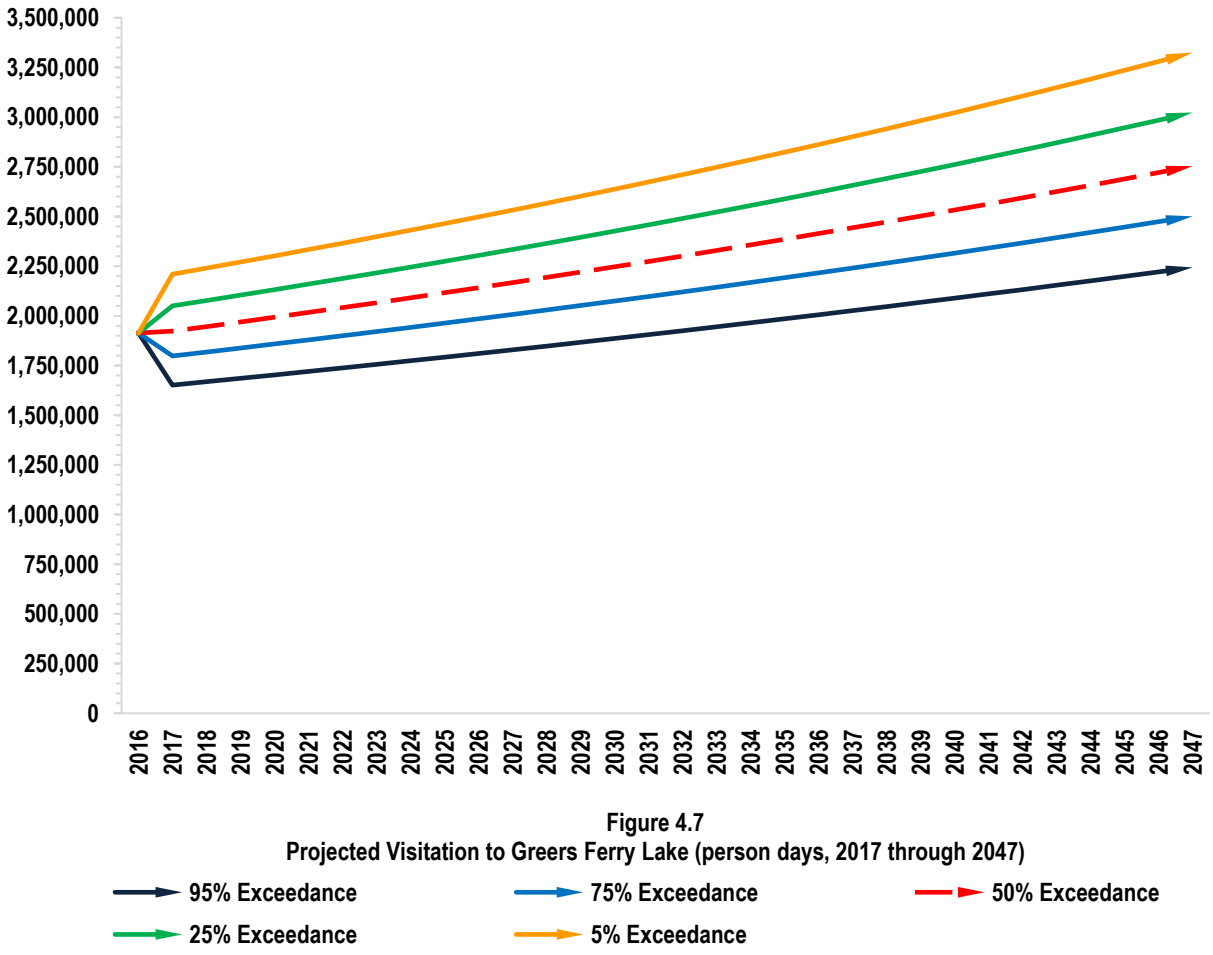


Figure 4.7
Projected Visitation to Greers Ferry Lake (person days, 2017 through 2047)

In terms of the distribution of activities such as boating versus camping, a comparison of historical figures and current data show some change (Table 4.17), but overall, changes are not significant with the exception of a decline in the proportion of people reporting camping as their primary activity. However, this may be due to variations in self reporting and survey methods in 1970 versus today. For planning purposes, it is probably safe to assume that the distribution of activities will remain constant over the period of analysis.

Table 4.17
Current and Historical Distribution of Recreational Activities

Activity	1970 Visitation	1970 Distribution	Current Visitation	Current Distribution
Picnicking	3,052	5.74%	269,491	8.18%
Camping	10,682	20.10%	16,066	0.49%
Swimming	13,989	26.32%	717,176	21.76%
Boating and water skiing	38,388	18.66%	690,703	21.0%
Sightseeing	8,902	16.75%	241,280	7.32%
Fishing	6,613	12.44%	256,313	7.78%
Other	NA	NA	1,104,496	33.52%

Historical data from: Design Memorandum 19-5 Updated Master Plan for Development and Management for Greers Ferry Lake, U.S. Army Corps of Engineers, Little Rock District. May 1975. Current (2016) data from: U.S. Army Corps of Engineers, Value to the Nation, Recreation Fast Facts for Greers Ferry Lake.

4.10 Recreation Resources

The recreational resources of Greers Ferry Lake Project are considered to be of great importance to Arkansas. USACE has taken advantage of the natural and scenic beauty and constructed a variety of recreational facilities around the lake. Greers Ferry Lake Project offers many recreational activities such as sightseeing, camping, swimming, picnicking, scuba diving, boating, water skiing/wakeboarding, canoeing/kayaking, nature study, bird watching, fishing, hunting, and hiking. There are sixteen designated recreation areas on Greers Ferry Lake. The City of Fairfield Bay and the City of Heber Springs operate and maintain one recreation area each; Eden Isle Marina leases one recreation area. Nine full-service marinas are owned and operated by commercial concessionaires. Twenty-seven boat ramps are licensed to local County or State Government. Four limited-motel/resorts have facilities on Government property and are owned and operated by lease agreement. Greers Ferry Lake's parks are some of the busiest in the nation. This is evidenced by total fee collections ranking as one of the highest in USACE, consistently ranking in the top 10.

The criteria discussed in this section are of a basic nature to be used for the planning, development, and management of the project with consideration being given to the latest trends in recreational activities and needs. These criteria furnish guidelines for determining the type and number of facilities needed to satisfy the current and projected demand and also furnishes guidelines for serviceability, operation, and maintenance of facilities. Considerations for the physically handicapped will be included in the design of facilities.

Over seventy five percent of visitors in 2012 engaged in some sort of water sports (swimming, boating, skiing and fishing). The lake is a popular destination for anglers seeking largemouth, smallmouth, and spotted bass, crappie, bream, hybrid striped bass, walleye, and catfish. Hunting is also a popular sport in the Greers Ferry Lake vicinity. A mixture of hardwood and pine forests provide habitat for many different species of wildlife. Sportsmen and women can find many remote areas where they can hunt various types of upland game animals such as white-tailed deer, eastern wild turkey, rabbits and squirrels.

Recreation at the lake has a substantial impact on local economies based on surveys of visitor spending and attendance at USACE projects. Based on 2012 data, the roughly 7.4 million people that visited Greers Ferry Lake spent over $240 million in local economies within 30 miles of the lake. This spending generated $113.9 million in business sales revenue, and supported about 2,200 full and part time jobs with $43.8 million in labor income.

Table 4.18: Greers Ferry Lake 2012 Visitation Data

Greers Ferry Visitors and Facilities	
Visits total	**11,897,547**
Picnickers	1,038,753
Campers	61,928
Swimmers	2,764,352
Water Skiers	376,300
Boaters	1,480,971
Sightseers	930,013
Fishermen	987,958
Other	4,257,272

Table 4.19: Recreation Facilities at Greers Ferry Lake

Facilities	Number of sites
Recreation Areas	18
Picnic Sites	105
Camping Sites	1,159
Playgrounds	10
Swimming Areas	11
Number of Trails	4
Boat Ramps	27
Marina Slips	4,061

Computations of Economic Impacts of CE Visitor Spending

Four components are needed to estimate economic effects: recreation spending, visitor use estimates, capture rates and economic multipliers.

Economic effects = # of visits × average spending per visit × capture rate × regional economic multiplier

The visitation data used here was derived from the OMBIL and VERS database with 2012 data, while the spending profiles were estimated from a national visitor spending survey that was conducted in 1999/2000 and price indexed to 2012 dollars using Consumer Price Index by sectors.

Capture rates and economic multipliers were estimated using the Impact Analysis for Planning (IMPLAN) system. IMPLAN is a microcomputer based input-output (I-O) modeling system that is currently maintained by the Minnesota IMPLAN Group Inc. Regional IMPLAN models were developed for each of the CE projects, districts, divisions, plus a national model and 43 state models to estimate the total economic effects at various geographic levels. Spending averages were computed and multiplied by visitation statistics to estimate total annual visitor spending. Generalized spending profiles were developed for two sets of visitor segments: (1) campers, other overnight visitors and day users, and (2) boaters and non-boaters. These profiles were applied to recreation use data gathered from the visitation use survey and from the OMBIL and VERS to estimate total spending by each segment for each of the 402 CE projects.

It is important to distinguish these results that employed local models, or "bottom-up" approach (aggregation of local effects) from the "top-down" approach that used state or U.S. models. The top-down effects were the results of total trip spending by CE visitors (both within and outside 30 miles of projects' borders) and employed state or national multipliers. These effects were much higher than the aggregation of local effects because the higher capture rate and higher multipliers. The economic impact estimates the employed the "top-down" approach are available on this website for all district, division, state and the national level reports. Table 4.20 summarizes economic impact for Greers Ferry Lake.

Table 4.20: Economic Impact Greers Ferry Lake FY 12

	($ thousands)
Visitor spending within 30 Miles	$243,908
Sales within 30 Miles	$113,909
Jobs within 30 Miles	2,184
Labor Income within 30 Miles	$43,855
Value Added within 30 Miles	$69,161
Total Sales	$164,296
Jobs Total	2,706
Labor Income	$58,986
Value Added wages & salaries, payroll benefits, profits, rents, and indirect business taxes)	$98,499

4.11 Health and Safety

Safety of project visitors and project staff are the highest priority in daily project operations. Facilities and recreational areas are routinely evaluated to ensure sites are safe for visitor use. Project staff conducts numerous water safety programs and public announcements to educate children and project visitors about ways to be safe on the lake.

Shoreline Management Plan guidelines are all structured with focus on safety-i.e. AAV permits for handicapped or physically impaired individuals, steps/stairs allowed for excessive slopes, and licensed/certified electric service requirements for safety enhancement.

In coordination with the Arkansas Game and Fish Commission, no wake zones are marked with buoys. USACE Park Rangers provide visitor assistance and work with county law

enforcement agencies to ensure public safety. USACE Park Rangers, local law enforcement, and the AGFC personnel provide water safety and enforcement patrols on the lake as their budgets allow.

4.12 Aesthetics

Management objectives include maintaining scenic vistas while limiting impacts that would negatively affect aesthetics. Natural landscapes and views of undeveloped lands are an important feature that enhances the recreational experience. The perimeter lands around Greers Ferry Lake provide a natural setting that is aesthetically pleasing as well as buffering the lake from development and negative impacts such as erosion and storm water runoff. However, there are problems in maintaining these aesthetic qualities. Project resource staff are continually investigating trespasses that include activities such as timber cutting and land destruction by unauthorized off road vehicles. In addition, litter and illegal trash dumping both on project lands and project waters are continual problems. Vandalism within recreation areas also occurs. Other concerns that impact aesthetics are demands put upon project resources for uses such as road and utility line corridors.

5.0 ENVIRONMENTAL CONSEQUENCES

The following table summarizes the resources that are likely to be affected by each of the alternatives for an update of the *Greers Ferry Lake Shoreline Management Plan* including the No Action alternative. A detailed discussion of the potential impacts of each of the alternatives follows the synopsis provided in the table.

Table 5.1 Resource Impact with Implementation of Alternatives

Resource Category	Alternative 1 No Action	Alternative 2 Preferred	Alternative 3 Conservative
Climate, Topography, Geology and Soils	The No Action Alternative is used as the base line for comparison with the action alternative. This alternative represents the current conditions that exist and the potential for additional development under the current regulations. There is no documentation of significant environmental concerns on climate, topography, geology and soils from current activities on and around the lake.	There would be a positive impact, although not significant, on climate, topography and geology as a result of implementation of the Preferred Alternative due to the potential for minimal development around the lake due to a 0.3 mile increase of LDAs and a 17.3 mile reduction in PRAs. Any additional boating activity above current uses may come from increased use of existing public launching facilities and commercial marinas.	There would be a potentially positive impact on climate, topography and geology as a result of implementation of the Conservative Alternative due to a reduction of 18.7 miles of LDA and an increase of 9.2 miles of PRA.
Aquatic Environment	The No Action Alternative would result in little to no impacts on the hydrology and groundwater components of the aquatic environment of Greers Ferry Lake. Water quality impacts would likely be minimally impacted under this alternative due to continuing the issuance and renewal of vegetation modification and dock permits.	The Preferred Alternative is similar to the No Action Alternative in terms of potential impacts to the hydrology and groundwater components of the aquatic environment, but water quality would be enhanced due to relatively unchanged LDA and a 17.3 mile reduction in PRA shoreline miles.	The Conservative Alternative could have a potential for positive impacts to the hydrology and groundwater components of the aquatic environment due to greater reduction in LDA shoreline allocation, which serves to reduce negative impacts that result from property development.

Resource Category	Alternative 1 No Action	Alternative 2 Preferred	Alternative 3 Conservative
Terrestrial Resources	The No Action Alternative would have minimal negative impact on the lakeside terrestrial resources due to continuing the issuance and renewal of vegetation modification and dock permits.	Implementation of the Preferred Alternative would have a similar impact on terrestrial resources in comparison to the No Action Alternative. Due to an increase in PSAs, this would have a positive benefit to the vegetation and wildlife around the lake.	The Conservative Alternative could have a potential for positive impacts to the terrestrial resources due to greater reduction in LDA shoreline allocation, which serves to reduce negative impacts that result from property development.
Threatened & Endangered Species	The No Action Alternative could have a potential negative impact on Threatened, Endangered, Protected, or Species of State Concern, depending on whether or not new dock or vegetation modification permits impact the known location of a listed species.	The Preferred Alternative would likely have no significant impact on any listed Threatened, Endangered, Protected, or Species of State Concern. Due to the increase in PSA and PAA, there may be some positive benefits to any or all the listed species.	The Conservative Alternative could potentially have a greater positive impact on listed Threatened, Endangered, Protected, or Species of State Concern due to the highest reduction of LDA shoreline miles of all alternatives evaluated.

Resource Category	Alternative 1 No Action	Alternative 2 Preferred	Alternative 3 Conservative
Archaeological & Historic Resources	The No Action Alternative would have some potential to have a negative impact on cultural resource sites and historic properties compared to the Preferred Alternative due to the continued issuance of vegetation modification and boat dock permits.	The Preferred Alternative would potentially have little to no impacts on cultural resource sites or historic properties. There is a large reduction in PRA, with corresponding increase in PSA, which would enhance protection of these resources.	The Conservative Alternative could have potentially greater positive impacts on cultural resources and historic properties due to the lowest number of shoreline miles of LDA allocation for the evaluated alternatives, which high l reduces potential for development.
Air Quality	Implementation of the No Action Alternative would have minimal impacts to existing air quality due to a continuation of the permitting process, creating a potential for increased boating activity.	Implementation of the Preferred Alternative would result in some reduction in negative air quality impacts as compared to the No Action Alternative due to a decrease in PRA lands and an increase in PSA, thereby having a potential for a decrease in future development.	Implementation of the Conservative Alternative would result in the air quality around the lake remaining similar to currently existing air quality. There could be a decrease in vehicular exhaust emissions due to a reduction in localized development, and associated construction equipment. No violations of the current National Ambient Air Quality Standards (NAAQS) established by the EPA would be expected under this alternative.

Resource Category	Alternative 1 No Action	Alternative 2 Preferred	Alternative 3 Conservative
Socio-economics and Environmental Justice	The No Action Alternative may have beneficial impacts on the socio-economic situation in the counties surrounding Greers Ferry Lake due to the retention of a larger percentage of PRA lands as compared to the Preferred Alternative.	The Preferred Alternative may have minimal negative impact on the socio-economic situation in the counties surrounding Greers Ferry Lake since this alternative reduces PRA lands by 17.3 miles from the No Action Alternative.	The Conservative Alternative may have some negative impact on the socio-economic situation in the counties surrounding Greers Ferry Lake due to the reduced potential for future development because of major reduction in LDA shoreline miles (18.7).
Recreation Resources	Under the No Action Alternative, areas around Greers Ferry Lake would have the potential to provide additional recreation since a higher percentage of Public Recreation Area is retained, as compared to the Preferred Alternative. This may enhance the recreational experience for boating and fishing activities on the lake.	The Preferred Alternative would reallocate some PRA lands to PSA. Implementation of this alternative would allow more recreation in the wildlife viewing, hiking, and hunting arena.	The Conservative Alternative would allow the provision of recreational facilities and services to continue at Greers Ferry Lake, with a modification of the type of recreation opportunities due to increases in PRA and PSAs.

Resource Category	Alternative 1 No Action	Alternative 2 Preferred	Alternative 3 Conservative
Health & Safety	The No Action Alternative would still allow potential development opportunities, but not to the degree to cause significant boat congestion or increase water related accidents. Recreational boating experiences and boater satisfaction may be impacted due to the potential for additional boats on the lake.	The Preferred Alternative would reduce PRA lands, thereby reducing the potential for increased development. Water quality may be positively impacted due to reduced traffic in some areas and a decrease in fuel and oil leakage. The increase in PSA could result in a potential increase in human exposure to insects and wildlife. The availability of recreational opportunities, balanced with conservation of natural environment could lead to better health, both mental and physical, for lake users.	The Conservative Alternative would further reduce LDA miles over the Preferred Alternative, thereby eliminating the potential for increased development. Water quality may be positively impacted due to reduced development and a decrease in fuel and oil leakage. The increase in PSA could result in a potential increase in human exposure to insects and wildlife. The availability of recreational opportunities, balanced with conservation of natural environment could lead to better health, both mental and physical, for lake users.
Aesthetics	The No Action Alternative would still allow potential development opportunities, but not to the degree to significantly impact the current aesthetic qualities that make Greers Ferry Lake a desired location for both residents and visitors. This alternative would maintain the area of pristine shoreline and preserve regions of boulders, bluffs, and mature forest flora that currently dominate views.	Under the Preferred Alternative, the reduction of 17.3 miles of PRA, along with the addition of 19.4 miles of PSA would enhance a sense of the pristine nature of the lake. The developed areas are, for the most part, shielded from the lake view, which preserves the viewscapes of those recreating on the lake.	Under the Conservative Alternative the visual characteristics surrounding the Greers Ferry Lake landscape would likely change due to elimination of future shoreline development on the lake.

5.1 Climate

5.1.1 No Action (Alternative 1)

The No Action Alternative could have potential impacts on air and water temperatures due to continued development, with its associated vegetation modification and removal. This development activity could remove shoreline shading, causing air and water temperature increases, and possible increases in storm water runoff velocity. This would increase the potential for erosion and sediment deposition in the lake which could increase the turbidity of the water, resulting in a possible slight increase in water temperature.

5.1.2 Preferred (Alternative 2)

The Preferred Alternative implementation could result in some potential impact to climate. While 22.0 miles of shoreline is allocated as LDA, with a potential for development that could modify the vegetation component near the shoreline, the reduction of PRA by 17.3 miles and reallocation to PSA would preserve 83.5% of the shoreline in its natural state. Greater temperature fluctuations generally occur when woody vegetation is removed from an area so undisturbed vegetative cover typically reduces temperature fluctuations and results in cooler water temperatures near the shoreline due to shading. The potential impact could come from development of lands in LDA, but are anticipated to be minimal.

5.1.3 Conservative (Alternative 3)

The Conservative Alternative is more protective than the No Action Alternative in terms of potential impacts on air and water temperature modification. A conversion of LDA lands to PSA would reduce the potential for development, which reduces the potential impact on climate due to vegetation removal. This reallocation would provide increased shading due to more vegetation retention, thereby reducing ground and surface water temperatures.

5.2 Topography, Geology and Soils

5.2.1 No Action (Alternative 1)

Soil erosion would persist due to development being allowed under this alternative. Issuance of additional vegetation and dock permits requires soil disturbance, vegetation removal and transforming pervious surfaces to impervious areas. This promotes erosion due to previous unmodified vegetative areas being modified through permits and increased runoff velocity after modification is completed. The remaining pervious surfaces around these developed areas will become more impervious due to increased foot traffic to boat docks, along with Ambulatory Assistance Vehicle (AAV) permitted use to boat docks.

5.2.2 Preferred (Alternative 2)

The Preferred Alternative is more restrictive than the No Action Alternative in terms of potential impacts to topography, geology and soils. This alternative may result in potential minimal impacts on topography, geology, and soils due to vegetation modification resulting from additional dock permits issued in LDA. This alternative adds 0.3 shoreline miles of LDA to the existing 21.7 miles in the No Action Alternative, representing an increase of 0.1 percent of total

shoreline miles. However this alternative will have less impact to topography, geology, and soils due to the increased LDA mileage being located where there are existing docks. In this alternative there are an additional 19.4 miles of shoreline with PSA, which further reduces overall activity, as compared to the No Action Alternative, where this land was allocated to PRA.

5.2.3 Conservative (Alternative 3)

The Conservative Alternative is more restrictive than the No Action Alternative in terms of potential impacts to topography, geology and soils. Only three miles of LDA would be retained in this alternative, providing some limited potential for development, but 245.8 miles of shoreline are allocated to PSA, representing 80.3% of total shoreline miles. These lands would provide a natural vegetated lake buffer area. This vegetation helps to reduce storm water velocity and acts as a filtering mechanism. This would help reduce erosion and sediment deposition in the lake.

5.3 Aquatic Environment

5.3.1 Hydrology and Groundwater

5.3.1.1 No Action (Alternative 1)

The hydrology and groundwater components of Greers Ferry Lake would not change from the existing condition due to the implementation of a No Action Alternative. The potential for additional development under this alternative would have a minor effect on reducing percolation through the soil layers due to ground cover removal, and potentially increasing storm water velocity. Wetland areas are relatively limited within Greers Ferry Lake and throughout the adjacent government property surrounding the lake and would not undergo any significant change from existing conditions due to implementation of the No Action Alternative.

5.3.1.2 Preferred (Alternative 2)

The Preferred Alternative is different than the No Action Alternative in terms of potential impacts to the hydrology and groundwater components of the aquatic environment. This alternative would have a positive minor impact on the hydrology and groundwater components of the aquatic environment as compared to the No Action Alternative. PRA has been reduced to 26.3 miles, representing 8.6% of available shoreline, while PSA occupy 255.7 miles, representing 83.5% of shoreline. The natural vegetation in PSAs will enhance hydrology and groundwater conditions and function by providing more pervious surface for rainfall absorption..

5.3.1.3 Conservative (Alternative 3)

The Conservative Alternative is different than the No Action Alternative in terms of potential impacts to the hydrology and groundwater components of the aquatic environment. The hydrology and groundwater conditions are generally a function of the watershed drainage and existing geology of the area, but having 80.3% of the shoreline allocated as PSA in the Conservative Alternative, as compared to 77.1% in the No Action Alternative, would enhance rainfall absorption and slow runoff velocity due to a larger percentage retention of PSA shoreline vegetation being retained.

5.3.2 Water Quality

5.3.2.1 No Action (Alternative 1)

While implementation of the No Action Alternative is relatively independent of the existing watershed drainage on the lake water quality, potential continued development around the lake shoreline would exacerbate existing water quality issues due to potential increased erosion, localized increases in turbidity and increased sedimentation in the lake following storm events. Under the No Action Alternative, PRA would be 43.6miles (14.2% of total shoreline, LDAs would be 21.7 miles (7.1%), PSA include 236.3 miles, representing 77.1% of the shoreline, and 4.8 miles (1.6%) are PAA. Based on the current allocations, the potential exists for continued degradation of shoreline vegetation due to potential increased development and subsequent vegetation removal and mowing activities. This would result in minor negative impacts to water quality due to increased storm water velocity, scour and sedimentation.

5.3.2.2 Preferred (Alternative 2)

Implementation of the Preferred Alternative would reduce PRA by 17.3 miles and reallocating to PSA. While LDA increases by 0.3 miles, providing some additional development potential in some areas, the 255.7 shoreline miles of PSA (83.5%) will provide a minor positive effect on lake water quality due to the rainwater filtering benefits from natural shoreline vegetation buffer associated with this allocation. The increased vegetation will also improve water quality by providing more shade, thereby having a cooler rainfall runoff which aids dissolved oxygen retention in the lake.

5.3.2.3 Conservative (Alternative 3)

Implementation of the Conservative Alternative may result in positive benefits to water quality due to an 18.7 mile reduction in LDA lands, as compared to the No Action Alternative. There is a corresponding increase in PSA, from 236.3 miles to 245.8 miles, which represents a gain of 9.6 shoreline miles. These land reallocations would serve to limit development on the shoreline, thereby reducing impacts to ground disturbance and subsequent increased erosion. These factors would reduce erosion sedimentation and pollutants scoured from reduced impervious surfaces, with additional benefits of retention of more shoreline vegetation, better fish habitat, increased water clarity, and cooler water temperature conditions due to the decrease of turbidity and sediment deposition.

5.3.3 Fish Species and Habitat

5.3.3.1 No Action (Alternative 1)

The fishery of Greers Ferry Lake may have potential minor impacts from the implementation of the No Action Alternative. Based on the current allocations, the potential exists for continual degradation of shoreline vegetation due to possible increased development and subsequent vegetation removal and mowing activities. A 100 foot of vegetation buffer is maintained at Greers Ferry Lake which prevents development and vegetation removal down to the water's edge. This buffer will enhance shoreline stability, increase fish cover provided by overhanging vegetation, tree trunks and roots, and help reduce storm water erosion and sedimentation. During the spring spawning season, sedimentation has the potential to disrupt spawning activity and productivity in the coves and lake arms where spawning commonly occurs.

5.3.3.2 Preferred (Alternative 2)

The Preferred Alternative is similar to the Conservative Alternative in terms of potential positive benefits to the lake fishery. A comparison with the No Action Alternative shows a 17.3 mile reduction in PRA lands. In this alternative, 83.5% of the available shoreline miles would be allocated as PSA, preserving a majority of the natural shoreline vegetation above the existing 100 foot vegetation buffer. Similar to the positive effects discussed in the Conservative Alternative, this alternative should have a beneficial effect on the fish and fish habitat of Greers Ferry Lake by reducing sedimentation and lake water temperature.

5.3.3.3 Conservative (Alternative 3)

Implementation of the Conservative Alternative would have a positive effect on the lake fishery resource as compared to the No Action Alternative. There is a major reduction in LDAs, 21.7 miles to 3 miles of shoreline that could potentially be impacted by limited development. There is a 9.6 mile increase in PSA, representing 80.3% of shoreline in this allocation. The reallocations would serve to limit development on these lands, thereby reducing impacts to ground disturbance and subsequent increased erosion. These factors would reduce erosion sedimentation and pollutants scoured from reduced impervious surfaces, with additional benefits of retention of more shoreline overhanging vegetation which provides cover for fish, increased water clarity and cooler water temperature conditions due to the decrease of turbidity and sediment deposition, and a reduction in storm flow velocity. These factors improve spawning habitat, thereby potentially enhancing fish population dynamics in the lake.

5.4 Terrestrial Resources

5.4.1 Wildlife

5.4.1.1 No Action (Alternative 1)

The terrestrial resources of Greers Ferry Lake may have potential minor impacts from the implementation of the No Action Alternative. Under the No Action Alternative, PRA would be 43.6 miles (14.2% of total available shoreline), LDA 21.7 miles (7.1%), PSA total 236.3 miles (77.1%), while 4.8 miles, representing 1.6%, are allocated as PAA. Based on the current allocations, the potential exists for continued degradation of watershed vegetation due to potential increased development and subsequent permitted vegetation removal and mowing activities. This would result in negative effects to wildlife due to potential removal of trees and understory vegetation (with the highest potential adjacent to the LDA allocated lands), thus altering food sources and migratory patterns of insects, birds and mammal species.

5.4.1.2 Preferred (Alternative 2)

Implementation of the Preferred Alternative is more similar to the Conservative Alternative than the No Action Alternative in terms of potential effects to the terrestrial resources and land use patterns. A proposed 0.3 mile increase in LDA lands would result in 22.0 miles (7.2%) of available shoreline being potentially available for limited vegetation modification. This amount of LDA land would likely have negligible effects on wildlife species and activity due to the primary impact on vegetation being meandering path permits. In spite of this increase in LDA allocation, the majority of natural shoreline vegetation (255.7 miles) would remain in PSA. Suitable habitat for wildlife would still be abundant under this alternative.

5.4.1.3 Conservative (Alternative 3)

Implementation of the Conservative Alternative would have a positive effect on terrestrial resources, when compared to the No Action alternative. There is a reduction of 17.3 miles of LDA, as compared to the No Action Alternative. There is a corresponding increase in PSA, from 236.3 miles to 245.8 miles, which represents a gain of 9.6 shoreline miles. These land reallocations would serve to limit development on and adjacent to these lands, thereby reducing impacts to ground disturbance and subsequent increased vegetation modification. The increases in PSA would provide additional protection for lakeside vegetation, and preservation of habitat for wildlife and migratory bird species. The buffer of natural vegetation that remains along the shoreline from this designated acreage would potentially enhance migration and feeding activities for many species of wildlife.

5.4.2 Vegetation

5.4.2.1 No Action (Alternative 1)

The No Action Alternative is used as the base line for comparison with the other action alternatives. This alternative represents the current conditions that exist. Currently 21.7 miles of shoreline (7.1 percent) is allocated for LDA uses, which may include additional adjacent lands development and vegetation modification. Continued issuing of vegetation permits will have a minor negative impact on the existing vegetation resources. Based on this, the potential exists for continued degradation of adjacent watershed vegetation due to increased development and subsequent vegetation removal and mowing activities. Potential removal of trees and understory vegetation may alter food sources and migratory patterns of insects, birds and mammal species, as well as increasing a potential for increased storm water erosion effects.

5.4.2.2 Preferred (Alternative 2)

The Preferred Alternative is more similar to the Conservative Alternative in terms of potential effects to the lakeshore vegetation than that of the No Action Alternative. A proposed 0.3 mile increase in LDA lands would result in 22 miles (7.2%) of available shoreline being potentially be available for permitted vegetation modification. This amount of LDA land would likely have some, but still minor negative effect, on the vegetation composition of the shoreline. In spite of this increase in LDA, the majority of natural shoreline vegetation (255.7 miles) would remain in the PSA. Good habitat for wildlife, due to the 83.5% of protected naturally vegetated shoreline, would still be abundant under this alternative.

5.4.2.3 Conservative (Alternative 3)

Implementation of the Conservative Alternative would have a positive effect on the shoreline vegetation, when compared to the No Action alternative. There would be only 3 miles (1.0%) allocated to LDA, and with 245.8 miles of PSA (80.3% of available shoreline), additional protection for lakeside vegetation and subsequent preservation of habitat for wildlife and migratory bird species will result. The buffer of natural vegetation that remains along the shoreline from this designated acreage would enhance migration and feeding activities for many species of wildlife, as well as mediate storm water velocity and scour.

5.5 Threatened and Endangered Species

5.5.1 No Action (Alternative 1)

The No Action Alternative could potentially have some negative effects on listed Threatened, Endangered, or Protected based on the potential watershed development adjacent to the 21.7 miles of LDA lands allocated in this alternative. Currently there is one LDA area located within 200 feet of a Bald Eagle's nest.

5.5.2 Preferred (Alternative 2)

The Preferred Alternative would potentially have negligible effects on federally listed threatened and endangered species based on the increased mileage of PSA as compared to the No Action Alternative, but one area of LDA in this alternative is within 200 feet of an active Bald Eagle nesting site.

5.5.3 Conservative (Alternative 3)

The Conservative Alternative would likely provide the most protection for any species listed as Threatened, Endangered, Protected, or Species of State Concern due to having only three shoreline miles allocated to LDA, potentially eliminating much of the watershed development that may occur in the other evaluated alternatives. There is no allocated LDA land within 1500 feet of any federally listed threatened and endangered species or species of state concern.

5.6 Archaeological and Historic Resources

5.6.1 No Action (Alternative 1)

Under the No-Action Alternative there is one cultural resource site located within 200 feet of an existing LDA tract. Any new ground disturbing activities on USACE lands that have the potential to impact a cultural resource site would require a survey to be completed prior to commencement of the activity. Through the site review process prior to issuance of a permit or any federal action, unknown sites would be identified, and known sites would be evaluated for their significance and eligibility for the National Register of Historic Places pursuant to 36 CFR Part 800 of the National Historic Preservation Act. Potential mitigation for impact to cultural or historic sites could be a requirement for a cultural or historic resource site evaluation. If evaluation of site identifies a cultural or historic resource, avoidance of the action would be recommended.

5.6.2 Preferred (Alternative 2)

Under the Preferred Alternative, there is also one cultural resource site within 200 feet of an existing LDA shoreline allocation. Any new ground disturbing activities on USACE lands that has the potential to impact a cultural resource site would require a survey to be completed prior to commencement of the activity. Through the site review process prior to issuance of a permit or any federal action, unknown sites would be identified, and known sites would be evaluated for their significance and eligibility for the National Register of Historic Places pursuant to 36 CFR Part 800 of the National Historic Preservation Act. Potential mitigation for impact to cultural or historic sites could be a requirement for a cultural or historic resource site evaluation. If evaluation of site identifies a cultural or historic resource, avoidance of the action would be recommended.

5.6.3 Conservative (Alternative 3)

Under the Conservative Alternative, there have been no cultural resource sites identified in any LDA. Any new ground disturbing activities on USACE lands that has the potential to impact a cultural resource site would require a survey to be completed prior to commencement of the activity. Through the site review process prior to issuance of a permit or any federal action, unknown sites would be identified, and known sites would be evaluated for their significance and eligibility for the National Register of Historic Places pursuant to 36 CFR Part 800 of the National Historic Preservation Act. Potential mitigation for impact to cultural or historic sites could be a requirement for a cultural or historic resource site evaluation. If evaluation of site identifies a cultural or historic resource, avoidance of the action would be recommended.

5.7 Socio-Economic Resources

5.7.1 No Action (Alternative 1)

The No Action Alternative may have the most effect on the socio-economic situation in the counties surrounding Greers Ferry Lake due to the fact that 7.1% of the available shoreline miles are allocated as LDA and 14.2% as PRA lands. While the potential for some development exists around the lake, current population growth and the demographic makeup of the population are expected to remain similar to the current rates and percentages the area experiences now. Housing units and their values would not be affected if the No Action Alternative is implemented. It is likely that changes in the socio-economic conditions of the Greers Ferry Lake area would be the result of outside influences, and not those created by the No Action alternative.

5.7.2 Preferred (Alternative 2)

The Preferred Alternative would likely result in a similar socio-economic situation as Alternative 1, but possibly would have less of a positive effect as compared to the No Action Alternative due to reallocation of 19.4 miles of PRA to PSA. LDA lands are increased by 0.3 miles over the No Action Alternative, providing a potential for some additional docks on the lake. The economy in the area could possibly grow slightly due to a potential increased opportunity for recreation, both on the water and on the 255.7 miles of PSA.

5.7.3 Conservative (Alternative 3)

The Conservative Alternative would likely have a minor effect on the socio-economic situation in the counties surrounding Greers Ferry Lake. Population would be expected to stay the same or decline slightly due to the decreased LDA shoreline miles from 21.7 to 3. Total housing units may stay the same or decrease due to the potential decreased availability of recreation at the lake, but it is unlikely that housing values would change as a result of the alternative. The economy of the area would likely stay the same or have a slight decline if this alternative is implemented.

5.8 Recreation Resources

5.8.1 No Action (Alternative 1)

Under the No Action Alternative, provision of recreational facilities and services would continue at Greers Ferry Lake. However, the plan by which the Resource Manager and staff operate, would not accurately reflect the current status of project facilities. Nor would there be additional

measures in place, such as potential trail corridors and additional land use designations, to better accommodate recreational needs while protecting the natural resources. Currently, there are several boat docks outside of areas of zoning.

5.8.2 Preferred (Alternative 2)

The Preferred Alternative would deviate significantly from the current uses in terms of provision of recreational opportunities on the lake. The 255.7 miles of shoreline that would be allocated to PSA from PRA, and the addition of 0.3 miles of LDA in this alternative would allow for the potential to have additional private boat docks for fishing and lake access. A potential to develop nature trails and wildlife viewing areas is available, thus possibly increasing recreational traffic along Greers Ferry Lake and its adjacent lands. The proposed increase in PSA would provide an opportunity of forging partnerships between public and private entities for recreational and wildlife conservation opportunities.

5.8.3 Conservative (Alternative 3)

Under the Conservative Alternative, LDA lands are reduced to 3.0 shoreline miles, representing 1.0%, PRA lands are increased to 52.8 miles (17.2%), and PSA include 245.8 miles, occupying 80.3% of the lake shoreline. The increase in PRA lands, combined with the 80.3% of PSA tend to favor fishing, hunting and wildlife viewing as the dominant recreational activities on the lake, which provide a minor beneficial impact on recreation. The retention of a major percentage of the natural shoreline vegetation would lead to improved water quality, due to its buffering and filtering capability.

5.9 Air Quality

5.9.1 No Action (Alternative 1)

Under the No Action alternative, the air quality around the lake would remain similar to that currently existing. There would likely be increases in vehicular exhaust emissions due to localized development, and the associated construction equipment and traffic in the area. However, no violations of the current National Ambient Air Quality Standards (NAAQS) established by EPA would be expected as a result of the implementation of this alternative.

5.9.2 Preferred (Alternative 2)

Implementation of the Preferred Alternative would result in fewer air quality effects as compared to the No Action Alternative. This alternative would reallocate less shoreline miles to PRA lands than Alternative 1, and having 83.5% of the shoreline in an undevelopable state will enhance existing air quality around the lake due to decreased development. No violations of the current NAAQS established by EPA would be expected as a result of the implementation of this alternative.

5.9.3 Conservative (Alternative 3)

Mirroring the Preferred Alternative, implementation of the Conservative Alternative would possibly result in improved air quality impacts as compared to the No Action Alternative. Since this alternative would incorporate less shoreline mileage into LDA, there would likely be a reduction in potential development, local vehicular exhaust emissions, and construction equipment activity, which would avoid or reduce potential impacts on localized air quality.

No violations of the current NAAQS established by EPA would be expected as a result of the implementation of this alternative.

5.10 Health & Safety

5.10.1 No Action (Alternative 1)

Safety of project visitors and project staff are highest priority in daily project operations. The No Action Alternative would have 7.1% of available shoreline miles allocated for LDA, and with 14.2% allocated as PRA lands, would allow for a potential reduction in lake water quality, as described in Section 5.3.2. There could potentially be an increase in boat traffic on the lake and a possible increase in congestion, creating additional safety issues. The lake could experience increased user conflict, for example, boats vs. personal watercrafts. Under the No Action Alternative, populations who recreate at the lake could be exposed to greater health risks associated with impaired water quality, such as *E. coli,* and potential hazardous run off due to the overall potential for increased recreation at the lake.

5.10.2 Preferred (Alternative 2)

The Preferred Alternative could also create a potential for additional boat docks being built due to a small increase in LDA allocation (22.0 miles), compared to the 21.7 miles in the No Action Alternative. This alternative would potentially result in a small increase of traffic congestion on the water, thus water related incidents could potentially become an issue under this alternative, but to a lesser potential in comparison to the No Action Alternative due to the large decrease of 17.3 miles of PRA. An increase in PSA, from 236.3 shoreline miles to 255.7 miles, could potentially increase exposure to insects and animals during land based recreational activities.

5.10.3 Conservative (Alternative 3)

The recreational opportunities, balanced with conservation of natural environment could lead to better health, both mental and physical, of the visiting population. Implementation of the Conservative Alternative would likely result in reduced private land development adjacent to the lake, and provide more recreational opportunity at the public ramps, parks, and marinas on the lake. The increase in PSA could potentially increase exposure to insects and animals.

5.11 Aesthetics

5.11.1 No Action (Alternative 1)

Aesthetics is an important feature that enhances the recreational experience. Lands around Greers Ferry Lake provide a natural setting that is aesthetically pleasing as well as buffering the lake from views of development and clearings. Under the No-Action Alternative the visual character of the landscape would slowly change due to potential continued development increasing the amount of land with views of development and human structures. This would increase the amount of visual contrast between the natural and developed landscapes around the lake. Visual contrast is a measure of impact on visual quality and aesthetics. Dock development would reduce the unspoiled and untamed aesthetic of this landscape. Road and utility line corridors also impact aesthetics and visual resources at Greers Ferry Lake. In many instances, requests for new shoreline use permits are in areas where the natural vegetation and landscape would be disturbed.

5.11.2 Preferred (Alternative 2)

The conversion of 255.7 of the 306.3 total shoreline miles to PSA would continue to preserve the sense of relatively pristine shoreline, while still allowing some limited development around the lake. The natural vegetation along the shoreline would enhance the viewscapes of the people recreating on the lake, while potentially impeding the view of the lake from the shore. Public Recreation Area lands have been reduced by 26.3 miles, thereby allowing more natural shoreline vegetation to remain in an unaltered state.

5.11.3 Conservative (Alternative 3)

This would increase the amount of visual contrast between the natural and developed landscapes around the lake. Visual contrast is a measure of impact on visual quality and aesthetics. Dock development would eliminate the unspoiled and untamed aesthetic of this landscape. Road and utility line corridors also impact aesthetics and visual resources at Greers Ferry Lake. Since the lake is partially surrounded by pockets of residential and commercial development, these demands would continue to increase. The natural vegetation and landscape would be disturbed, in many instances, by requests for new shoreline use permits. The reduction of LDA to only 3.0 shoreline miles keeps the aesthetic qualities of the lake at a high level.

5.12 Cumulative Impacts

Cumulative impacts are those that may result from the incremental impact of the evaluated alternatives added to those of other past, present, or reasonably foreseeable future actions in the local area. The Shoreline Management Plan for Greers Ferry Lake was last approved in 2004. During the time that has elapsed public use patterns have remained similar, but trends, facility and service demands have shifted due to the need for alternative experiences in recreation and tourism. Visitation to the lake has remained fairly constant from 2013 to 2016, averaging approximately 1.9 million visitors per year; however, the demand for high quality recreational experiences remain. Greers Ferry Lake receives pressure for both private shoreline and public recreation use, resulting in management concerns regarding the overall sustainability of the lake. With public use at project facilities changing, reallocations of services at these facilities need to be addressed. Changes involving recreation area closures and improvements have occurred over the years to meet the evolving public use. In addition, cooperative agreements are being considered in order to operate and maintain facilities, which would reduce the financial burden on the tax payers. It should be noted that a water reallocation study is currently underway at Greers Ferry Lake for municipal and industrial water supply; impacts to the overall missions of Greers Ferry Lake are considered not significant for a conservation pool reallocation.

The scoping process, which was a cumulative exercise involving private and public entities, and local, state and federal agencies, primarily generated comments related to specific permitting requests. Other comments included a desire for more docks on the lake, keep the lake the way it is, and removal of invasive species. Some stressed maintenance of the environmental setting around the lake. Preservation of the natural shoreline and lack of extensive development has enhanced and maintained good water quality since the lake was constructed. There were also comments that included a need for adequate parking at boat launch ramps (public accessibility), some additional commercial development (expand

existing services at current restaurants and/or new restaurants), and updating USACE campgrounds (trails, restrooms/showers, electric/water service at campsites, etc.).

Existing conditions at the lake allow for some continued development around the lake, but it should be noted that reallocation of lands under the Preferred Alternative would enhance water quality by reducing available PRA shoreline miles by 5.7% from the No Action Alternative. Approximately 83.5% of the linear shoreline would have a natural vegetated shoreline due to these land reallocations identified in the Preferred Alternative. There would be insignificant impacts to climate, topography, geology and soils under this alternative. The aquatic environment of the lake should benefit from a potential reduction in storm water runoff velocity, reduced sedimentation, improved water quality, and a cleaner substrate for macroinvertebrate production and fish spawning activity. This alternative would also enhance wildlife foraging and movement patterns, offer more protection for threatened and endangered species that inhabit the area, and result in minimal impacts to cultural resources. A provision for additional potential development opportunities coupled with an abundance of lands remaining in their natural condition would balance and enhance recreational experiences, which would potentially stimulate the socio-economics of the area. This balanced approach should provide a safe and aesthetically pleasing recreational experience for the public that visits and/or lives at Greers Ferry Lake.

Continued collaboration and coordination with state and federal resource agencies, as well as local agencies and watershed groups, is necessary to monitor, evaluate and remediate aging infrastructure, failing septic systems around the shoreline, and potential water quality impacts. Coordination with these entities could also evaluate and promote watershed enhancement programs that would serve to institute stream bank stabilization, land improvement and conservation programs, and implementation of best management practices to reduce watershed runoff and erosion.

As management of Greers Ferry Lake ensues, USACE would continue to coordinate with Federal, state, and local agencies to avoid, minimize, or mitigate potential impacts.

6.0 ENVIRONMENTAL COMPLIANCE

Compliance with Federal Acts and Executive Orders are summarized in the following table.

Act/Executive Order	Status	Compliance
Wetlands (EO 11990)	No effect	C
Prime/Unique Farmlands	No effect	CA
Floodplain Management (EO 11988)	No effect	C
Clean Water Act		
Section 404	No effect	N/A
Section 401	No effect	N/A
NPDES	No effect	C
Fish and Wildlife Coordination Act	No effect	C
Endangered Species Act	No effect	C
National Historic Preservation Act	No effect	C
Environmental Justice (EO 12898)	No effect	C
Clean Air Act	No effect	C
Comprehensive Environmental Response Compensation and Liability Act (CERCLA)	N/A	N/A
Resource Conservation and Recovery Act (RCRA)	N/A	N/A
Wild and Scenic Rivers Act	N/A	N/A
Rivers and Harbors Act	N/A	N/A
N/A—not applicable C--Compliant		

Table 6: Federal Act/Executive Order Compliance

6.1 Fish and Wildlife Coordination Act

USACE is required to coordinate with the USFWS and AGFC under the Fish and Wildlife Coordination Act (FWCA) (48 Stat. 401, as amended; 16 USC 661 et. seq.). Coordination was initiated with a scoping notice; no concerns were raised by these agencies during Scoping. Notification for the draft release and subsequent public review and comment period will allow opportunity for any agency to comment on the draft *Greers Ferry Lake Shoreline Management Plan* and draft EA.

6.2 Endangered Species Act

The Endangered Species Act (ESA) requires the determination of possible effects on species or degradation of habitat critical to Federally-listed endangered or threatened species. Implementation of an updated *Greers Ferry Lake Shoreline Management Plan* is not likely to affect threatened or endangered species. Individual requests for use of project lands would be evaluated to ensure compliance with this Act.

6.3 Environmental Justice

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations* requires Federal agencies to promote "nondiscrimination in Federal programs substantially affecting human health and environment". In response to this directive, Federal Agencies must identify and address a disproportionately high and adverse human health and environmental effects of their programs, policies, and activities on minority and low-income populations. The final step in the environmental justice

evaluation process is to evaluate the impact of the project on the population and to ascertain whether target populations are affected more adversely than other residents.

Implementing the 2020 *Greers Ferry Lake Shoreline Management Plan* would not disproportionately affect minority or low-income populations.

6.4 Cultural Resource Requirement

Section 106 of the National Historic Preservation Act of 1966 requires USACE to identify historic properties affected by the Selected Alternative and to evaluate the eligibility of those properties for the National Register of Historic Places. Section 110 of the Act requires the USACE to assume responsibility for the preservation of historic properties in its ownership. The Act also requires Federal agencies to provide the Advisory Council on Historic Preservation an opportunity to comment on undertakings through the process outlined in the Council's regulations (36 CFR 800).

There would be no effect on cultural resources with implementation of an updated 2020 *Greers Ferry Lake Shoreline Management Plan*. Individual requests for use of project lands would be evaluated on a case-by-case basis to ensure compliance with this act.

7.0 Scoping and Public Concern

7.1 Introduction

No single agency has complete oversight of stewardship activities on the public lands and waters surrounding Greers Ferry Lake. Responsibility for natural resource and recreation management falls to several agencies that own or have jurisdiction over these public lands and waters.

Increasingly, competition for the use of these lands and waters and their natural resources can create conflicts and concerns among stakeholders. The need to coordinate a cooperative approach to protect and sustain these resources is compelling. Many opportunities exist to increase the effectiveness of Federal programs through collaboration among agencies and to facilitate the process of partnering between government and non-government agencies. To sustain healthy and productive public lands and water with the most efficient approach requires individuals and organizations to recognize their unique ability to contribute to commonly held goals. The key to progress is building on the strengths of each sector, achieving goals collectively that could not be reasonably achieved individually. Given the inter- jurisdictional nature of Greers Ferry Lake, partnering opportunities exist and can promote the leveraging of limited financial and human resources. Partnering and identification of innovative approaches to deliver justified levels of service defuse polarization among interest groups, and lead to a common understanding and appreciation of individual roles, priorities, and responsibilities.

To the extent practical, the draft 2020 *Greers Ferry Lake Shoreline Management Plan* and a proactive approach to partnering would position Greers Ferry Lake to aggressively leverage project financial capability and human resources in order to identify and satisfy customer expectations, protect and sustain natural and cultural resources and recreational infrastructure, and programmatically bring USACE management efforts and outputs up to a justified level of service. Public involvement and extensive coordination within USACE and with other affected agencies and organizations is a critical feature required in developing or revising the 2004 Shoreline Management Plan.

Agency and public involvement and coordination have been a key element in every phase of the 2020 *Greers Ferry Lake Shoreline Management Plan* revision.

7.2 Scoping

One agency and two public scoping workshops were held on August 22, and August 23, 2019 with 46 members of the public registering their attendance.

A Scoping Report for the 2020 *Greers Ferry Lake Shoreline Management Plan* process was finalized in September 2019. The report summarizes the public participation process for, and the public comments resulting from, the *Greers Ferry Lake Shoreline Management Plan* revision public scoping workshops and comment period. “Scoping” is the process of determining the scope, focus, and content of a NEPA document. Scoping workshops are a useful tool to obtain information from the public and governmental agencies. For a planning process such as the 2020 *Greers Ferry Lake Shoreline Management Plan* revision, the scoping process was also used as an opportunity to get input from the public and agencies about the

vision for the 2020 *Greers Ferry Lake Shoreline Management Plan* update and the issues that the 2020 *Greers Ferry Lake Shoreline Management Plan* should address where possible. The Scoping Report is located on the *Greers Ferry Lake Shoreline Management Plan* website, https://www.swl.usace.army.mil/Missions/Planning/Greers-Ferry-Lake-Shoreline-Management-Plan/.

7.3 Draft 2020 Shoreline Management Plan/Draft Environmental Assessment.

The Draft Shoreline Management Plan/Draft Environmental Assessment is on schedule to be released to the public February 2020. A public review period and second round of public workshops will be held to collect comments on the draft documents.

7.4 Final 2020 Shoreline Management Plan/Final EA.

The Final Shoreline Management Plan and EA will be completed in summer 2020, with public workshops currently scheduled in July 2020.

Public workshop format will be similar to the Scoping and Draft Release workshops; however, no comments will be accepted as the plan is final.

8.0 Conclusions

The Shoreline Management Plan for Greers Ferry Lake was last approved in 2004; this was followed by multiple supplements over the last 15 years. During that time, public use patterns have remained similar, but trends, facility and service demands have shifted due to the need for alternative experiences in recreation and tourism. Visitation to the lake has remained fairly constant from 2013 to 2016; however, the demand for high quality recreational experiences remain. Greers Ferry Lake receives pressure for both private shoreline and public recreation use, resulting in management concerns regarding the overall sustainability of the lake. With public use at project facilities changing, reallocations of services at these facilities need to be addressed. Changes involving recreation area closures and improvements have occurred during the last four decades to meet the evolving public use. In addition, cooperative agreements are being considered in order to operate and maintain facilities, which would reduce the financial burden on the tax payers.

The Shoreline Management Plan is not intended to address the specifics of regional water quality or water level management; these areas are covered in a project's water management plan. However, specific issues identified through the Shoreline Management Plan revision process can still be communicated and coordinated with the appropriate internal USACE resource (i.e. Operations for shoreline management) or external resource agency (i.e. Arkansas Dept. of Environmental Quality for water quality) responsible for that specific area. To facilitate this action, the current Shoreline Management Plan development evaluated three alternatives relative to their potential impacts on the land and water resources of Greers Ferry Lake.

These alternatives spanned the gamut of increased shoreline protection to increased shoreline development and the potential effects on the human, terrestrial, and aquatic environment from their implementation. A No Action Alternative examined leaving the lake as it currently exists in terms of developable areas and protected areas. Of the 306.3 acres of available land around the lake, 21.3% of this is allocated as LDA and PRA, with potential future development occurring.

The action alternatives included a Preferred Alternative and a Conservative Alternative. The Preferred Alternative shifted the majority of the available shoreline acreage to a PSA, with 83.5% of the shoreline in this category. Potential effects from this would be decreased vegetation removal and a reduction in soil erosion due to the retention of natural vegetation around most of the lakeshore. The Preferred alternative seeks to balance all components of lake usage, including the provision for growth and recreation potential, while protecting and preserving terrestrial and aquatic resources. The Conservative Alternative further reduces the LDA to 3.0 miles, occupying only 1.0% of the shoreline, but increases PRA lands to 17.2%. PSA in this alternative constitute 80.3% of the shoreline, which also enhances shoreline vegetation preservation, reduces stormwater runoff quantity and velocity, which results in less in-lake sedimentation and turbidity, and improves water quality. The action alternatives have the potential to improve health and safety issues, aesthetics, terrestrial and aquatic wildlife habitat.

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