US Army Corps of Engineers

Little Rock District

Draft Environmental Assessment

Greers Ferry Lake
Master Plan Revision
February 2019

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GREERS FERRY LAKE
MASTER PLAN REVISION
ENVIRONMENTAL ASSESSMENT

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MASTER PLAN REVISION
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1.0 INTRODUCTION

The Master Plan is the strategic land use document that guides the comprehensive management and development of all recreational, natural, and cultural resources throughout the life of the water resource project. The Master Plan guides the efficient and cost-effective management, development, and use of project lands. It is a vital tool for the responsible stewardship and sustainability of project resources for the benefit of present and future generations.

The Master Plan guides and articulates Corps' responsibilities pursuant to Federal laws to preserve, conserve, restore, maintain, manage, and develop the project's lands, waters, and associated resources. The Master Plan is a dynamic operational document projecting what could and should happen over the life of the project and is intended to be flexible to respond to changing conditions. The Master Plan deals in concepts, not in details, of design or administration. Detailed management and administration functions are addressed in the Operational Management Plan (OMP), which implements the concepts of the Master Plan into operational actions.

Master Plans are required to be developed and kept current for Civil Works projects operated and maintained by the Corps and they include all land (fee, easements, or other interests) originally acquired for the projects and any subsequent land (fee, easements, or other interests) acquired to support the operations and authorized missions of the project.

The Master Plan is not intended to address the specifics of regional water quality, shoreline management, or water level management; these areas are covered in the project’s updated shoreline management plan. However, specific issues identified through the Master Plan revision process can still be communicated and coordinated with the appropriate internal Corps resource (i.e. Operations for shoreline management) or external resource agency (i.e. Arkansas Department of Environmental Quality-water quality) responsible for that specific area.

The revised Master Plan updates Design Memorandum No. 19-5, Updated Master Plan for Development and Management of Greers Ferry Lake (USACE 1976).

With the Master Plan revision, an Environmental Assessment (EA) was completed to evaluate 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 CFR,1500–1517), and the Corps implementing regulation, Policy and Procedures for Implementing NEPA, Engineer Regulation (ER) 200-2-2 (1988).

2.0 PURPOSE AND NEED FOR ACTION

2.1 Purpose and Need

The Greers Ferry Lake Master Plan is the required USACE approval document (ER 1130-2-550, Chapter 3) that guides all use and development on the project's more than 40,000 acres of Federal public lands and waters for environmental stewardship and recreation related purposes, throughout the life of the project. Greers Ferry Lake's Master Plan was last updated in 1976, and it is now out of date.

The need for the proposed action is based on the age of the current plan and the changed conditions around the lake and in lake use. The preliminary Master Plan for Greers Ferry Lake was approved in December 1961 and an updated Master Plan was approved in August 1968. The last update to the Master Plan was completed in 1976. There are currently 27 supplements to the 1976 Master Plan. From 1976 to the present, public use patterns have remained similar, but trends, facility and service demands have shifted in the past 41 years due to the increase in visitation and tourism. Greers Ferry Lake incurs recreation pressure for both private shoreline and public recreation use, resulting in environmental and management issues, which cause sustainability concerns. Over the last four decades, the existing plan format and mapping technology has become outdated and is not compliant with current Master Plan format and current Corps policies/regulations, budget processes, business line performance measures, and priorities are not reflected in the existing Master Plan.

2.2 Project History

Greers Ferry Lake is a multiple purpose water resource development project initially authorized for flood control, hydropower generation and other beneficial uses by the Flood Control Act dated 3 September 1954. The inclusion of storage in the lake for municipal and industrial water supply was authorized by the Water Supply Act of 1958. 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 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 at 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 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 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 many years ago 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 mean sea level), the water area comprises 31,207 acres and 306 miles of shoreline. The shoreline is irregular with topography ranging from steep bluffs to gentle slopes. .

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. There are 18 public use areas around Greers Ferry Lake. There are 18 recreation areas on the lake; 15 are presently operated by the Corps of Engineers. Three public use areas are currently leased to others: Eden Isle, Fairfield Bay, and Sandy Beach.

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*	

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3.0 ALTERNATIVES

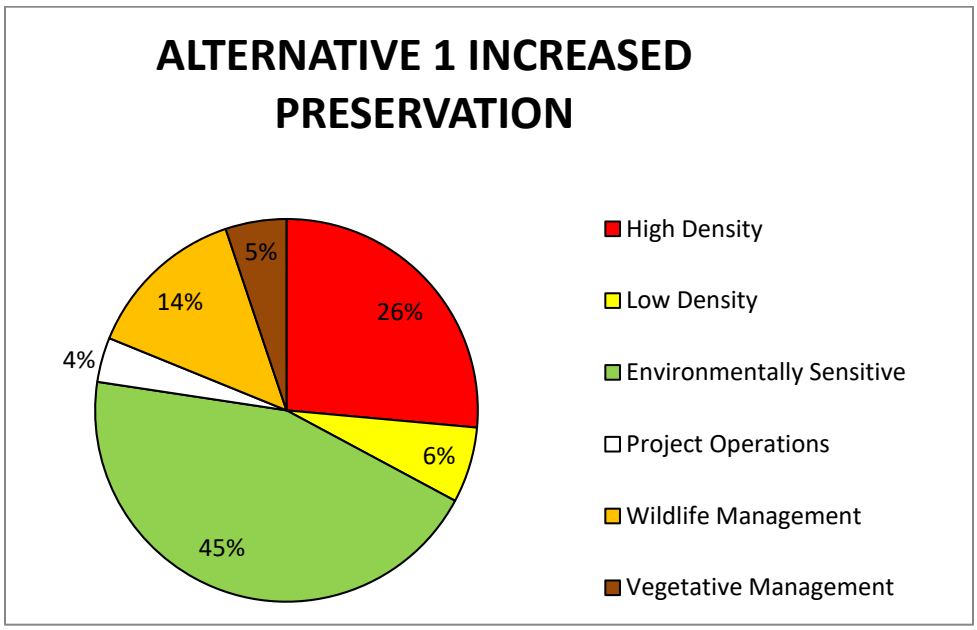
Alternatives evaluated in this EA are depicted in Table 3.1, and in Figure 3.1. The alternatives include: Alternative 1 (Increased Preservation); Alternative 2 (Current Management/Increased Conservation - Preferred); Alternative 3 (No Action); and Alternative 4 (Increased Development). A complete set of maps for each alternative is located in an appendix to this document.

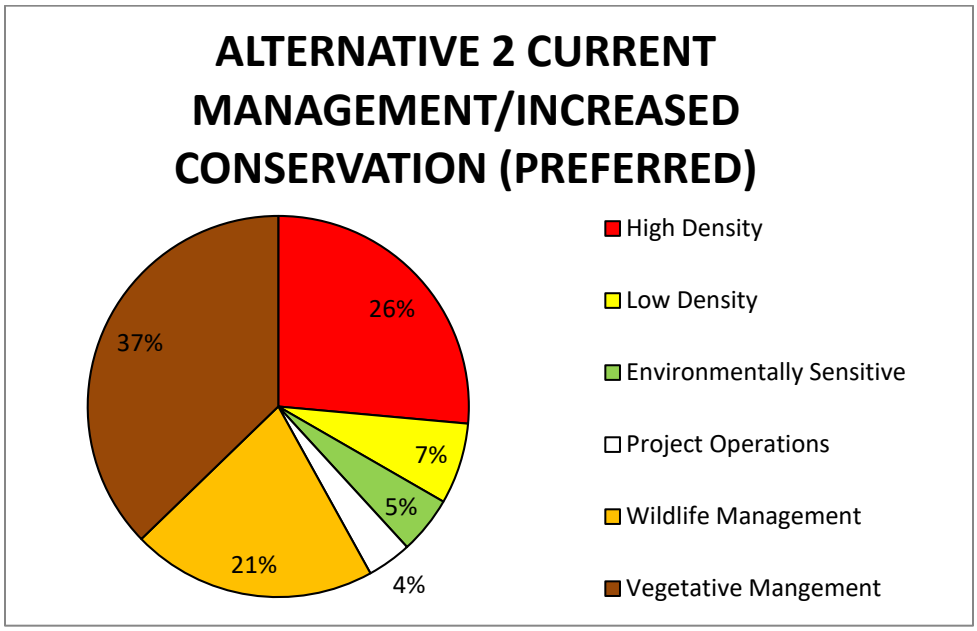
In this EA development, the different alternatives are compared to the No Action Alternative in order to evaluate potential positive and negative effects on the natural and human environment based on the various shoreline acreage classifications determined by each action alternative. All evaluated alternatives 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 updated Master 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.

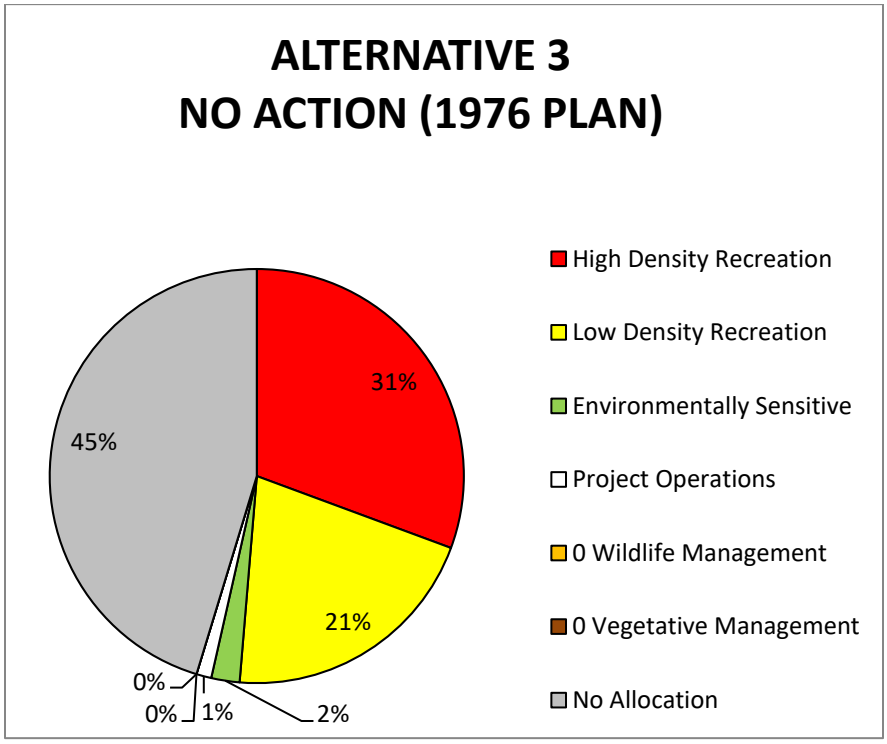
Table 3.1 Comparison of Land Classifications by Alternative

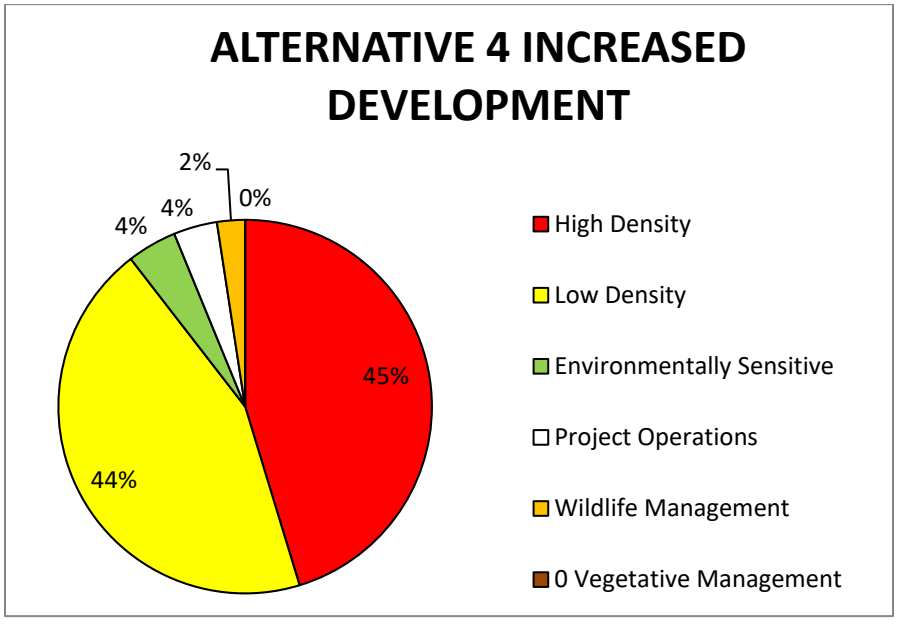
Land Classification	Alternative 1 Increased Preservation		Alternative 2 Current Management/Increased Conservation - Preferred		Alternative 3 No Action		Alternative 4 Increased Development	
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
High Density	2,645.2	26%	2,645.2	26%	3,066.1	31%	4,531.7	45%
Low Density	640.6	6%	688.8	7%	2,069.5	21%	4,424.6	44%
Environmentally Sensitive	4,457.0	45%	487.6	5%	221.1	2%	429.6	4%
Project Operations	377.3	4%	377.3	4%	117.1	1%	377.3	4%
Wildlife Management	1,370.3	14%	2,080.7	21%	0	0%	242.4	2%
Vegetative Management	515.3	5%	3,726.0	37%	0.0	0%	0.0	0%
Not Allocated	0	0%	0.0	0%	4,532.0	45%	0.0	0%

Figure 3.1 Pie Charts for Percentage of Land Classifications for Each Alternative.






ALTERNATIVE 3
NO ACTION (1976 PLAN)
31%
21%
2%
1%
0%
0%
45%
High Density Recreation
Low Density Recreation
Environmentally Sensitive
Project Operations
0 Wildlife Management
0 Vegetative Management
No Allocation


ALTERNATIVE 4 INCREASED DEVELOPMENT
45%
44%
4%
4%
2%
0%
High Density
Low Density
Environmentally Sensitive
Project Operations
Wildlife Management
0 Vegetative Management

3.1 Increased Preservation (Alternative 1)

Under the Increased Preservation Alternative 2,645.2 acres, representing 26% of the shoreline, are classified as High Density lands. This represents a 4% reduction from the High Density acreage in the No Action Alternative. The 2,069.7 acres of Low Density lands in the No Action Alternative have been reduced by 1,429.2 acres to 640.6 acres, representing 6% of the shoreline. Environmentally Sensitive lands was increased to 4,457.3 acres (45%). Wildlife Management lands are increased from 0 acres in the No Action Alternative to 1,370.3 acres in this alternative (14%). Vegetative Management lands also increased from no classified acreage in the No Action to 515.3 acres (5%) in this alternative. Project Operation lands total 377.3 acres (4%) under this alternative.

3.2 Current Management/Increased Conservation – Preferred (Alternative 2)

Changes from Alternative 3 (No Action) to Alternative 2 increases resource protection by classifying 4,531.9 acres of unallocated land, primarily to Wildlife Management and Vegetative Management classifications. Low Density lands are reduced to 688.8 acres, representing 7% of available shoreline. High Density lands are reduced to 2,645.2 acres 26% of the shoreline. Environmentally Sensitive lands are increased to 487.6 acres (5%), while Wildlife Management lands total 2,080.7 acres, comprising 21% of the shoreline acreage. Project Operation lands total 377.3 acres (4%). Vegetative Management acreage totaled 3,726.3 acres (37%), representing the largest acreage classification under this alternative.

3.3 No Action (Alternative 3)

The No Action Alternative land classification, which is based on the 1976 master plan, does not accurately reflect the land use activities or resource management of the lake. In addition, this alternative does not address resource management laws, policies, and regulations that were implemented after the 1976 Greers Ferry Lake Master Plan.

Under the No Action Alternative, the 1976 Master Plan land use classifications will remain the same and none of the 9,821.8 acres of land around the lake will be reclassified. This includes the current 4,531.9 acres that is currently unallocated. This alternative will continue to allow for increased land and water based impacts within the Low Density land classification.

3.4 Increased Development (Alternative 4)

Changes from Alternative 3 (No Action) to Alternative 4 increases potential resource impacts by classifying 4,531.9 acres of unallocated land mainly to High and Low Density land classifications. This alternative will continue to allow for increased land and water based impacts within the proposed 4,424.9 acres (44%) of Low Density land classification. There is also a potential increase in lake activity from the increase in High Density acreage totaling 4,531.7 acres (45%).

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 Counties. 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, 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; 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; Higden, which is immediately above the Narrows; and 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 lake is divided into two distinct water bodies connected by a straight, deep channel called the Narrows. This connection is 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 about 25 miles. The average width of the Upper Lake is 0.66 mile. The area of the lake south of the Narrows, termed the Lower Lake for this report, 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 narrower moving east. This narrow 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.

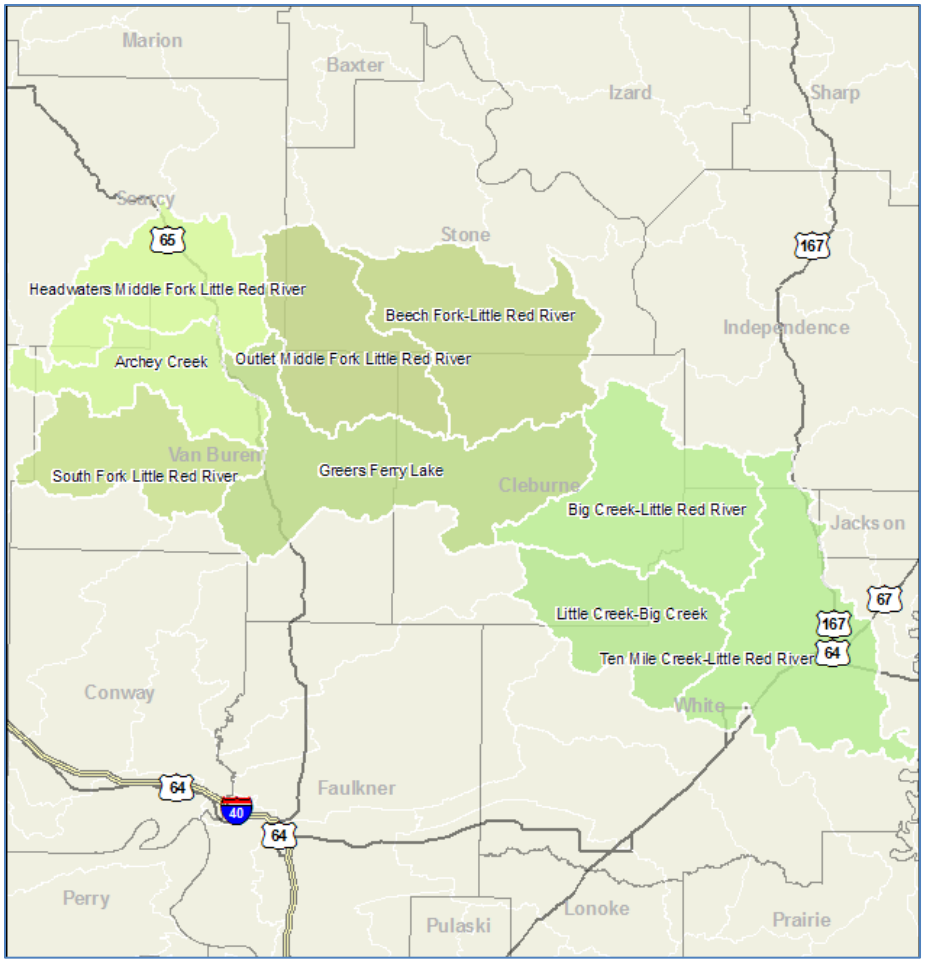


Figure 4.1: Little Red River Watershed

4.2 Climate

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. Similarly, January is the coolest month, with an average temperature of 37.3°F. Daily lows in the 20's is not uncommon, however.

The Study Area receives approximately 51 inches of rain, with November and August typically recording the most and least, 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 (http://www.globalchange.gov/publications/reports/scientific-assessments/us-impacts). 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 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, and Soils

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 above sea level 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 2-1/4 miles from the dam, Round Mountain peaks at elevation 918 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 feet, 533 feet and 427 feet 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.

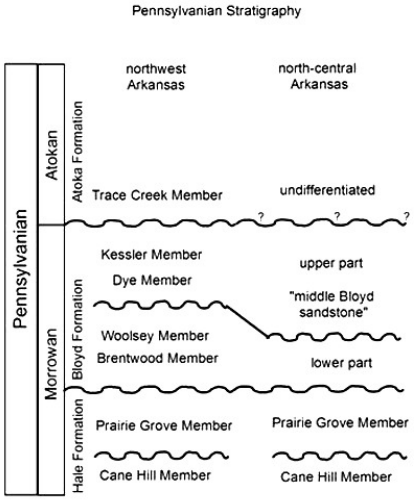


Figure 4.2 Geologic Column

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

[1] "Pennsylvanian," AGS, Little Rock, AR, 5 June 2015, http://www.geology.ar.gov/geology/ozark_pennsylvanian.htm

emplacement of concrete structures, and all of the foundation rock on which concrete was placed was of the Bloyd and Hale Formations.

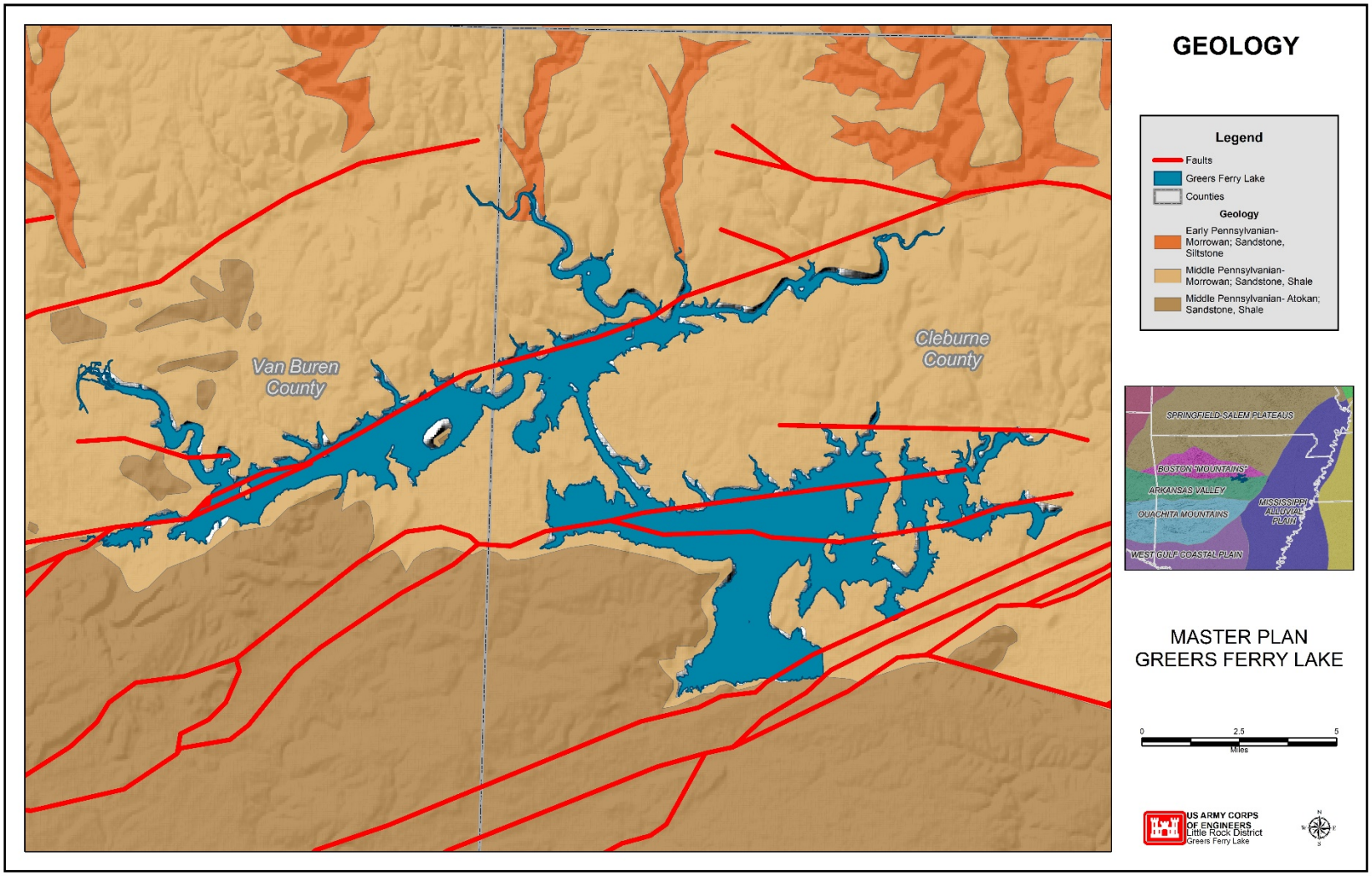


Figure 4.3 Geology of Greers Ferry Lake Watershed

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 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 load reflect the immediate Upper and Lower Lake watersheds (adjacent land uses, marina development).
- Permitted point source discharges to the tributaries and Greers Ferry Lake (10 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, 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 (ADEQ 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).

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 black bass, sunfish, catfish, walleye, and white and 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 4.1 lists fish species documented as occurring in Greers Ferry Lake and its tributaries.

Table 4.1: 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 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 said that the best spawns on Greers Ferry Lake take place during high water years when terrestrial vegetation is flooded for an extended period. 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 is 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, squirrels, turkey, doves, rabbits, 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 4.2 provides a partial list of common bird and mammal species known to occur around Greers Ferry Lake.

Table 4.1: 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 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 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 mephitis*	Bobcat	*Felis rufus*

4.5.2 Vegetation

Vegetation around Greers Ferry Lake can be most 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.

Lake 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 (*Salix*

nigra), 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.

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 U.S.C. 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 District consulted the Arkansas Ecological Services Field Office of the U.S. Fish and Wildlife Service (FWS) on July 29, 2015 and obtained a list of potential threatened and endangered species in the Greers Ferry Lake Project area (Table 4.3). The District also consulted the FWS IPaC website to obtain a list of species.

Table 4.3: 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	*Lampsilis abrupta*	Endangered
Rabbitsfoot	*Quadrula cylindrica cylindrica*	Threatened
Speckled Pocketbook	*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 (*Myotis grisescens*) 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 (USFWS 2017). Gray bats are likely to forage near lake tributary streams and wooded lake shores, but its use of specific lakeshore habitats is unknown.

Northern Long-eared Bat

The northern long-eared bat (*Myotis septentrionalis*) 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, *Myotis*, which are actually bats noted for their small ears (*Myotis* means mouse-eared). 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 6-100 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 6.4 cm (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 (Robison and Buchanan 1988).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

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

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 FWS 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

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 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).

The Arkansas Natural Heritage Commission database lists 55 Species of Conservation Concern occurring within 5 miles of the Corps of Engineers boundary surrounding Greers Ferry Lake (Table 4.4). 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.

Table 4.4: 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 pocketbook	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
✓	*Quadrula cylindrica 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 mussel	-	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 pipewort	-	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 &		-	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

✓- These elements have been recorded within a five-mile radius of the Greers Ferry Lake 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) 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. Project 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.

4.7 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).

Culture 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 Arkansas State Historic Preservation Officer (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 done. Until this is done, and it is determined what BSO's 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 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 349 good days and 16 moderate days of air quality in 2016.

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.[2] Twenty one percent

[1]U.S. Army Corps of Engineers, Little Rock District. “Recreational Carrying Capacity Study for Greers Ferry Lake.” Prepared by Tetra Tech, November 2001.

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 4.5 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 a 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 4.5
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 4.6 and 4.7). 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, on the other hand, earn a decent living with average wages (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 4.8). 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.

Table 4.6
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

Table 4.7
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

Table 4.8
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 the Project must be considered in the context of the overall region. Guidance from the Council on Environmental Quality (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 4.9 displays 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 4.9 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 4.9
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

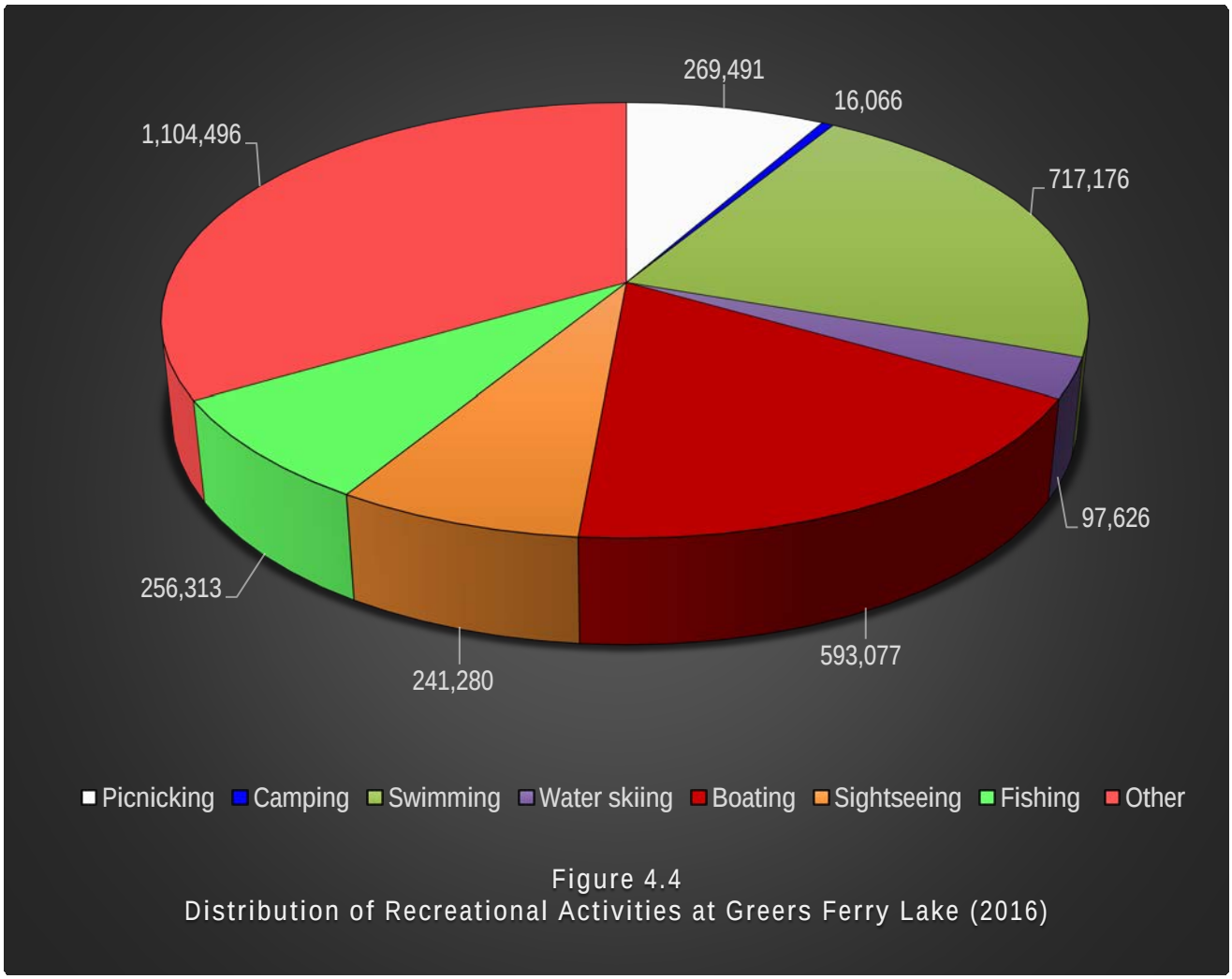
Greer Ferry Lake has a variety of recreational facilities (Table 4.10). Paved access roads wind through 18 recreation sites with 1,159 campsites. Other facilities include 11 swimming areas, 4 hiking trails, 27 boat launching ramps, sanitary dump stations, and picnic shelters. There are also numerous 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 and activities await the visitor, picnicking, hiking and sightseeing.

Table 4.10
Recreation Facilities at Greers Ferry Lake, Arkansas

Facilities	Number of sites
Recreation sites	18
Picnic sites	105
Camping sites	1159
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 4.11 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 the Corps changed the way it counts the number of visitors after 2012. Before 2012, a recreation “visit” to a Corps project was

defined as entry by one person to a Corps project for recreation for any length of time – 15 minutes to 14 days. After 2012, the Corps 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 Section 1.4 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 Corps projects is available through the Corps OMBIL web application from 2000 through 2016.

Table 4.11
Annual Number of Person Trips 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 Corps project was defined as the entry by one person to a Corps project for recreation for any length of time be it 15 minutes or 14 days. After 2012, the Corps 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.

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 4.12 shows historical trends for annual lake visitation, while Table 4.13 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, which may be due to the idea that in years where incomes are lower, people tend to forgo more costly out of state vacations, and opt for local or regional destinations. In other words, rather than taking the family to the Florida Keys and spending thousands of dollars, people go to Greers Ferry.

Table 4.12
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 4.13
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, GDP 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 UALR 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.

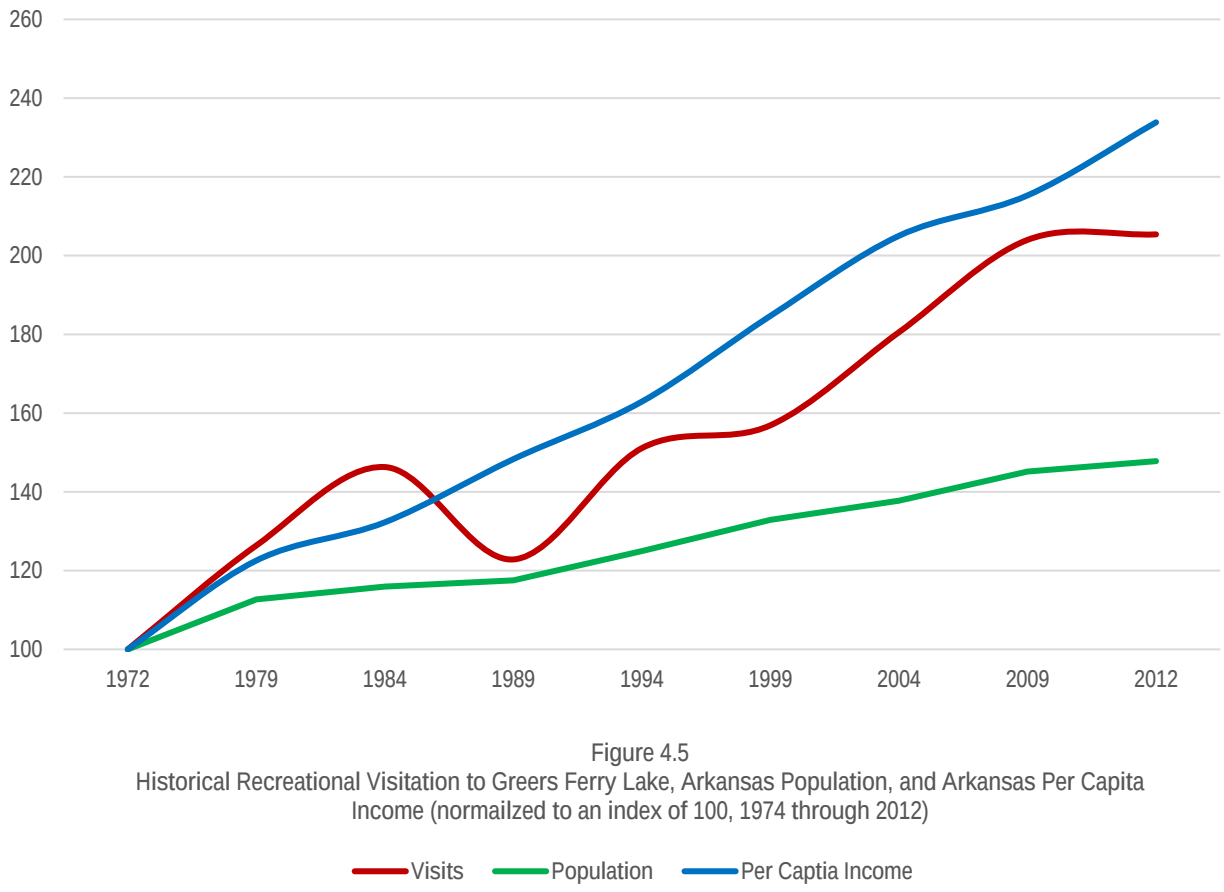


Figure 4.5
Historical Recreational Visitation to Greers Ferry Lake, Arkansas Population, and Arkansas Per Capita Income (normailzed to an index of 100, 1974 through 2012)

1

2

Table 4.14
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 dispersion of historical data from 1999 through 2000. Using deviation is 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 4.15 and Figure 4.7 displays 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).

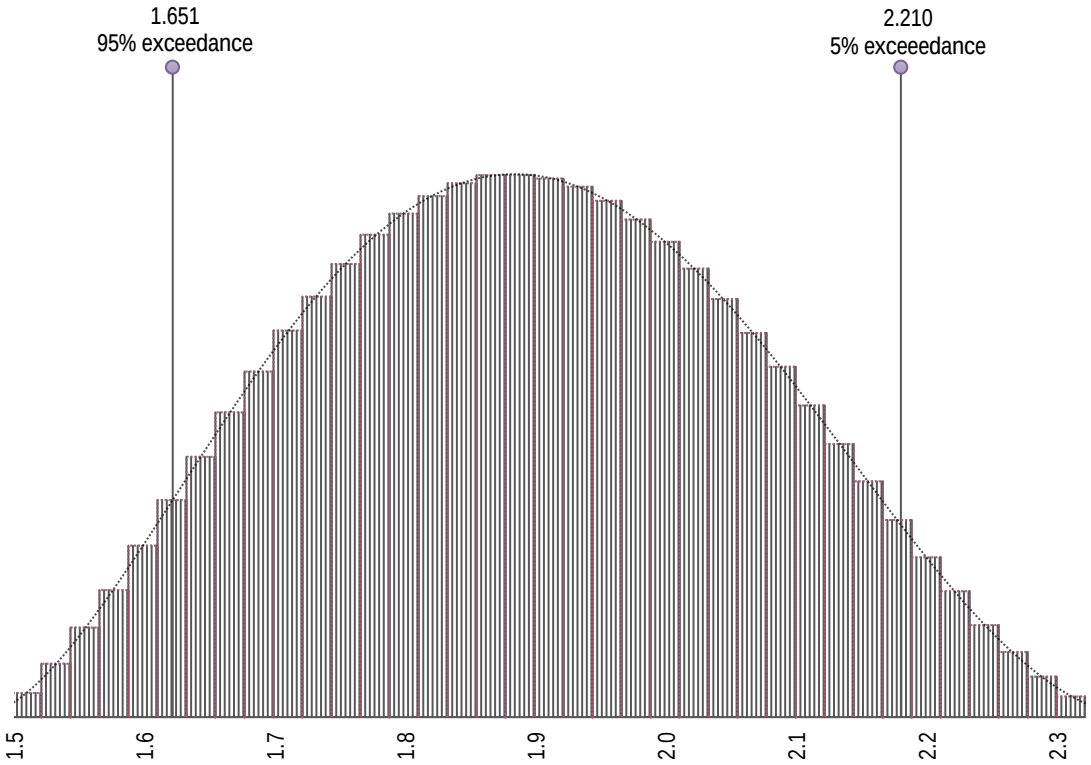


Figure 4.6
Simulation Results based on Beta Frequency Distribution for Variation in Historical Annual Visitation to Greers Ferry Lake (FY 1999-2013, millions of visitors)

Table 4.15
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

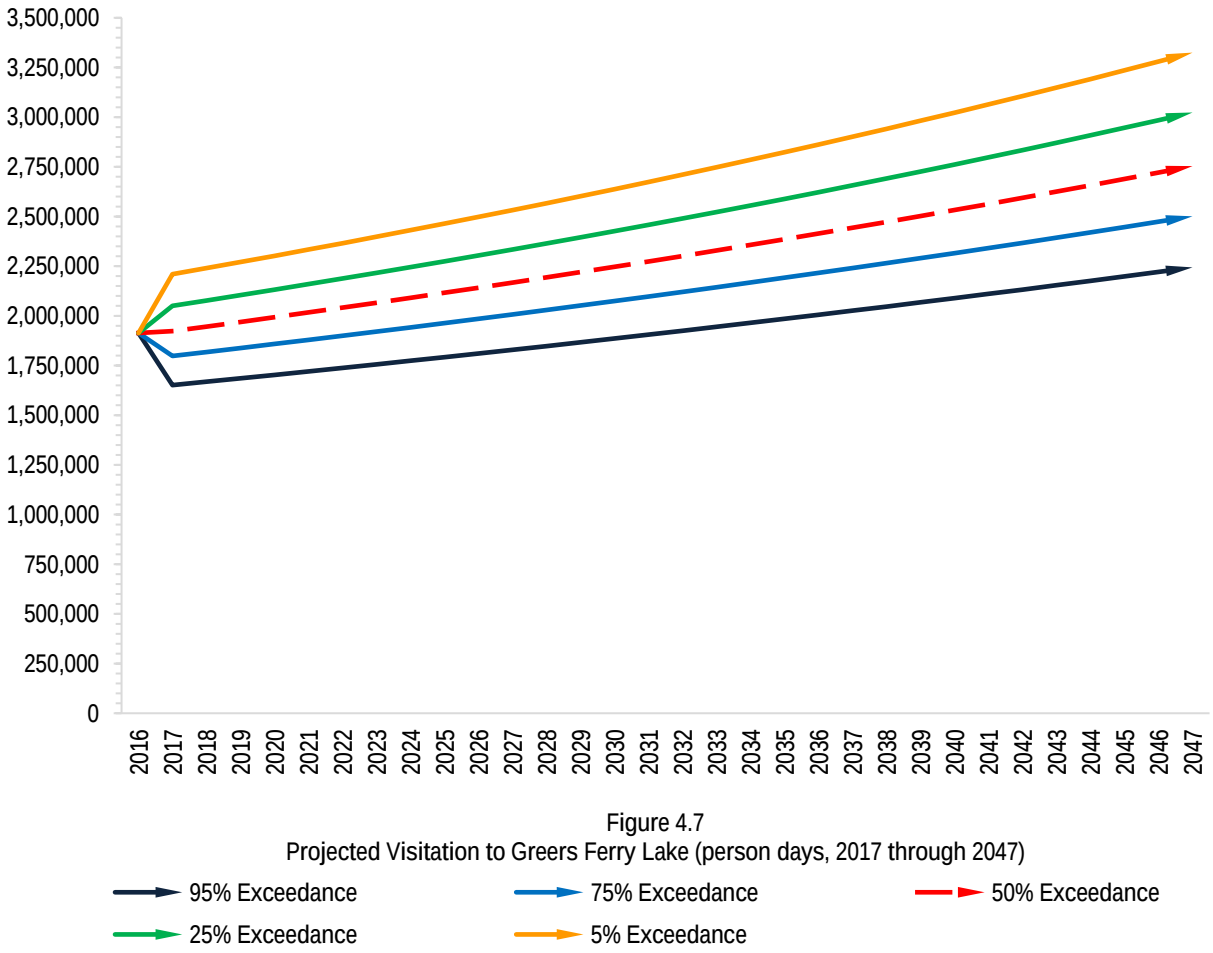


Figure 4.7
Projected Visitation to Greers Ferry Lake (person days, 2017 through 2047)

In terms of the distribution of activities such as boating versus camping, a comparison of historical figures and current data show some change (Table 4.16), 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 4.16
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 resource of Greers Ferry Lake Project is considered to be of great importance to Arkansas. The Corps of Engineers 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 eighteen designated recreation areas on Greers Ferry Lake, fifteen of which are operated by the Corps of Engineers. 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-six 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 the Corps of Engineers, 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 Corps 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 4.17: 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 4.18: 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 4.19 summarizes economic impact for Greers Ferry Lake.

Table 4.19: Economic Impact Greers Ferry Lake FY 12

Visitor spending within 30 Miles ($ thousands)	$243,908
Sales within 30 Miles ($ thousands)	$113,909
Jobs within 30 Miles	2,184
Labor Income within 30 Miles ($ thousands)	$43,855
Value Added within 30 Miles ($ thousands)	$69,161
Total Sales ($ thousands)	$164,296
Jobs Total	2,706
Labor Income ($ thousands)	$58,986
Value Added ($ thousands)(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.

In coordination with the Arkansas Game and Fish Commission, no wake zones are marked with buoys. 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 is 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 Master 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.

The Preferred Alternative is Alternative 2, the Current Management/Increased Conservation alternative. Lands were reclassified to reflect the current land use; portions of Low Density lands were reclassified to Vegetative Management and Wildlife Management lands. High Density lands total 2,645.2 acres; Low Density lands total 688.8 acres; Environmentally Sensitive Area lands total 487.6 acres; Wildlife Management lands total 2,080.7 acres; Project Operations lands total 377.3 acres; and Vegetative Management lands total 3,726.3 acres.

Under this alternative, High Density and Low Density acreage decreased and were primarily reclassified to Vegetative and Wildlife Management areas, which reflects current utilization of the adjoining lands. Additional acreage in these two classifications was due to classifying 4,531.9 acres of unallocated land from the 1976 SMP. Both the Vegetative Management and Wildlife Management classifications had zero acres in the 1976 plan.

Table 5.1 Resource Impact with Implementation of Alternatives

Resource Category	Alternative 1 Increased Preservation	Alternative 2 Current Management/Increased Conservation - Preferred	Alternative 3 No Action	Alternative 4 Increased Development
Climate, Topography, Geology and Soils	The Increased Preservation Alternative is the most protective of all alternatives in terms of potential impacts on climate, topography, geology, and soils due to 63% of shoreline with classifications that generally protect existing shoreline vegetation, including 45% in the Environmentally Sensitive classification.	The Preferred Alternative would have less potential impacts on climate, topography, geology and soils than the No Action Alternative due to a reduction in low density and high density acreage.	There would be a potentially negative impact on climate, topography and geology as a result of implementation of the No Action Alternative due to the potential for new development around the lake (31% high density, 21% low density). The largest land percentage (45%) is unallocated in this alternative and the potential exists for more development on these lands.	There would be a potentially negative impact on climate, topography and geology as a result of implementation of the Increased Development Alternative due to the potential for new development around the lake provided by a large proportion of Low and High Density designated lands, which would comprise 89% of available shoreline acres.
Aquatic Environment	The hydrology and groundwater components of Greers Ferry Lake would change from the existing condition due to the implementation of the Preservation Alternative. Water quality may be improved due to the reduction of 420.9 acres of High Density lands and 1,429.2 acres of Low Density lands, with corresponding reduced potential for new development.	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 reduced potential for new development from a reduction in High and Low density lands, and increased acreage in Vegetative and Wildlife Management lands due to classification of unallocated acreage.	The No Action Alternative could have a potential for negative impacts to the hydrology and groundwater components of the aquatic environment due to 52% of shoreline acreage consisting of High and Low Density lands, and 45% of shoreline having no allocation.	The Increased Development Alternative would result in the greatest negative impact on the hydrology and groundwater components of the aquatic environment due to 89% of shoreline acres consisting of High Density and Low Density land classifications. Potential development with vegetation removal would increase erosion and lake turbidity. A potential for diminished water quality would be more prevalent under this alternative due to the potential for continued shoreline development.

Resource Category	Alternative 1 Increased Preservation	Alternative 2 Current Management/Increased Conservation - Preferred	Alternative 3 No Action	Alternative 4 Increased Development
Terrestrial Resources	The Increased Conservation Alternative would have the greatest positive impact on the lakeside terrestrial resources of all the alternatives evaluated due to a reduction in both High Density and Low Density lands and a 45% increase in Environmentally Sensitive lands, with a reduced potential for new development.	Implementation of the Preferred Alternative would have a positive impact on terrestrial resources in comparison to the No Action Alternative. Due to a small increase in Environmentally Sensitive lands, and a 58% combined increase Wildlife Management and Vegetative Management lands, this would have a positive benefit to the terrestrial resources around the lake.	Implementation of the No Action Alternative would have a potential for negative impact on terrestrial resources around the lake. Due to 31% of the lands classified as High Density and 21% as Low Density, as well as 45% of unallocated lands, the potential exists for additional shoreline development.	Under the Increased Development Alternative there is a large increase in both High Density and Low Density lands (45% and 44%, respectively). Based on this, the potential exists for continual degradation of shoreline vegetation due to probable increased development and subsequent vegetation removal/mowing activities.
Threatened & Endangered Species	The Preservation Alternative could have a significant positive impact on Threatened, Endangered, Protected, or Species of State Concern, due to the fact that this alternative would reduce High and Low Density lands, reducing the potential for future development. There would be positive effects on lakeside flora and fauna due to shoreline protection afforded by the 45% Environmentally Sensitive land classification.	The Preferred Alternative could have some positive impact on any listed Threatened, Endangered, Protected, or Species of State Concern. Due to the large increase in Vegetative Management and Wildlife Management lands, along with a reduction in High and Low Density lands, there may be some positive benefits to any or all the listed species.	The No Action Alternative could potentially have a negative impact on listed Threatened, Endangered, Protected, or Species of State Concern due to the 52% of High and Low Density lands combined, and the potential to develop the 45% of existing unallocated lands.	The Increased Development Alternative would likely have a significant negative impact on species listed as Threatened, Endangered, Protected, or Species of State Concern due to the preponderance of lands classified as High and Low Density (89% of available acreage). This classification would ultimately result in vegetation removal, soil disruption, increased rainfall runoff velocity, increased turbidity, elevated heat in both shoreline and in-lake due to vegetation removal, with associated reduction in shade.

Resource Category	Alternative 1 Increased Preservation	Alternative 2 Current Management/Increased Conservation - Preferred	Alternative 3 No Action	Alternative 4 Increased Development
Archaeological & Historic Resources	The Increased Preservation Alternative would have the highest potential to avoid and decrease impacts on cultural resource sites and historic properties compared to all the alternatives due to the reduction of Low Density acreage and the increase of Environmentally Sensitive lands from 2% in the No Action Alternative to 45% in this alternative.	The Preferred Alternative would potentially have little to no impacts on cultural resource sites or historic properties. There is a reduction in both High and Low density lands, with a corresponding increase in Vegetative Management and Wildlife Management lands which would enhance protection of these resources due to a reduction of land surface disruption activities.	The No Action Alternative would likely have potential negative impacts on cultural resources and historic properties due to the classification of 31% of available acres as High Density recreation, and 21% as Low Density lands. The existing 45% of unallocated lands, having a potential for development, would also potentially negatively impact cultural resources.	Under the Increased Development Alternative, the greatest potential for effects to cultural resources and historic properties would occur in the areas classified as Low Density and High Density, which comprise 89% of available shoreline acreage under this alternative.
Air Quality	Implementation of the Increased Preservation Alternative would have the greatest positive impact to air quality of all the evaluated alternatives due to the reduction of Low Density lands and the reclassification of 45% of available shoreline acreage as Environmentally Sensitive lands, thereby resulting in a decrease in future development.	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 classification of the 45% unallocated lands in the No Action Alternative primarily to Vegetative Management and Wildlife Management lands. This would result in 58% of shoreline acreage remaining primarily forested, thereby providing a potential decrease in future development.	Implementation of the No Action Alternative would result in the air quality around the lake remaining similar to currently existing air quality. There could be an increase in vehicular exhaust emissions due to 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.	Under the Increased Development Alternative, the air quality around the lake could potentially be negatively impacted due to development activity due to the classification of 89% of available acreage as High and Low Density lands. There would likely be an increase in vehicular exhaust emissions due to localized development, and associated construction equipment. Possible violations of the current National Ambient Air Quality Standards (NAAQS) established by the EPA would be expected under this alternative. .

Resource Category	Alternative 1 Increased Preservation	Alternative 2 Current Management/Increased Conservation - Preferred	Alternative 3 No Action	Alternative 4 Increased Development
Socio-economics	The Increased Preservation Alternative may have negative impacts on the socio-economic situation in the counties surrounding Greers Ferry Lake due to the reclassification most Low Density lands (1,429.2 acres) and all unallocated lands (4,531.9 acres) to Environmentally Sensitive, Wildlife Management, and Vegetative Management acreage.	The Preferred Alternative may have minimal negative impact on the socio-economic situation in the counties surrounding Greers Ferry Lake since this alternative reduces High Density lands by 420.9 acres and Low Density lands by 1,381.0 acres from the No Action Alternative.	The No Action Alternative may have some positive impact on the socio-economic situation in the counties surrounding Greers Ferry Lake due to the potential for future development in the Low Density, High Density and No Allocation lands.	The Increased Development Alternative would likely have positive impact on the socio-economic situation in the counties surrounding Greers Ferry Lake since this alternative proposes 45% of shoreline acreage as High Density and 44% as Low Density lands. This classification would greatly enhance the potential for future development around the lake.
Recreation Resources	Under the Increased Preservation Alternative, areas around Greers Ferry Lake would receive greater protection since all most Low Density lands and all unallocated lands would be reclassified as Environmentally Sensitive, Wildlife Management, and Vegetative Management lands. This may enhance the recreational experience for wildlife viewing, hunting, fishing, and lake aesthetics.	The Preferred Alternative would reclassify some High and Low Density acreage to Environmentally Sensitive and Wildlife Management lands. Implementation of this alternative would allow more recreation in the wildlife viewing, hiking, and hunting arena.	Provision of recreational facilities and services would continue at Greers Ferry Lake without an update to the Greers Ferry Lake Master Plan. However, the master plan would not accurately reflect the current status of project facilities. Lands with no allocation would remain unclassified.	The Increased Development Alternative would reclassify shoreline acreage to primarily High Density and Low Density lands. Implementation of this alternative would potentially result in increased public recreation use of the lakes' waters, while sacrificing shoreline vegetation, along with lost hunting, wildlife viewing, and aesthetic enjoyment potentially lost to increased development of the shoreline.

Resource Category	Alternative 1 Increased Preservation	Alternative 2 Current Management - Preferred	Alternative 3 No Action	Alternative 4 Increased Development
Health & Safety	The Increased Preservation Alternative would most likely promote a safer lake environment, by indirectly reducing boat traffic due to the conversion of 1,429.24 acres of Low Density lands and classification of 4,531.9 acres of unallocated lands primarily to Environmentally Sensitive. Recreational boating experiences and boater satisfaction may be impacted. Water quality may be positively impacted due to reduced development and a decrease in fuel and oil leakage.	The Preferred Alternative would still allow potential development opportunities, but not to the degree to cause significant boat congestion or increase water related accidents. The increase in Environmentally Sensitive, Vegetative Management and Wildlife Management areas could result in an 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 No Action Alternative could potentially allow development depending upon the fate of the current 4387.9 acres of unallocated lands. Possible significant boat congestion or increases water related accidents could be an outcome of this alternative.	The Increase Development Alternative would result in the majority of shoreline acreage (89%) being High and Low Density lands, in which potential development could impact water quality. Continued development may lead to increased water traffic, with the potential for increased accidents and pollution.
Aesthetics	Under the Increased Preservation Alternative, the conversion of Low Density lands and unallocated lands to primarily Environmentally Sensitive would enhance the unspoiled and untamed aesthetic appearance of the landscape. 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 addition of 2,080.7 acres of Wildlife Management lands, 3,726.34 acres of Vegetative Management, and 266.6 acres of Environmentally Sensitive lands 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 No Action Alternative the visual characteristics surrounding the Greers Ferry Lake landscape could potentially change due to continued development in the High Density, Low Density and No Allocation lands.	Under the Increased Development Alternative, the addition of 1,465.6 acres of High Density lands and 2,355.1 acres to Low Density lands, with associated potential development would continue to degrade the shoreline. This would disrupt the unspoiled and untamed aesthetic appearance of the landscape. A potential increase of boat traffic and crowding issues may result, which would detract from a pleasing aesthetic appearance on the water and along the shoreline.

5.1 Climate

5.1.1 Increased Preservation (Alternative 1)

The Increased Preservation Alternative is the most protective alternative in terms of potential impacts on climate. While this alternative retains 2,645.2 acres of High Density lands, 1,429.2 acres of the current 2,069.7 acres of Low Density lands were converted to either Environmentally Sensitive, Vegetative Management or Wildlife Management lands. The combination represents 63% of available acreage around the lake which protects the shoreline from vegetation modification. This reclassification would provide for the most vegetation protection, which could result in increased shade and improved climate conditions.

5.1.2 Current Management/Increased Conservation - Preferred (Alternative 2)

The Preferred Alternative is more protective than the No Action Alternative in terms of potential impacts on air and water temperature modification. A conversion of portions of both High Density and Low Density lands to Environmentally Sensitive, Vegetative Management, and Wildlife Management lands would reduce the potential for development, which reduces the potential impact on climate due to vegetation removal.

5.1.3 No Action (Alternative 3)

There could be some potential impact to climate as a result of implementation of the No Action alternative. Of the 10,005.9 total land acres, 5,135.8 acres are classified as either High Density or Low Density lands under this alternative. Unallocated lands total 4,531.9 acres (45% of shoreline), which could possibly be developed as well. This potential for development could modify the vegetation component near the shoreline, allowing more sunlight penetration. Greater temperature fluctuations generally occur when woody vegetation is removed from an area. Reduced ground cover could cause an increase in sedimentation during rainfall events, which could increase the turbidity of the water, resulting in a potential for a slight increase in water temperature.

5.1.4 Increased Development (Alternative 4)

The Increased Development Alternative may have the greatest potential to negatively impact air and water temperatures. A conversion of all unallocated lands in the No Action Alternative primarily to High Density (45%) and Low Density (44%) lands would increase the potential for development, which increases the potential impact on climate due to vegetation removal.

5.2 Topography, Geology and Soils

5.2.1 Increased Preservation (Alternative 1)

The Increased Preservation Alternative is different from the No Action Alternative in terms of potential impacts to topography, geology and soils. There would be less impact to the existing conditions regarding these features. High Density recreation acreage encompass 2,645.2 acres, representing 26% of the lake shore acreage, while the Low Density lands have been reduced to 640.6 acres, due to reclassification of 1,429.2 acres to Environmentally Sensitive lands. Under this alternative the combination of Environmentally Sensitive and Wildlife Management lands would represent 59% of available acreage around the lake. This alternative would have significant positive effects due to reduced erosion and lake sedimentation due to vegetation

retention. This additional buffer helps reduce storm water velocity and surface scour during storm events.

5.2.2 Current Management/Increased Conservation - Preferred (Alternative 2)

The Preferred Alternative is more restrictive than the No Action Alternative in terms of potential impacts to topography, geology and soils. There would be little to no change in impacts on the existing conditions regarding these features due to the fact that this alternative generally reflects current lake usage patterns. High Density Recreation acreage would be reduced from the No Action Alternative, to 2,645.2 acres, and the Low Density recreation acreage has been reduced to 688.8 acres. These lands would be reclassified to Vegetative Management and Wildlife Management lands, which provide more of a 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.

5.2.3 No-Action (Alternative 3)

The No Action Alternative could allow potential development on the 4,531.9 acres of No Allocation lands, and while there is fragmentation of this acreage around the shoreline, a major surge in development could have potential impacts on the topography, geology and soils. High Density recreation acreage comprises 31% of available shoreline (3,066.1 acres), while Low Density lands comprise an additional 21% (2,069.7 acres). The combination of High Density and Low Density recreation lands represents 52% of available acreage around the lake. With the majority of shoreline acres consisting of these classifications, some potential impacts from erosion and sedimentation would result from the implementation of this alternative.

5.2.4 Increased Development (Alternative 4)

The Increased Development Alternative is more liberal than the No Action Alternative in terms of potential impacts to topography, geology and soils. High Density acreage would be increased from the No Action Alternative to 4,531.7 acres and Low Density acreage has been increased from 2,069.7 to 4,424.9 acres. This has the potential to remove much of the vegetated lake buffer area, thereby increasing erosion and sediment deposition in the lake.

5.3 Aquatic Environment

5.3.1 Hydrology and Groundwater

5.3.1.1 Increased Preservation (Alternative 1)

The Increased Preservation Alternative is likely to be more protective than the No Action Alternative in terms of potential impact on the hydrology and groundwater components of the aquatic environment. The hydrology and groundwater conditions are generally controlled by the watershed drainage and existing geology of the area. Since 64% of the land is classified as Environmentally Sensitive, Wildlife Management, and Vegetative Management lands, rainfall would be much more likely to be absorbed, thereby replenishing the groundwater to a greater degree.

There would be little to no change in the wetland status from the existing condition due to implementation of the Conservative Alternative. Most of the limited wetland acreage has been identified in the lower reaches of the major tributary streams, therefore the limited High and

Low Density shoreline development along the main body of the lake would have little impact to this resource.

5.3.1.2 Current Management/Increased Conservation - 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. The hydrology and groundwater conditions are generally a function of the watershed drainage and existing geology of the area, but having 34% of the land classified as High and Low Density lands in this alternative, as compared to 52% in the No Action Alternative, as well as 61% more Environmentally Sensitive, Vegetative Management, and Wildlife Management lands, would enhance rainfall absorption and slow runoff velocity due to retention of shoreline vegetation.

5.3.1.3 No-Action (Alternative 3)

The No Action Alternative has the potential to negatively impact the hydrology and groundwater components of the aquatic environment due to potential development of the 4,531.9 acres of unallocated lands in this alternative. This, in conjunction with the 52% of existing High Density and Low Density acreage, would create the potential for more development, thereby decreasing rainfall absorption and increasing runoff velocity due to removal of additional shoreline vegetation.

5.3.1.4 Increased Development (Alternative 4)

The hydrology and groundwater components of Greers Ferry Lake may not substantially change from the No Action Alternative due to the implementation of a Increased Development Alternative. The potential for additional development under this alternative would have a higher level of certainty, based on the High Density lands comprising 45% of available acreage, and Low Density lands comprising 44%. This potential development would reduce percolation through the soil layers due to ground cover removal, and potentially increase storm water velocity, scour, and in-lake turbidity and sedimentation.

Wetland areas are relatively limited within Greers Ferry Lake and throughout the adjacent government property surrounding the lake, yet may be negatively impacted due to the implementation of this alternative.

5.3.2 Water Quality

5.3.2.1 Increased Preservation (Alternative 1)

Implementation of the Increased Preservation Alternative should result in positive benefits to water quality due to a reduction in both High Density and Low Density acreage by 420.9 and 1,429.2 acres respectively as compared to the No Action Alternative. There is a corresponding major increase in Environmentally Sensitive acreage, from 221.1 acres to 4,457.3 acres. These land reclassifications would serve to limit development on these lands, thereby reducing impacts to ground disturbance and subsequent increased erosion. Wildlife Management lands increased from 0 acres to 1,370.3 acres, constituting 14% of available shoreline acres. These factors would reduce erosion sedimentation and pollutants scoured from reduced impervious surfaces, with additional benefits of retention of more shoreline vegetation, better fishery habitat, increased water clarity and cooler water temperature conditions due to the decrease of turbidity and sediment deposition.

5.3.2.2 Current Management/Increased Conservation - Preferred (Alternative 2)

Implementation of the Preferred Alternative may result in positive benefits to water quality due to a reduction in both High Density and Low Density acreage by 420.9 and 1,381.0 acres respectively as compared to the No Action Alternative. There is an increase in Environmentally Sensitive acreage to 487.6 acres and a much larger gain in Vegetative Management, with 3,726.3 acres added to this land class. These land reclassifications would serve to limit development on these lands, thereby reducing impacts to ground disturbance and subsequent increased erosion. Wildlife Management lands increased from 0 acres to 2,080.7 acres as well. These factors would reduce erosion sedimentation and pollutants scoured from reduced impervious surfaces, with additional benefits of retention of more shoreline vegetation, better fishery habitat, increased water clarity and cooler water temperature conditions due to the decrease of turbidity and sediment deposition.

5.3.2.3 No-Action (Alternative 3)

Lake fluctuations, associated with power production and flood control procedures, causes change in the environment along the shoreline of the lake. Turbidity from heavy rainfall has a temporary, adverse effect on Greers Ferry Lake. During these periods of increased runoff, urban areas and other parts of the terrain, especially those that have had the protective vegetation removed, contribute silt and other suspended particles to the tributaries. 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 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, High Density recreation land classification would be 3,066.1 acres (31% of total available area), Low Density recreation lands would be 2,069.7 acres (21%), Environmentally Sensitive lands would include only 221.1 acres (2%), while 4,531.9 acres have no current classification. Based on the current classification, the potential exists for continual degradation of shoreline vegetation due to potential increased development and subsequent vegetation removal and mowing activities. This would result in negative impacts to water quality due to increased storm water velocity, scour and sedimentation.

5.3.2.4 Increased Development (Alternative 4)

Implementation of the Increased Development Alternative may result in the most negative benefits to water quality due to an increase in both High Density and Low Density acreage (totaling4,531.7 and 4,424.6 acres, respectively), as compared to the No Action Alternative. This additional acreage comes from the classification of the 4,387.9 acres of unallocated lands. These land reclassifications would serve to potentially increase development on these lands, thereby increasing impacts to ground disturbance and subsequent increased erosion. These factors would elevate erosion sedimentation and pollutants scoured from reduced impervious surfaces, with resulting degradation of fishery habitat, decreased water clarity and warmer water temperature conditions due to the increased turbidity and shade reduction.

5.3.3 Fish Species and Habitat

5.3.3.1 Increased Preservation (Alternative 1)

The Increased Preservation Alternative would enhance the fish resources in Greers Ferry Lake to the greatest degree of all evaluated alternatives. A comparison with the No Action Alternative shows a 420.9 acre reduction in High Density lands, and a reduction of 1,429.2 acres of Low

Density lands. The majority of the 4,531.9 acres of unallocated lands are being converted to Environmentally Sensitive lands, resulting in 4,457.3 acres comprising 45% of total shoreline. Along with the 1,370.3 acres of Wildlife Management lands and 515.3 acres of Vegetative Management lands in this alternative, 64% of the total shoreline acreage would retain its natural shoreline vegetation. Shoreline vegetation provides a buffer area that would attenuate storm water runoff, reduce scour and sedimentation, improve fish cover and spawning habitat, and provide a cleaner substrate for macro-invertebrate colonization, which improves the food supply for fish.

5.3.3.2 Current Management/Increased Conservation - Preferred (Alternative 2)

Implementation of the Preferred Alternative would have a positive effect on the lake fishery resource as compared to the No Action Alternative. There is a 1,381.0 acre reduction in Low Density recreation land classification, a 420.9 acre reduction in High Density lands, a 266.6 acre increase in Environmentally Sensitive lands classification and an increase in Wildlife Management lands from 0 acres to 2,080.7 acres, which results in 21% of available acreage classified as Wildlife Management lands. The largest change in classification is Vegetative Management lands, from 0 acres to 3,726.3 acres, representing 37% of the shoreline. The increases in lands classified in these areas would serve as additional protection for lakeside vegetation and preservation of overhanging vegetation, which provides cover for fish, reduces storm flow velocity, reduces erosion scour, and reduces sedimentation. These factors improve spawning habitat, thereby potentially enhancing fish population dynamics in the lake.

5.3.3.3 No Action (Alternative 3)

The No Action Alternative could potentially have a negative impact on the lake fishery resource due to the 52% of High and Low Density lands combined, and the potential to develop the 45% of existing unallocated lands. Implementation of the No Action alternative would allow potential development around much of the shoreline. Development often results in vegetation removal down to water's edge, which impacts shoreline stability, removes fish cover provided by overhanging vegetation, tree trunks and roots, and exacerbates storm water erosion and sedimentation. During the spring spawning season this sedimentation has the potential to disrupt spawning activity and productivity in the coves and lake arms where spawning commonly occurs.

5.3.3.4 Increased Development (Alternative 4)

The Increased Development alternative has the highest potential to negatively impact the lake fishery resource with allowing the possible development in High Density (4,531.7 acres) and Low Density (4,424.9 acres). Implementation of this alternative would allow for 89% of the shoreline to be developed. Development often results in vegetation removal down to water's edge, which impacts shoreline stability, removes fish cover provided by overhanging vegetation, tree trunks and roots, and exacerbates storm water erosion and sedimentation. During the spring spawning season this sedimentation has the potential to disrupt spawning activity and productivity in the coves and lake arms where spawning commonly occurs..

5.4 Terrestrial Resources

5.4.1 Wildlife

5.4.1.1 Increased Preservation (Alternative 1)

The Increased Preservation Alternative would have the greatest positive impact on the lakeside terrestrial resources of all the alternatives evaluated due to a reduction in both High Density

and Low Density lands and a 45% increase in Environmentally Sensitive lands, with a reduced potential for new development. White-tailed deer and eastern wild turkey are common game animals found and hunted in the Greers Ferry Lake area. Black bear have also become common in the area and are hunted on the more remote areas of Greers Ferry Lake. Gray and fox squirrels are common in upland wooded areas and are also popular with sportsmen. All these wildlife species fare better in a natural, undeveloped vegetation cover. This alternative would provide the most wildlife benefits in this regard. Some habitat management activities, including wildlife food plot plantings, removal of exotic species and application of prescribed fire would potentially benefit these populations as well.

5.4.1.2 Current Management/Increased Conservation - Preferred (Alternative 2)

Implementation of the Preferred Alternative would have a positive effect on terrestrial resources, when compared to the No Action alternative. There would be a 1,381.0 acre reduction in Low Density recreation land classification (to 688.8 acres), a 420.9 acre reduction in High Density lands (to 2,645.2 acres), a 5% increase in Environmentally Sensitive lands classification (487.6 total acres) and an increase in Wildlife Management lands from 0 acres to 2,080.7 acres. This would result in 21% of available acreage classified as Wildlife Management lands. The increases in lands classified as Environmentally Sensitive and Wildlife Management land 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.

5.4.1.3 No-Action (Alternative 3)

Under the No Action Alternative, no land classifications would change. There are currently 3,066.1 acres classified as High Density, 2,069.7 acres classified as Low Density, 221.1 acres classified as Environmentally Sensitive, and 117.1 acres classified as Project Operations. There are 4,531.9 acres have no current classification. Based on the current shoreline classification, the potential exists for continual degradation of shoreline vegetation due to increased development and potential vegetation removal and mowing activities. Unclassified lands are potentially developable, resulting in 45% of the shoreline acreage subject to possible increased or new development. This would result in negative effects to wildlife due to potential removal of trees and understory vegetation (with the highest potential in the High Density lands), thus altering food sources and migratory patterns of insects, birds and mammal species.

5.4.1.4 Increased Development (Alternative 4)

The Increased Development alternative has the highest potential to negatively impact the lake terrestrial resources by allowing the possible development in High Density (4,531.7 acres) and Low Density (4,424.9 acres). Implementation of this alternative would allow for 89% of the shoreline to be developed. Negative effects to wildlife are expected due to potential removal of trees and understory vegetation (with the highest potential in the High Density lands), thus altering food sources and migratory patterns of insects, birds and mammal species. A potentially smaller amount of good habitat for wildlife would be available under this alternative.

5.4.2 Vegetation

5.4.2.1 Increased Preservation (Alternative 1)

The Increased Preservation Alternative would convert a majority of the unallocated lands to Wildlife Management, Vegetative Management, and Environmentally Sensitive acreage. This alternative would result in significant positive effects on the vegetation resources around the shoreline of the lake due to the restrictions placed on vegetation modification actions under the majority of the land classifications remaining. Some habitat management activities, including wildlife food plot plantings, removal of exotic species and application of prescribed fire would still take place under this alternative and could potentially be beneficial to the area.

5.4.2.2 Current Management/Increased Conservation - Preferred (Alternative 2)

Implementation of the Preferred Alternative would have a positive effect on the shore line vegetation, when compared to the No Action alternative. There would be a 1,381.0 acre reduction in Low Density land classification (688.8 total acres), a 420.9 acre reduction in High Density lands (2,645.2 total acres), a 266.6 acre increase in Environmentally Sensitive lands classification (487.6 total acres), an increase in Wildlife Management lands from 0 acres to 2,080.7 acres, which results in 21% of available acreage classified as Wildlife Management lands, and an increase in Vegetative Management lands from 0 to 3,726.3 acres. The increases in lands classified as Wildlife Management lands, Vegetative Management lands, and Environmentally Sensitive lands would serve as additional protection for lakeside vegetation and subsequent preservation of habitat for wildlife and migratory bird species. 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.

5.4.2.3 No Action (Alternative 3)

Under the No Action Alternative, no land classifications would change. There are currently 3,066.1 acres classified as High Density, 2,069.7 acres classified as Low Density, 221.1 acres classified as Environmentally Sensitive, and 117.1 acres classified as Project Operations. There are 4,531.9 acres have no current classification. . Based on this, the potential exists for continued degradation of shoreline vegetation due to increased development and subsequent vegetation removal and mowing activities. Unclassified lands are potentially developable, resulting in 45% of the shoreline acreage subject to possible increased or new development. This would result in potential negative effects to the natural shoreline vegetation composition due to potential removal of trees and understory vegetation, thus possibly altering food sources and migratory patterns of insects, birds and mammal species, as well as increasing a potential for increased storm water erosion effects.

5.4.2.4 Increased Development (Alternative 4)

The Increased Development Alternative would result in less protection to the lakeshore vegetation than that of the No Action Alternative. Increases in High Density lands of 1,465.6 acres and a 2,355.1 acre increase in Low Density lands would result in 89% of shoreline acreage available for potential development. This would result in the greatest potential negative effects to the natural shoreline vegetation composition of all evaluated alternatives due to potential removal of trees and understory vegetation. This action would have an impact on wildlife food sources and migratory patterns of insects, birds and mammal species, as well as increasing a potential for increased storm water erosion effects.

5.5 Threatened and Endangered Species

5.5.1 Increased Preservation (Alternative 1)

The Increased Preservation Alternative would likely provide the most protection for any species listed as Threatened, Endangered, Protected, or Species of State Concern due to classifying the majority of unallocated lands (4,531.9 acres) to Environmentally Sensitive, Wildlife Management, and Vegetative Management. Potentially developable lands under this alternative include only 2,645.2 acres of High Density lands and 640.6 acres of Low Density lands, representing 32% of available shoreline acreage. Due to the significant increase of Wildlife Management, Vegetative Management, and Environmentally Sensitive acreage from the No Action land classifications, there may be potential positive benefits to any or all the listed species, and possibly other yet undiscovered species that may exist in the area.

5.5.2 Current Management/Increased Conservation - Preferred (Alternative 2)

The Preferred Alternative would likely have some potential positively impact on listed threatened, endangered, protected, or species of state concern based on the reductions in High and Low Density lands acreage, and increases in Environmentally Sensitive, Wildlife Management, and Vegetative Management lands acreage, as compared to the No Action Alternative. Due to the classification of 4,531.9 acres of unallocated lands to to Wildlife Management, Vegetative Management, and Environmentally Sensitive land classifications, there may be potential positive benefits to any or all the listed species, and possibly other yet undiscovered species that may exist in the area. This is due to the higher level of protection offered by these land classifications.

5.5.3 No-Action (Alternative 3)

The No Action Alternative could potentially have some negative effects on listed Threatened, Endangered, Protected, or Species of State Concern based on the presence of 4,431.9 acres of unallocated lands, which could be potentially developable acreage. Along with the 3,066.1acres of High Density lands and 2,069.7 acres of Low Density lands, 97% of available shoreline could be potentially impacted. This may result in some potential negative effects to listed species based on possible development activity on this shoreline acreage.

5.5.4 Increased Development (Alternative 4)

The Increased Development Alternative would result in less protection to the lakeshore vegetation than that of the No Action Alternative. Increases in High Density lands of 1,465.6 acres and a 2,355.1 acre increase in Low Density lands would result in 89% of shoreline acreage available for potential development. This would result in the greatest potential negative effects to the natural shoreline vegetation composition of all evaluated alternatives due to potential removal of trees and understory vegetation. This action could have a potential impact on feeding and roosting activity of the three listed species of bats, impacts to the Yellowcheek darter, impacts to the three mussel species, and as well as possible impacts on existing habitat of the listed species of herbaceous plants.

5.6 Archaeological and Historic Resources

5.6.1 Increased Preservation (Alternative 1)

The Increased Preservation Alternative would result in the greatest benefit to preservation of cultural resource sites and historic properties. Under this alternative, there would only be 640.6 acres identified as Low Density and 2,645.2 acres classified as High Density. Approximately 64% of all land would be classified as Environmentally Sensitive, Wildlife Management, and Vegetative Management. This alternative is very preservation-oriented and would constitute the best opportunity to minimize any potential effects to cultural resource sites and historic properties.

5.6.2 Current Management/Increased Conservation - Preferred (Alternative 2)

Under the Preferred Alternative, the unallocated lands under the No Action alternative would be classified (by majority) as Wildlife Management, Vegetative Management, and Environmentally Sensitive lands. With the proposed increases in these classifications, there would be minimal potential for ground disturbing activities along the shoreline, thus decreasing the potential for effects on cultural resources.

5.6.3 No Action (Alternative 3)

Under the No-Action Alternative there would be no change in the current Master Plan land classifications as designated under the 1976 MP. Under this alternative, the greatest potential for effects on cultural resources and historic properties would occur in the areas classified as Low and High Density Recreation and those lands with no classification. Cultural Resources under the No Action Alternative would be at risk of disturbance in areas where the land classification would allow for intensive development. Any new ground disturbing activities on USACE lands would require a permit to be issued 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. Cultural Resource sites within Low Density or High Density classification areas could potentially undergo the most severe impact due to the fact that activities such as boat dock construction and shoreline use permits result in a degree of ground disturbance which could pose a threat to intact cultural deposits. Potential mitigation for impact to cultural or historic sites would be the 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.

5.6.4 Increased Development (Alternative 4)

Under the Increased Development Alternative, High Density land classification would be increased by 1,465.6 acres around Greers Ferry Lake. In addition, Low Density would be increased by 2,355.1 acres, giving the potential for 89% of the shoreline to be developed. This alternative would have the greatest potential for negative impacts to archeological and historic resources based on the large increase (and greatest potential for ground disturbance) in the High and Low Density land classifications as compared to the No Action Alternative or other action alternatives.

5.7 Socio-Economic Resources

5.7.1 Increased Preservation (Alternative 1)

The Increased Preservation Alternative could potentially have an effect on the socio-economic situation in the counties that surround Greers Ferry Lake due to the decreased High Density and Low Density lands. An indirect impact from this alternative would be a reduction in tax revenue to local counties, essentially reducing their economic development, due to the fact that the Corps would decrease new permits allowing expansion or new development. Total housing units would likely stay the same due to the decreased availability of recreation (private shoreline uses) at the lake resulting in minimal new development, but it is unlikely that property values would change. It is unlikely that other facets of socio-economics would change due to the implementation of this alternative.

5.7.2 Current Management/Increased Conservation - Preferred (Alternative 2)

The Preferred Alternative would likely have a minimal effect on the socio-economic situation in the counties surrounding Greers Ferry Lake when compared to the No Action Alternative. Population would be expected to stay the same or decline slightly due to the slight decrease in High Density and Low Density acreage. Under this Preferred Alternative, the demographic makeup of the population would likely be unaffected. Total housing units would stay the same or decrease due to the 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 if this alternative is implemented.

5.7.3 No Action (Alternative 3)

The No Action Alternative would likely have some effect on the socio-economic situation in the counties surrounding Greers Ferry Lake due to the fact that 97% of the available shoreline acreage is classified as High or Low Density lands, and no allocation 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.

5.7.4 Increased Development (Alternative 4)

The Increased Development Alternative would result in a more positive effect on the socio-economic situation around the lake, as compared to the No Action Alternative. Low Density acreage in this alternative would be 4,424.9 acres, representing 44% of available shoreline acreage. The economy in the area could possibly grow slightly due to a potential increased opportunity for development, which would typically enhance water-based recreation opportunities on the lake.

5.8 Recreation Resources

5.8.1 Increased Preservation (Alternative 1)

Under the Increased Preservation Alternative, some recreation opportunities would be reduced, such as private boat docks, due to an increase in the areas classified as Environmentally

Sensitive, Wildlife Management, and Vegetative Management, which do not allow most types of development. This alternative would also limit commercial opportunities based on the proposed 2,645.2 acres of High Density classification. Although it minimizes potential for development, it would improve land-based recreational opportunities such as hunting, hiking, bird watching. This alternative also would improve viewscapes from the lake since it would allow for native flora and fauna to thrive.

5.8.2 Current Management/Increased Conservation - Preferred (Alternative 2)

Under the Preferred Alternative, all lands would be classified and some of the existing classifications would be changed. This proposed update in classification would be structured to achieve a balance based on the present public use of the lake while sustaining the natural, cultural, and socio- economic resources of the area and reflecting the current management and operation of lands at Greers Ferry Lake. Under Alternative 2, the current High and Low Density lands, comprising 52% of available shoreline acreage, would be reduced to 33%, while Environmentally Sensitive, Wildlife Management and Vegetative Management lands, at 2%, 0%, and 0%, respectively, would increase to 5%, 21%, and 37% of shoreline acreage. These classifications reflect existing lake usage, with fishing, boating, hunting and wildlife viewing dominating the recreational activity on the lake. The proposed increase in Wildlife Management, Vegetative Management, and Environmentally Sensitive classified lands action would assist in forging stronger partnerships between public and private entities for recreational and wildlife conservation opportunities. The retention of the natural shoreline vegetation would lead to improved water quality, due to the buffering and filtering capability of this vegetation.

5.8.3 No Action (Alternative 3)

Provision of recreational facilities and services would continue at Greers Ferry Lake without an update to the Greers Ferry Lake Master Plan. However, the plan by which the OPM and staff operate would not accurately reflect the current status of project facilities. Nor would there be additional measures in place, such as 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 currently zoned for them and under the No Action Alternative these uses would remain inconsistent with the Master Plan. A total of 4,531.9 acres of shoreline would remain unclassified, generating confusion about which uses are allowed in these areas.

5.8.4 Increased Development (Alternative 4)

The Increased Development Alternative would result in a more positive effect on the lake recreation, as compared to the No Action Alternative. Low Density acreage in this alternative would be 4,424.9 acres, representing 44% of available shoreline acreage. This could allow for additional shoreline development, and a potential for increased private dock construction. This would likely enhance water-based recreation opportunities on the lake, but could reduce traditional recreational activities like hiking, bird watching, and hunting by limiting acreage in Environmentally Sensitive, Wildlife Management, and Vegetation Management land classifications..

5.9 Air Quality

5.9.1 Increased Preservation (Alternative 1)

Implementation of the Increased Preservation Alternative would result in much less of an impact to existing air quality than that of the No Action Alternative, due to the reduction in lands classified

for development around the Greers Ferry Lake shoreline. Since the majority of the available acreage would be classified as Environmentally Sensitive, Wildlife Management, and Vegetative Management lands (64% of total available acreage), this would result in much less potential vehicular traffic, boat traffic, construction equipment usage, and mower exhaust emissions on these lands.

5.9.2 Current Management/Increased Conservation - Preferred (Alternative 2)

Implementation of the Preferred Alternative would also result in some positive change in air quality impacts, as noted under the No Action Alternative. Since this alternative would incorporate more shoreline acreage into the Environmentally Sensitive, Wildlife Management, and Vegetative Management land classification, 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.

5.9.3 No Action (Alternative 3)

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.

5.9.4 Increased Development (Alternative 4)

Implementation of the Increased Development Alternative may result in more air quality impacts, as compared to the No Action Alternative. This alternative would reclassify an additional 2,355.1 acres to Low Density lands and 1,465.6 acres to High Density lands. These reclassifications could result in a greater potential for more development, which could lead to increased local vehicular exhaust emissions. This effect could be potentially significant on a short term basis, due to an increase in construction activity, vehicular emissions, vegetation removal, and other air impacts from development and increased lake usage activities. Due to the excellent air quality in the Greers Ferry Lake area, 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 Increased Preservation (Alternative 1)

This alternative limits development to 2,645.2 acres of High Density lands and 640.6 acres of Low Density lands, which would imply that there would be more limited access to Greers Ferry Lake, potentially causing a decrease in water-based recreational opportunities, leading to a reduction of traffic congestion on the water, and a lower potential for water related incidents. Although water-based activities would be impacted, there would be an increase in land-based, alternative recreation opportunities such as hiking, hunting and wildlife observation. There could also be some partnership opportunities with conservation-based organizations within the region. The decrease in rate of development could also have positive impacts on water quality by reducing runoff quantity and velocity from rainfall events, thereby decreasing sedimentation and shoreline contaminants to the water.

5.10.2 Current Management/Increased Conservation - Preferred (Alternative 2)

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 Preferred Alternative could result in some reduction of traffic congestion on the water, and a lower potential for water related incidents. The increase in Environmentally Sensitive, Wildlife Management, and Vegetative Management Areas could potentially increase exposure to insects and animals, which is generally understood by the public who utilize these lands.

5.10.3 No Action (Alternative 3)

Safety of project visitors and project staff are highest priority in daily project operations. The No Action Alternative would have 52% of available shoreline acreage classified for High and Low Density development, as well as an additional 4,531.9 acres of unallocated lands (which could be developed). This would allow for a higher potential for a 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 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.

5.10.4 Increased Development (Alternative 4)

The Increased Development Alternative would have 89% of available shoreline acreage classified for High and Low Density development. An increase of 2,355.1 acres of Low Density lands could create more potential private dock development, and associated ground disturbance. This would result in a higher potential for increased erosion and a reduction in lake water quality. 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. Populations who recreate at the lake could be exposed to 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.

5.11 Aesthetics

5.11.1 Increased Preservation (Alternative 1)

Implementation of the Increased Preservation Alternative would minimize most activities which could disturb the scenic beauty and aesthetics of the lake. This alternative would be the most aesthetically pleasing for those recreating along the lake, but could potentially be a hindrance to property owners and their viewshed of the lake. The user experience in areas such as Corps parks would still be relatively peaceful at most times, with the aesthetic of domesticated nature. However, some of the more developed and heavily used parks could experience annual wear and deterioration of acreage and existing facilities due to the potential increased usage of these parks.

5.11.2 Current Management/Increased Conservation -Preferred (Alternative 2)

The wide panorama of Greers Ferry Lake and the nearby shore conveys a sense of enormity to the lake, and the conversion of 1,381.0 acres of Low Density lands, and 420.9 acres of High

Density lands, and 4,531.9 acres of unallocated lands to Vegetative Management, Wildlife Management, and Environmentally Sensitive lands would help to preserve the sense of relatively pristine shoreline. 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. Under this proposed alternative, property owners could work with Corps staff to determine the appropriate vegetation management measures for their specific property location adjacent to the shoreline of the lake.

5.11.3 No Action (Alternative 3)

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 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.

5.11.4 Increased Development (Alternative 4)

Implementation of the Increased Development Alternative would have the most impact in regards to aesthetics of all evaluated alternatives. Under this alternative there would be 2,355.1 more acres of Low Density lands compared to the No Action Alternative, which would have the potential for additional boat dock construction and vegetation modification permits. In addition, High Density lands would increase by 1,465.6 acres. This gives a total of 89% of shoreline available for potential development. Some visual impacts to aesthetics would be expected under this alternative.

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 Master Plan for Greers Ferry Lake was last approved in 1976; this was followed by multiple supplements over the last 41 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 2009 to 2012, averaging approximately 2.5 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 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. 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.

Two main themes came out of the scoping process, which was a cumulative exercise involving private and public entities, and local, state and federal agencies—improved water quality and 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 Corps campgrounds (trails, restrooms/showers, electric/water service at campsites, etc.). There were numerous comments across that board that warrant a big picture view of what changes should be made at Greers Ferry Lake in order to achieve a balance.

Existing conditions at the lake allow for some degree of development on 52% of available acreage, with an additional 4,531.9 acres having no specific land classification, but it should be noted that reclassification of lands under the Preferred Alternative would enhance water quality by restricting Low Density recreation development, increasing the amount of Vegetative Management, Wildlife Management, and Environmentally Sensitive, thereby retaining more of the natural shoreline vegetation. Approximately 63% of the linear shoreline could have a natural vegetated shoreline due to these land reclassifications 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, the Corps 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	N/A	N/A
Floodplain Management (EO 11988)	N/A	N/A
Clean Water Act		
Section 404	No effect	N/A
Section 401	No effect	N/A
NPDES	No effect	N/A
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

The Corps 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 Master 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 Master 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 Master Plan Revision 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 the Corps 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 Corps 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 Master 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, this Master 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 Corps management efforts and outputs up to a justified level of service. Public involvement and extensive coordination within the Corps of Engineers and with other affected agencies and organizations is a critical feature required in developing or revising a Project Master Plan.

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

7.2 Scoping

One agency and two public scoping workshops were held on September 19, 20, and 21 with 78 people registering their attendance.

A Scoping Report for the Greers Ferry Lake Master Plan process was finalized in early 2018. The report summarizes the public participation process for, and the public comments resulting from, the Greers Ferry Lake MP 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 MP revision, the scoping process was also used as an opportunity to get input from the public and agencies about the vision for the MP update and the issues that the MP should address where possible. The Scoping Report is located on the

Greers Ferry Lake Master Plan website,
https://www.swl.usace.army.mil/Missions/Planning/Greers-Ferry-Lake-Master-Plan-Revision/

7.3 Draft Master Plan/Draft Environmental Assessment.

The Draft Master Plan/Draft Environmental Assessment is on schedule to be released to the public during January/February 2019. A public review period and second round of public workshops will be held to collect comments on the draft documents.

7.5 Final Master Plan/Final EA.

The Final Master Plan will be completed in Summer 2019, with public workshops scheduled accordingly.

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 Master Plan for Greers Ferry Lake was last approved in 1976; this was followed by multiple supplements over the last 41 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 1999 to 2012; 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 Master Plan is not intended to address the specifics of regional water quality, shoreline management, or water level management; these areas are covered in a project's shoreline management plan or water management plan. However, specific issues identified through the Master Plan revision process can still be communicated and coordinated with the appropriate internal Corps 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 Master Plan development evaluated four 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 looked at leaving the lake as it currently exists in terms of developable areas and protected areas. Of the 10,005.9 acres of available land around the lake, 52% of this is classified as High and Low density recreation (31% High Density), with potential future development occurring. While 2% of available acreage is classified as Environmentally Sensitive lands, 4,531.9 acres of land or 45% of the shoreline currently has no classification. Under each of the action alternatives, the lands with no classification are allocated to one of the land classifications.

The action alternatives included an Increased Preservation Alternative, Current Management/Increased Conservation Alternative (Preferred), and an Increased Development Alternative. The Increased Preservation Alternative (Alternative 1) shifted the majority of the available shoreline acreage toward future preservation, with 26% classified as High Density recreation, 45% classified as Environmentally Sensitive, and 14% classified as Wildlife Management lands. Potential effects from this would be decreased vegetation removal and a reduction in soil erosion due to the reclassification of lands previously included as High and Low density lands, having the potential for construction and conversion of pervious surfaces to impervious. This construction activity is generally detrimental to water quality and terrestrial and aquatic wildlife species. Development has the potential to increase the number of boats on the lake, increased health and safety issues, aesthetic impacts, and impaired recreational

experiences for many visitors. The Current Management/Increased Conservation Alternative (Preferred) also include the 26% High Density lands, while decreasing Low Density lands to 7%. Environmentally Sensitive and Wildlife Management classifications are 5% and 21%, respectively. Vegetative Management classification would include 3,726.3 acres, or 37% of shoreline acreage. This action would preserve shoreline vegetation, reduce stormwater runoff quantity and velocity, resulting in less in-lake sedimentation and turbidity, and improve water quality. This action also has the potential to improve health and safety issues, aesthetics, terrestrial and aquatic wildlife habitat. 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.

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