WHITE RIVER WATERSHED GREERS FERRY LAKE ARKANSAS

MASTER PLAN FOR DEVELOPMENT AND MANAGEMENT OF GREERS FERRY LAKE

FINAL: May 2019

EXECUTIVE SUMMARY

The original Master Plan for Greers Ferry Lake was first approved in December 1961. Subsequent revisions were prepared with the latest revision being approved on January 26, 1976. The Greers Ferry Master Plan (hereafter, "Master Plan or Plan") is intended to serve as a guide for the orderly and coordinated development, management, and stewardship of all Federal lands and water resources of the project. It presents data on existing conditions, anticipated recreational use and the type of facilities needed to service anticipated use, sensitive resources requiring protection, and an estimate of future requirements. Since the 1976 Master Plan revision, development has created new and unforeseen demands on the public lands and resources of the project in the Greers Ferry Lake region. These new demands on project resources as well as naturally occurring changes to the resources, combined with the need to bring the Master Plan in line with current management practices at the project, and with new guidance and directives within the U.S. Army Corps of Engineers (USACE), has dictated the preparation of this Master Plan revision.

This revised Master Plan presents an inventory of land resources, and existing recreation facilities, as well as revised land classifications, new resource management objectives, and an evaluation of future needs to provide a balanced Plan that serves public needs and protects resources. Included in the revised Master Plan is an evaluation of expressed public opinion, an analysis of regionally important natural resources, and an evaluation of trends in outdoor recreation. The format utilized for this plan is outlined in Engineer Regulation/Engineer Pamphlet 1130-2-550 (dated 30 January 2013), which sets forth policy and procedure to be followed in preparation and revision of project Master Plans. The Greers Ferry Lake original Master Plan can be found in Design Memorandum 19-2 (21 December 1961); a listing of all the supplements, including Design Memorandum 19-5 the 1976 Greers Ferry Lake Master Plan revision, can be found in Appendix B.

A draft Environmental Assessment (EA) and draft Finding of No Significant Impact (FONSI) were completed as part of the environmental documentation portion of the process. Both documents are included as Appendix A. Upon completion of the Master Plan revision process, if no significant impacts due to Federal action are determined, the FONSI will be signed signifying the end of the revision process.

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Chapter 1 Introduction

a. Project Authorization

Authorization is defined as permission to undertake a specific activity. In the context of this Master Plan revision, project authorization refers to congressional legislation which granted authority to the USACE to study, construct, and eventually operate the White River Basin reservoirs, specifically Greers Ferry Lake. Initial authorizations for the project included the primary project purposes of flood control and generation of hydroelectric power, followed by subsequent authorizations for recreation, fish and wildlife habitat, and water supply.

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

The Greers Ferry Dam and Lake project was authorized by the Flood Control Act of 28 June 1938 (P.L. 75-761), which approved the general comprehensive plan for flood control and other purposes for the White River Basin. The 1938 Act was modified by the Flood Control Act of 1941 (P.L. 77-228) and the Flood Control Act of 1954 (P.L. 83-780). The 1954 Act specifically authorized the generation of hydroelectric power in conjunction with flood control on the Greers Ferry Reservoir.

Section 4 of the Flood Control Act approved 22 December 1944 (P.L. 78-534), as amended by Section 4 of the Flood Control Act of 1946 (P.L. 79-526), and as further amended by Section 209 of the Flood Control Act of 1954 (P.L. 83-780), authorizes the Department of the Army to provide for recreational use of the lakes under its control. The Federal Water Project Recreation Act of 1965 (P.L. 89-72) directs that in investigating and planning any Federal navigation, flood control, reclamation, hydroelectric, or multipurpose water resource project, full consideration must be given to the opportunities, if any, which the project affords for outdoor recreation. Additionally, the Fish and Wildlife Coordination Act approved 12 August 1958 (P.L. 85-624) provides for more effective integration of a fish and wildlife conservation program with Federal water-resource developments. Useful references concerning recreation and project operations can be found in ER 1130-2-550 (https://www.publications.usace.army.mil/Portals/76/Publications/EngineerRegulations/ER_1130-2-550.pdf), Appendix A, as well as the most current version of EC 1130-2-550 (https://www.publications.usace.army.mil/Portals/76/Publications/EngineerCirculars/EC_1130-2-550.pdf).

On 3 July 1958, Congress passed the Water Supply Act of 1958 (P.L. 85-500) which allowed the inclusion of storage for municipal and industrial water supply in any USACE reservoir, simultaneously requiring Congressional authorization when such inclusion seriously affects the purposes for which the project was authorized, surveyed, planned, or constructed, or which would involve major structural or operational changes.

b. Project Purpose

The project is a multiple-purpose flood-control and hydropower project and is a major unit in a comprehensive plan for development of the water resources of the White River Basin in Arkansas and Missouri. Additional benefits are derived through utilization of the impounded water and resulting shoreline for recreational pursuits. Utilization of the lake area for forestry, soil conservation, and fish and wildlife management are additional benefits created by the impoundment. The impounded water also serves as a municipal and industrial water supply for communities around Greers Ferry Lake.

c. Purpose and Scope of Master Plan

Master Plans are developed and kept current for Civil Works projects operated and maintained by the USACE and will include all land (fee, easements, or other interests) originally and subsequently acquired to support the operations and authorized missions of the projects.

The Master Plan is the strategic land use management document that guides the comprehensive management and development of all project 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 USACE responsibilities pursuant to federal laws to preserve, conserve, restore, maintain, manage, and develop the project 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 flexible based upon changing conditions. The Master Plan deals in concepts, not in details, of design and 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.

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 (SMP) or water management plan. However, specific issues identified through the Master Plan revision process can still be communicated and coordinated with the appropriate internal USACE resource (i.e. Operations for shoreline management) or external resource agency (i.e. Arkansas Department of Environmental Quality for water quality) responsible for that specific area.

This revised Master Plan replaces Design Memorandum No. 19-5, Updated Master Plan for Development and Management of Greers Ferry Reservoir approved January 1976.

d. Brief Watershed and Project Description

The Greers Ferry Dam is located at river mile 79.0 on the Little Red River, a tributary of the White River, and is about two miles northeast of Heber Springs, Arkansas, about 65 miles northeast of Little Rock, Arkansas, and about 132 miles northwest of Memphis, Tennessee. 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 306.3 miles of shoreline lie within Cleburne and Van Buren Counties and the perimeter of the lake is almost entirely forested with a cover of mixed shortleaf pine and upland hardwoods.

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

The total area contained in the Greers Ferry project, including both land and water surface, consists of 41,194.5 acres. In addition, 3,770.6 acres are in flowage easement (Note: A small difference in acreage figures exists throughout this document due to the use of newer technologies, like LiDAR, to generate data. LiDAR is a snapshot of the conditions at the time the LiDAR was completed, and therefore, conditions may slightly change over time. Because of this, the USACE recommends that adjacent landowners obtain a survey prior to taking any action that might impact federal property rights. Where flowage or other easements belonging to the United States are located, adjacent landowners should reference the relevant deed language for specific locations and rights. Generally, adjacent landowners must contact the USACE for approval prior to beginning any action that may impact federal property rights.). 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 (462.0 feet above mean sea level (msl)), the water area comprises 31,206.6 acres and 306.3 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 USACE. Three public use areas are currently leased to others: Eden Isle, Fairfield Bay, and Sandy Beach. A more detailed description of USACE parks follows in Chapter 2.

e. Listing of Prior Design Memorandum

A listing of prior design memorandums and accompanying supplements are provided in a table listing in Appendix B and, with the release of this Master Plan, are considered incorporated into this document.

f. Pertinent Project Information

Although this revised Master Plan is focused on management of land and water surface related to project purposes of outdoor recreation and environmental stewardship of natural and cultural

resources, the following information about primary project facilities is provided to aid in understanding how all project purposes are interrelated.

Greers Ferry Dam is concrete gravity structure comprising a total length of 1,704 feet. The height of the dam above streambed is 243 feet. There are two earthen auxiliary dams that have lengths of 3,350 and 4,500 feet. The spillway is controlled by six 40 feet wide by 36.5 feet tall tainter gates. The reservoir contains 934,000 acre-feet (AF) of flood control storage and 1,910,000 AF of power regulation water supply. Flowage easements were acquired to elevation 491 feet above msl or in some locations up to elevation 498 feet above msl on the Little Red River.

In 2005, the USACE started Screening for Portfolio Risk Analysis (SPRA). This analysis screened each dam in the USACE inventory based on available information, to expeditiously identify and classify every dam according to perceived risk. The screening has yielded a basic understanding of the greatest risks and priorities for dams throughout USACE. The Dam Safety Action Classification System (DSAC) is intended to provide consistent and systematic guidelines for appropriate actions to address the dam safety issues and deficiencies of USACE dams. USACE dams are placed into a DSAC class based on their individual dam safety risk considered as a combination of probability of failure and potential life safety concerns. Other considerations such as economic and environmental issues, while important, are secondary compared to life safety issues. The DSAC table presents different levels and urgencies of actions that are commensurate with the different classes of the safety status of USACE dams. These actions range from recognition of an urgent situation requiring immediate action through normal operations and dam safety activities for dams without known issues.

> ***DSAC I (Very High Urgency of Action)*** – Dams where progression toward failure is confirmed to be taking place under normal operations and the dam is almost certain to fail under normal operations within a time frame from immediately to within a few years without intervention, or the combination of life and/or economic consequences make probability of failure extremely high.
> ***DSAC II (High Urgency of Action)*** – Dams where failure could begin during normal operations or be initiated as the consequence of an event. The likelihood of failure from one of these occurrences, prior to remediation, is too high to assure public safety, or the combination of life and/or economic consequences make probability of failure very high.
> ***DSAC III (Moderate Urgency of Action)*** – Dams that have issues where the dam is significantly inadequate, or the combination of life, economic, and/or environmental consequences make the risks moderate to high.
> ***DSAC IV (Low Urgency of Action)*** – Dams are inadequate but with low risk such that the combination of life, economic, and/or environmental consequences make a probability of failure low, although the dam may not meet all essential USACE engineering guidelines.
> ***DSAC V (Normal)*** – Dams considered adequately safe, meeting all essential agency guidelines and the residual risk is considered tolerable.

A SPRA was performed on Greers Ferry Dam in April of 2007 and approved in 2008, giving Greers Ferry Dam a DSAC IV Rating. The 2007 SPRA classified the dam according to relative risk in order to prioritize funding, investigations, and measures for risk-informed dam safety

management. Potential failure modes (PFMs) were identified and engineering assessments were assigned to each PFM and assigned to each dam according to the DSAC.

For more information on USACE Dam Safety, please reference the following website: http://www.usace.army.mil/Missions/CivilWorks/DamSafetyProgram/ProgramActivities.aspx

Table 1.1 General Dam Information

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 (msl)	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	23,735
Nominal top of conservation pool Elevation, feet above msl	462.0
Area, acres	31,206.6
Length of shoreline, miles	306.3
Nominal top of flood-control pool Elevation, feet above msl	491
Area, acres	39,762.5
Length of shoreline, miles	368.3
[1] *FC – flood control, P – power, Rec-Recreation, F&W – Fish and Wildlife, W – water supply*	

Table 1.2 Selected Plan Land Classifications

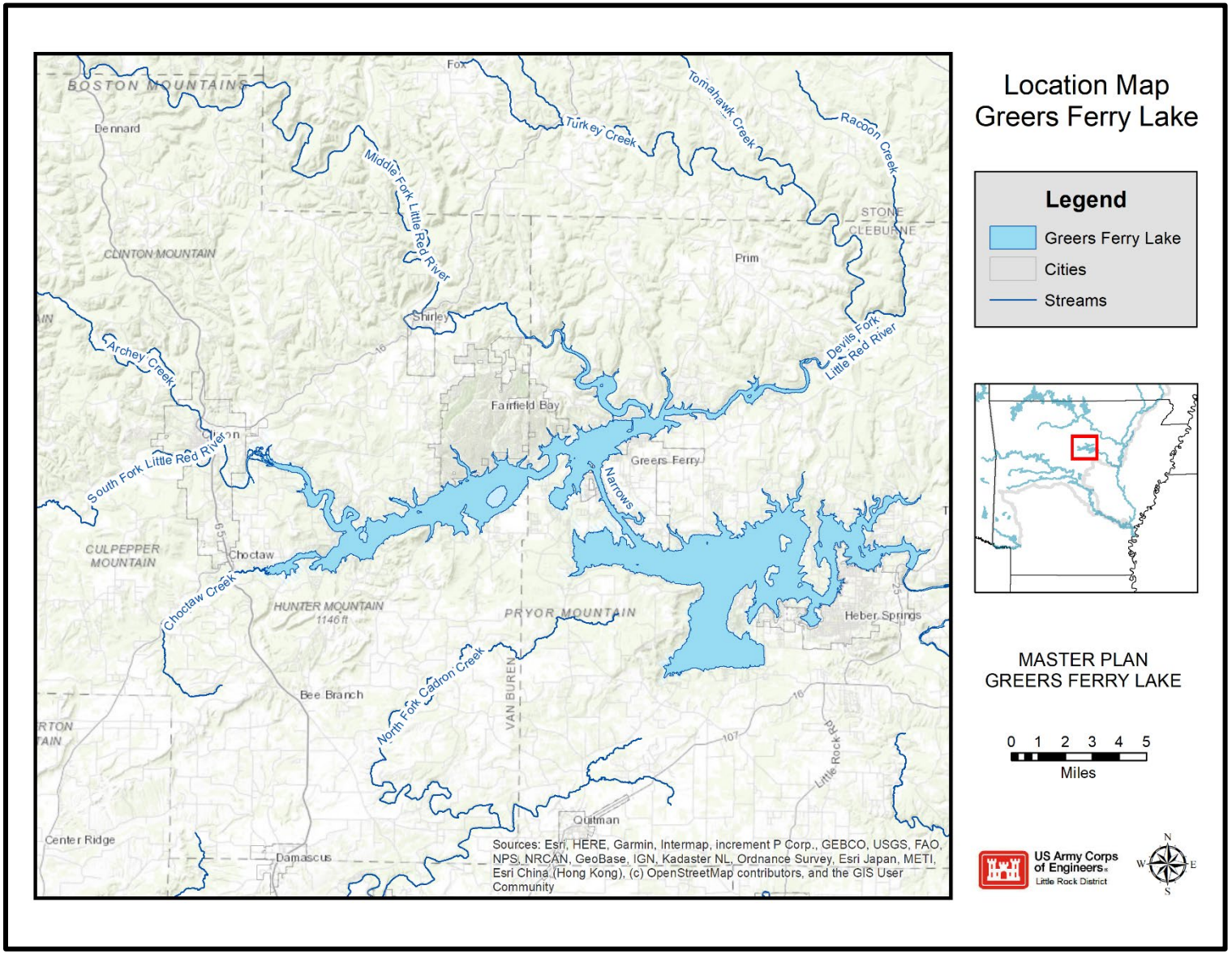
Classification	Acres
Project Operations	377.3
High Density Recreation	2,645.2
Environmentally Sensitive Areas	487.6
Multiple Resource Management Lands:	
Low Density Recreation	688.8
Wildlife Management	2,080.7
Vegetative Management	3,726.0
Water Surface:	
Restricted	49.1
Designated No-wake	0
Fish and Wildlife Sanctuary	0
Open Recreation	31,139.7
Total Acreage	**41,194.5**
Note: Acreages are approximate and are based on GIS data. Totals vary depending on changes in lake levels, sedimentation, and shoreline erosion.	

Chapter 2 Project Setting and Factors Influencing Management and Development (Existing Conditions)

a. Description of Reservoir

The Little Red River rises out of the Boston Mountains in north central Arkansas as three forks: South Fork, Middle Fork, and Devil's Fork. The basin is about 86 miles in length and averages about 21 miles in width, and has a total drainage area of approximately 1,146 square miles. About 85 percent of the basin area is in the Boston Mountains and the remainder opens out into the Mississippi River Alluvial Valley section of the Gulf Coastal Plain. The Little Red River is about 104 miles long and flows in a southeasterly direction to join the White River 182.6 miles from its mouth. There are no important tributaries downstream from the dam site. State Highway 16 crosses the lake in the portion of the lake referred to as the Narrows, at the approximate midpoint of the lake (Figures 2.1 and 2.2). The top of the dam serves as State Highway 25 (Figure 2.2).

Figure 2.1 Greers Ferry Lake Location Map



b. Hydrology and Groundwater

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

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

Wells in the WIP confining unit are generally inadequate for public supply, thus are limited to domestic, small community, and non-irrigation agricultural supply, owing to poor well yields and limited groundwater resources. Since domestic and water supply systems producing less than 50,000 gallons per day are not required to report groundwater use, there is no way to accurately quantify the number of domestic and livestock wells in use in the WIP. As of 2010, water use from 13 wells completed in the Atoka Formation of the WIP confining unit was reported. These wells were primarily used for public supply at parks, schools, stores, and some commercial businesses (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. Municipal water systems are utilized at all Greers Ferry recreation areas.

c. Sedimentation and Shoreline Erosion

The White River basin, including Greers Ferry Lake, has a relatively low sediment load, 0.0003 percent of average annual flow, and was estimated at the time of design to be about 350 AF per year. Sediment ranges have been obtained at 13 locations since the project was completed in 1964. These ranges were obtained in 1965, 1977, and 1995. In those 30 years only three ranges indicate any measurable deposition. Although the lake is now over 53 years old, there have been no reported sediment problems. Storage in Greers Ferry for sediment is not quantified but listed as one of the project purposes of the inactive pool. The inactive pool contains 1,194,000 AF of storage below elevation 435 feet above msl. The maximum probable drawdown is estimated to be 433 feet above msl, also the lowest rated pool for turbine operation, sometimes referred to as dead pool, is 1,147,000 AF. Assuming the sediment accruing in Greers Ferry Lake is at the estimated rate of 350 AF per year, then less than 3 percent of the total inactive pool storage would be filled in a 100 year period.

Erosion of the residual soil containing cherts and clays accounts for the tumbled gravels found in streambeds of the watershed. Slopes can be as steep as 90 degrees and tend to be steeper in areas close to creeks or water bodies. Noticeable erosion can be found where gravel roadways lead up to boat launches and docks. Most of these embankments are steep and allow stormwater to pick up speed as it heads toward the lake. As gravel washes into Greers Ferry Lake it also carries smaller sediments and soils. Sediment is a large contributor to nutrient input into any waterbody.

d. Water Quality

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

- Watershed runoff entering the lake through the three major tributaries of the Little Red River—the South Fork, the Middle Fork, and the Devils Fork.
- Watershed runoff draining directly to the lake and its smaller tributaries. These loads reflect the immediate Upper and Lower Lake watersheds (adjacent land uses, marina development).
- Permitted point source discharges to the tributaries and Greers Ferry Lake (10 National Pollutant Discharge Elimination System (NPDES) permits located in upstream tributaries and/or lake).
- Septic systems within the immediate Upper and Lower Lake watersheds.
- Boating activities on the lake (fueling, 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).

Floating portable toilets have been installed and are maintained by the Arkansas Department of Health to protect the water quality of Greers Ferry Lake. These floating facilities prevent 208,000 gallons of effluent from entering the waterway per year.

e. Project Access

The lake is surrounded by US, State, and county roads, making access possible at many points in any given area of the lake. Further highway and airport access can be referenced in Figure 2.3 Greers Ferry Lake Project Access.

Figure 2.2 Status of Highway Projects in Cleburne County (Source: Arkansas Department of Highways and Transportation)

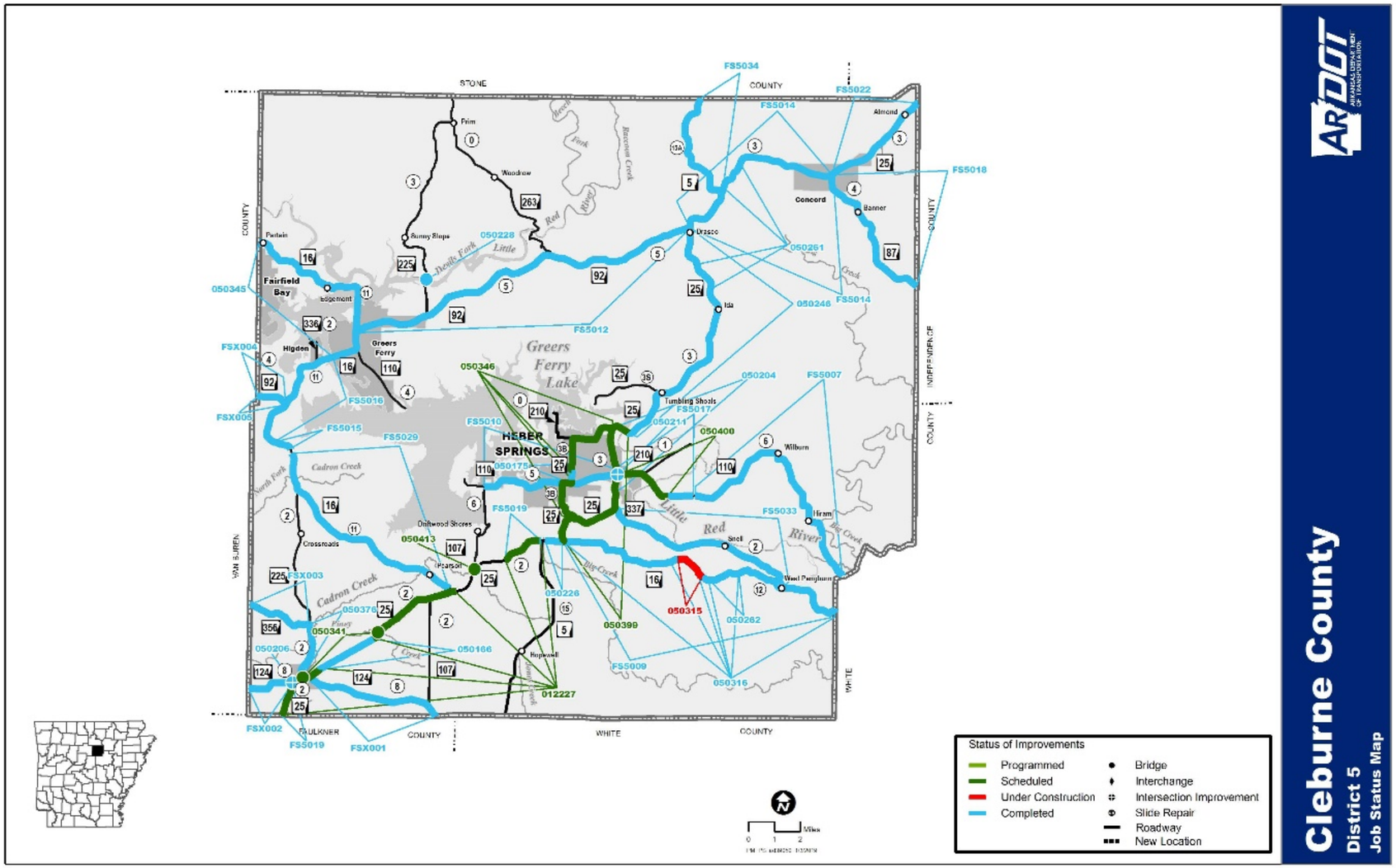
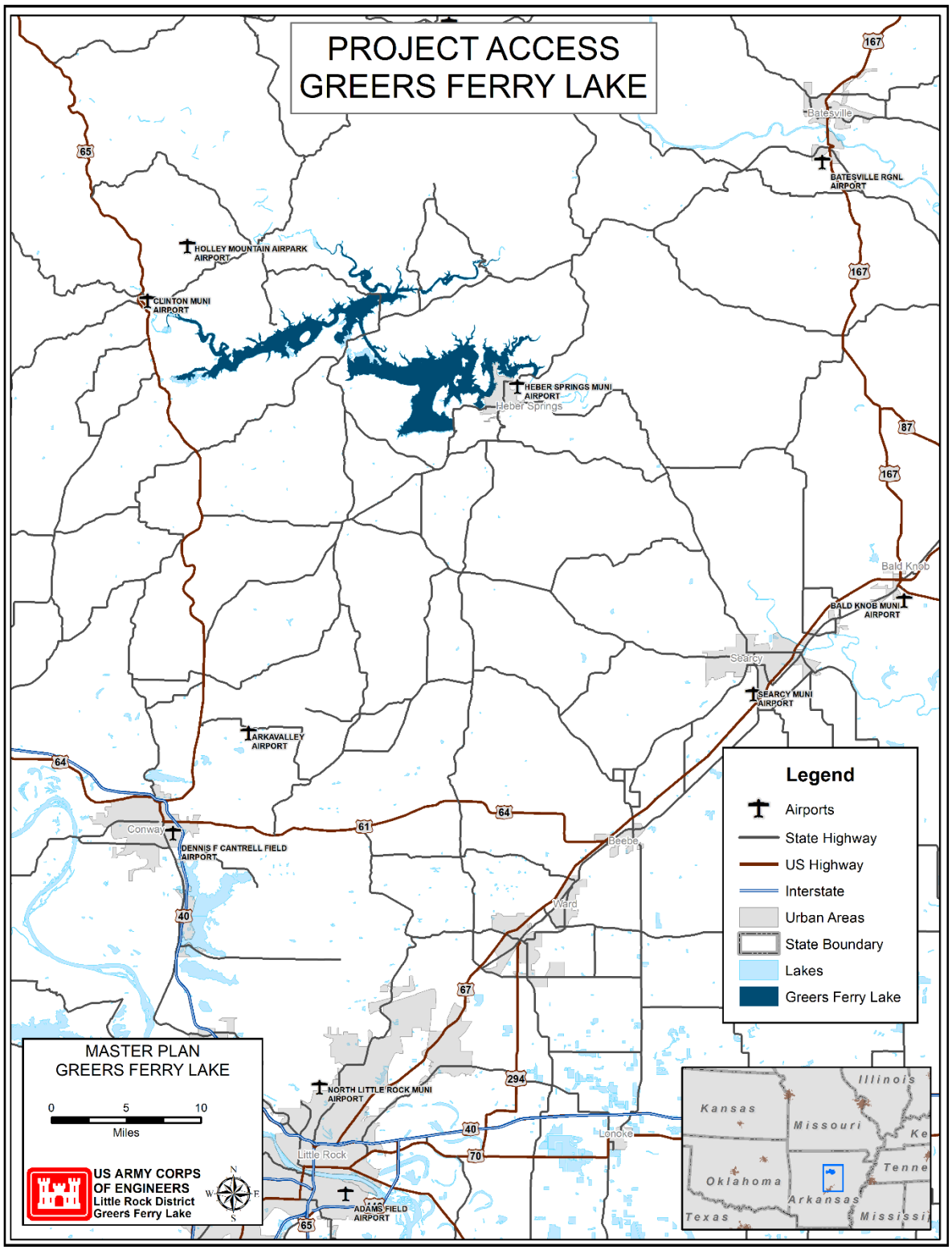


Figure 2.3 Greers Ferry Lake Project Access



f. Climate

The climate in north central Arkansas 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 degrees Fahrenheit (°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 are not uncommon, however.

Table 2.1 Temperature and Precipitation in Basin of Greers Ferry Lake

Temperature Greers Ferry	
Mean annual	59.3°F
Maximum in basin of Greers Ferry Lake	79.7°F
Minimum in basin of Greers Ferry Lake	37.3°F
Precipitation in Basin of Greers Ferry Lake	
Mean Annual (Period of record 2017-2018)	51 inches
Range of Annual Snowfall	1-2 inches

The area around Greers Ferry Lake 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).

National USACE missions associated with water resource development projects may include flood risk management, water conservation, navigation, mitigation, and hydroelectric power generation, which all serve to protect the built environment and natural resources of a region from the climate extremes of drought and floods. This creates a more resilient and sustainable region for the health, welfare, and energy security of its citizens. Maintaining a healthy vegetative cover and tree canopy on Federal lands within the constraints imposed by primary project purposes helps reduce stormwater runoff and soil erosion, mitigates air pollution, and moderates temperatures. The USACE Strategic Sustainability Performance Plan implements Executive Order (EO) 13693, stating:

"As a prominent Federal entity, a key participant in the use and management of many of the Nation's water resources, a critical team member in the design, construction, and management of

military and civil infrastructure, and responsible members of the Nation's citizenry, the USACE strives to protect, sustain, and improve the natural and manmade environment of our Nation and is committed to sustainability and compliance with applicable environmental and energy statutes, regulations, and Executive Orders.

Sustainability is … a natural part of the USACE decision processes, [and is a] part of our organizational culture. USACE is a steward for some of the Nation's most important natural resources and we must ensure our stakeholders and partners receive products and services that provide for sustainable solutions that address short and long-term environmental, social, and economic considerations."

Climate change became an area of concern due to the potential for effects on numerous 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 were projected to occur more frequently. Should these events become significant to impact the operation of Greers Ferry Lake, the Master Plan and associated documents (i.e. Operations Management Plan and SMP) will be reviewed and revised, if necessary.

To model future climate change, scientists utilize various general circulation models (GCM). Climate change analysis becomes more complex for the future than the past because there is not one time-series of climate, but rather many future projections from different GCM runs with a range of carbon dioxide emissions scenarios (IPPC 2007). It is important not to analyze only one GCM for any given emission scenario, but rather to use ensemble analysis to combine the analyses of multiple GCMs and quantify the range of possibilities for future climates under different emissions scenarios. Human population growth and related greenhouse gas (GHG) emissions and changes in land cover have been modeled under various scenarios in order to project future trends for global temperature and precipitation.

In May 2008, the Center for Climate Strategies (CCS) completed a GHG emissions inventory and reference case projection to assist in understanding past, current, and possible future GHG emissions in Arkansas (CCS 2008). The report found that GHG emissions are rising faster than those of the nation as a whole. As is common in many states, the electricity and transportation sectors have the largest emissions, and their emissions are expected to continue to grow faster than in other sectors. As well, the study found that from 2005 to 2025, emissions associated with electricity generation to meet both in-state and out-of-state demand are projected to be the largest contributor to future emissions growth, followed by emissions associated with the transportation sector. Other sources of emissions growth include the residential, commercial, and industrial fuel use sectors, the transmission and distribution of natural gas, and the increasing use of hydrofluorocarbons and perfluorocarbons as substitutes for ozone-depleting substances in refrigeration, air conditioning, and other applications.
In 2008, Arkansas completed a Climate Action Plan with assistance from the CCS. Arkansas' plan focuses exclusively on the reduction of GHG, including a comprehensive set of sector-based policies and measures. Its design is consistent with the national climate proposal passed in the

U.S. House of Representatives, but includes more specific listings and provisions for specific sector based policies and measures, and was less specific on the design of national market based mechanisms.

The USGCRP summarized information regarding climate change and its potential effects in regional assessments (USGCRP 2009). Arkansas is part of the Southeast Region, which encompasses a range of natural systems, from the Appalachian Mountains to coastal plains and the Caribbean. The geographic distribution of impacts and vulnerabilities is uneven due to the different systems. Extreme events such as heat waves, droughts, and heavy rainfall events are projected to occur more frequently. Temperatures across the Southeast Region are expected to increase during this century, with shorter-term (year-to-year and decade-to-decade) fluctuations due to natural climate variability (Carter et.al. 2014). Consequences of warming may include significant increases in the number of hot days (95 degrees F or more), and decreases in days with freezing temperatures. The USGCRP predicts that average annual temperatures in the Southeast Region will rise 4 to 8 degrees F depending upon the sub-region. Increases in the interior states in the Southeast Region will be more moderate, ranging from 1 to 2 degrees F.

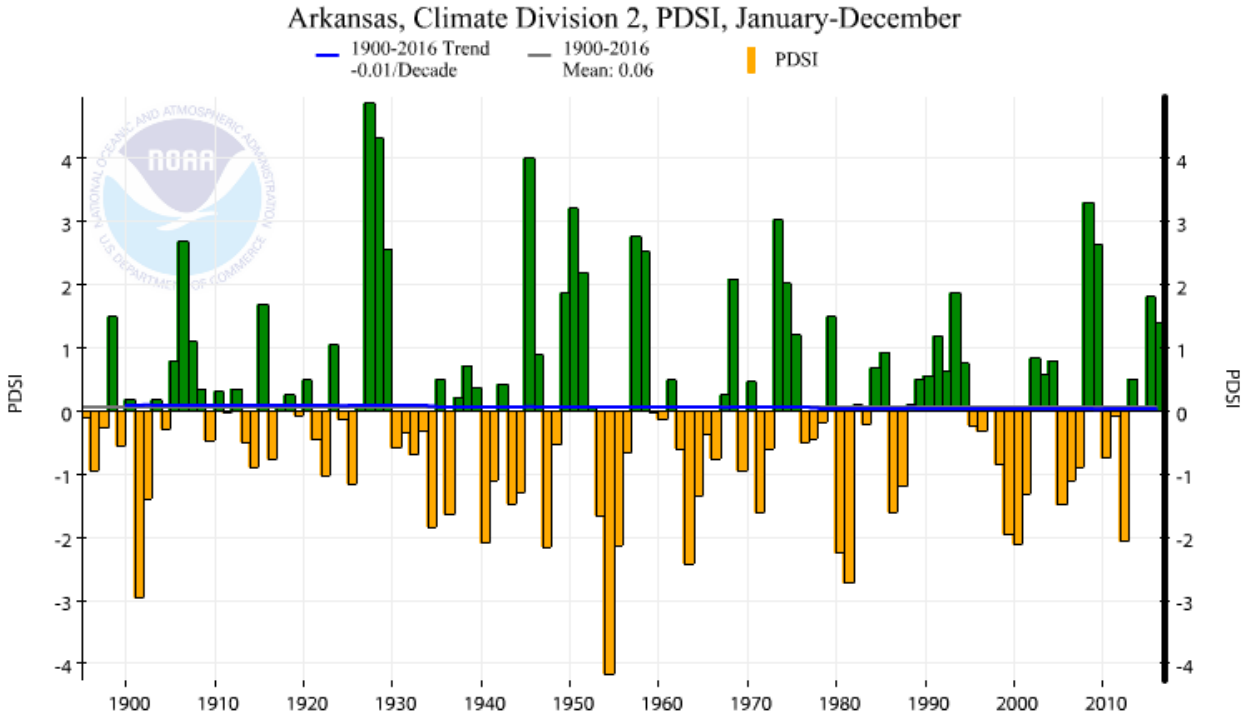
The Arkansas Water Plan is the state's policy for long term water management. The State of Arkansas last updated their water plan in 2014. The update will bring data, science, and public input together to define water demands, water supplies, issues, and potential solutions to meet the state's needs for the next 40 years. (http://www.arwaterplan.arkansas.gov/).

Droughts

Although climate change is likely to increase the risk of flooding, droughts are also likely to become more severe, because periods without rain will be longer and very hot days will be more frequent. Droughts pose challenges for water management and river transportation. If the spring is unexpectedly dry, reservoirs may have too little water during the summer, resulting in reduced hydropower generation. If droughts become more severe, restrictions in withdrawals for water supply could occur.

Although precipitation in north central Arkansas occurs year round, the region and the state as a whole is prone to occasional drought. Figure 2.4 below displays time series plots of the Palmer Drought Severity Index (PDSI) starting just before the year 1900 and going through the year 2016 for north central Arkansas. The PDSI is based on deviations of precipitation and temperature from normal conditions and takes into account the time that drought conditions last. With a scale of positive and negative 4, values less than zero indicate drought conditions with a negative 2 indicating moderate drought, a negative 3 severe drought, and a negative 4 extreme drought. The highest negative drought indices, as indicated by the yellow-orange line, occurred in 1902, 1954, 1963, 1981-82, 1999-2000, and 2012. The drought of 1953 through 1956 was the most intense over a 5-year period. The most recent drought took place from 2010 through 2013.

Figure 2.4 Palmer Drought Severity Index (PDSI) for north central Arkansas



g. Topography, Geology, and Soils

(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 the Ozark Plateaus province. While several anticlines, 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.

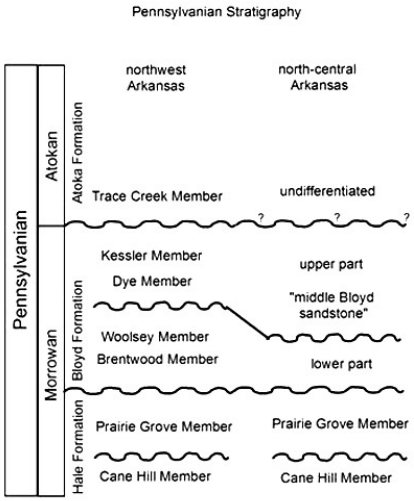
Topographically, the surrounding area of the reservoir consists of flat-topped mountains with elevations of 600 to 1,000 feet above msl and a bench and bluff topography resulting from erosion by high gradient streams and by wind-sapping. Bench widths average 30 feet and the extensive reach of the bluffs 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 feet above msl and is the highest relief in the surrounding area. At the actual dam site, the bed elevation of the Little Red River and the high points of the left and right abutments are 258 feet

above msl, 533 feet above msl and 427 feet above msl, respectively. The flood plain is about 500 feet wide and the stream channel is approximately 250 feet in width.

(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] (Figure 2.5). 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 (Figure 2.6). 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 2.5 Geologic Column



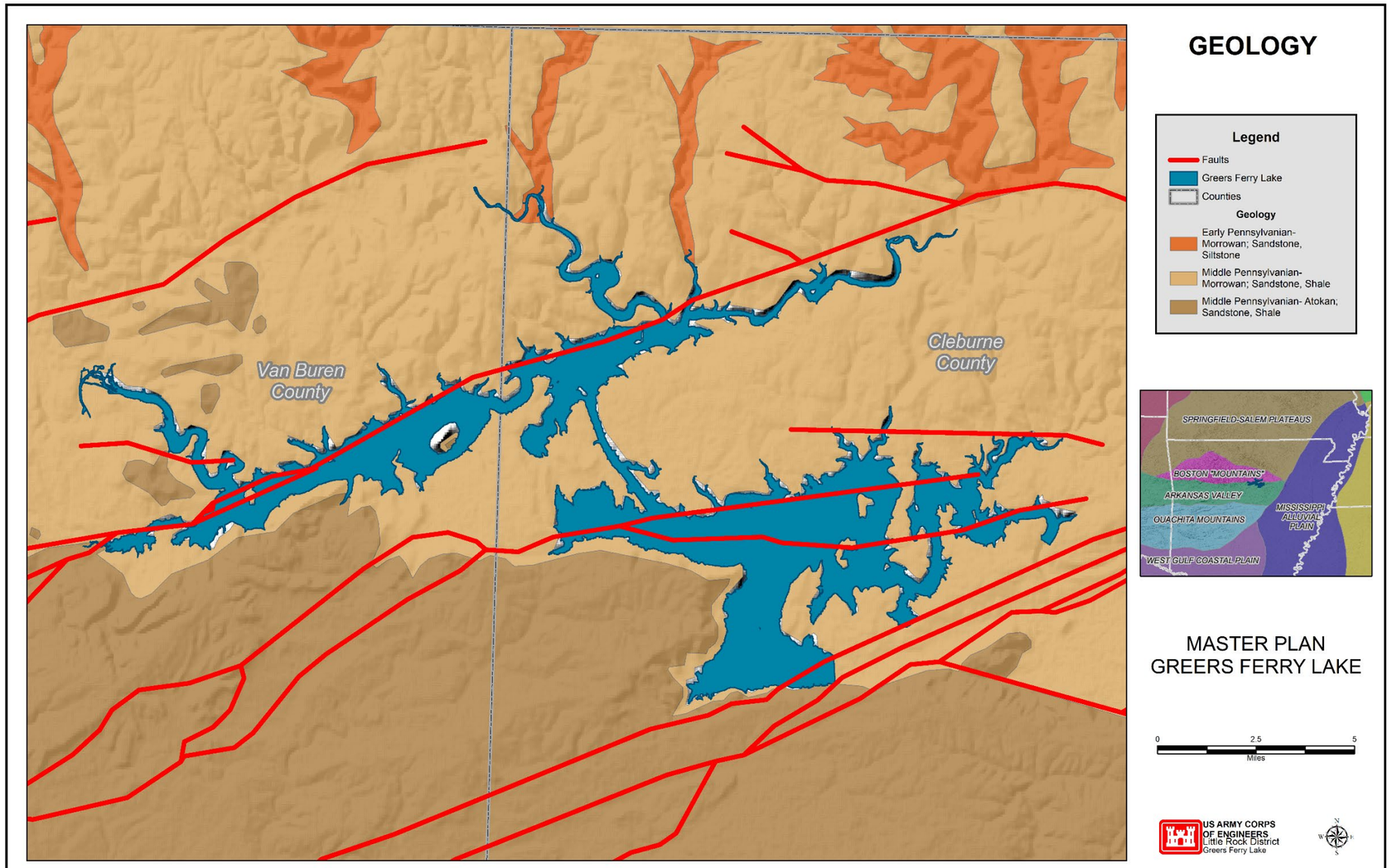
The Dye Shale Member is primarily shale with some siltstone and thinly to massively bedded sandstone. The shale ranges in grain size from clay to silt, gray to black in color, and weathers

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

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

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

Figure 2.6 Geology and Fault Lines of Greers Ferry Lake and surrounding area



GEOLOGY

Legend

- Faults
- Greers Ferry Lake
- Counties

Geology

- Early Pennsylvanian-Morrowan; Sandstone, Siltstone
- Middle Pennsylvanian-Morrowan; Sandstone, Shale
- Middle Pennsylvanian- Atokan; Sandstone, Shale

MASTER PLAN
GREERS FERRY LAKE

0 2.5 5
Miles

US ARMY CORPS OF ENGINEERS
Little Rock District
Greers Ferry Lake

(3) Soils

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

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

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

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

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

A soil survey by the Natural Resource Conservation Service (NRCS) shows there are six out of the eight possible general classifications (Classes I through Class VIII) occurring in the reservoir area. The erosion hazards and limitations for use increase as the class number increases. Class I has few limitations, whereas Class VIII has many. The soil class data for project lands is provided in Table 2.2. This data is compiled by the NRCS and is a standard component of natural resources inventories on USACE lands. This, and other inventory data, is recorded in the USACE Operations and Maintenance Business Information Link (OMBIL).

Table 2.2 Soil Classifications

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

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

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

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

(4) Minerals

According to the Arkansas Geological Survey website, Cleburne and Van Buren counties have 64 sand and gravel pits, shale, and crushed and dimension stone quarries that are either active, intermittent, abandoned or reclaimed (AGS 2017; Figure 2.7). Three abandoned coal mines are reported in the two counties, with only one in the Greers Ferry watershed. One phosphate rock mine is reported in Van Buren County near Leslie, but not within the Greers Ferry Lake watershed. The Arkansas Department of Environmental Quality monitors all sites to ensure there are no impacts to the surrounding environment.

Natural Gas and impacts to the Fayetteville Shale: To date, no drilling activity has taken place on USACE lands or under Greers Ferry Lake. Mineral rights for the Federal Government are managed by the Bureau of Land Management. Figure 2.8 shows the locations of the gas wells near Greers Ferry Lake.

Figure 2.7 Minerals at Greers Ferry Lake Study Area

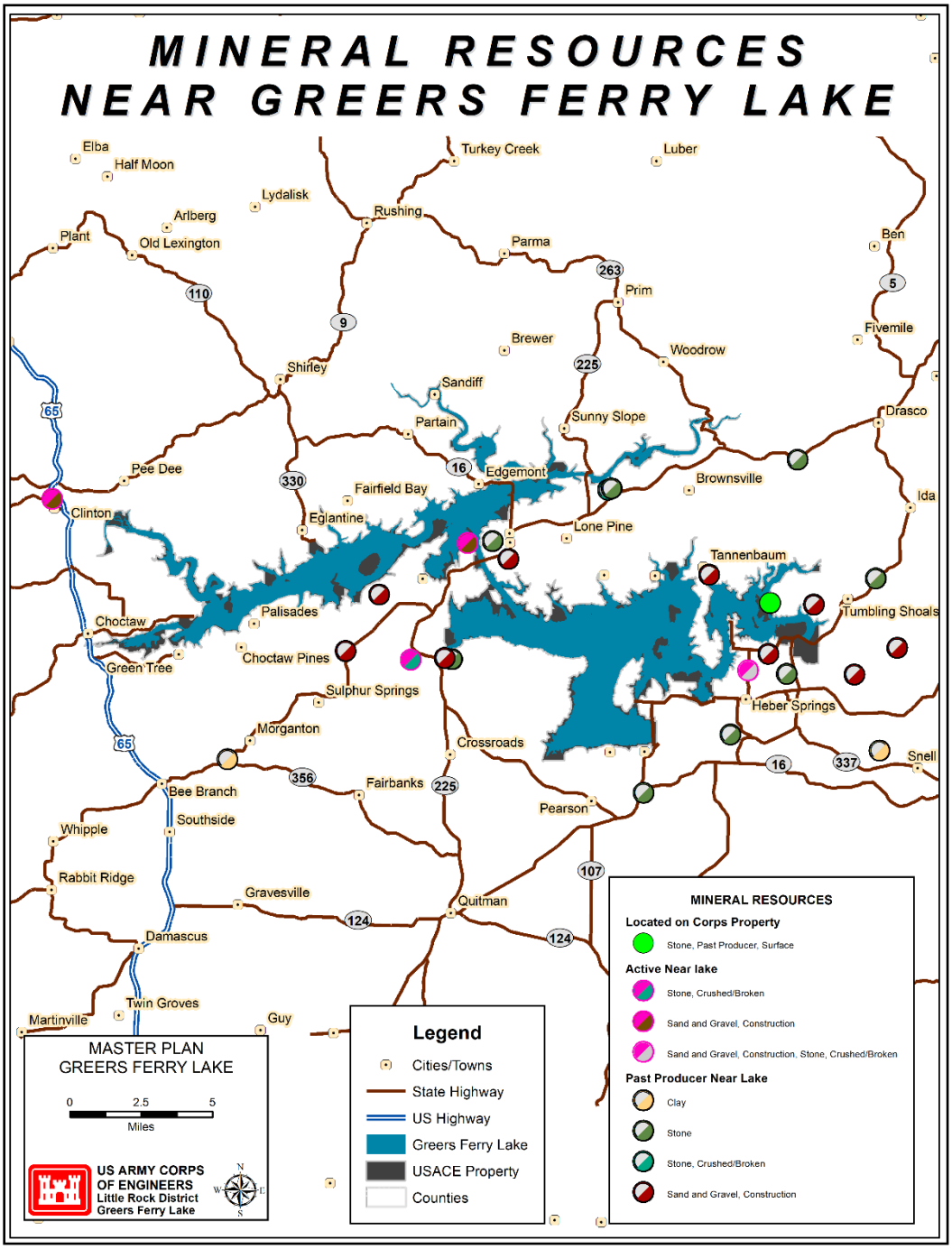
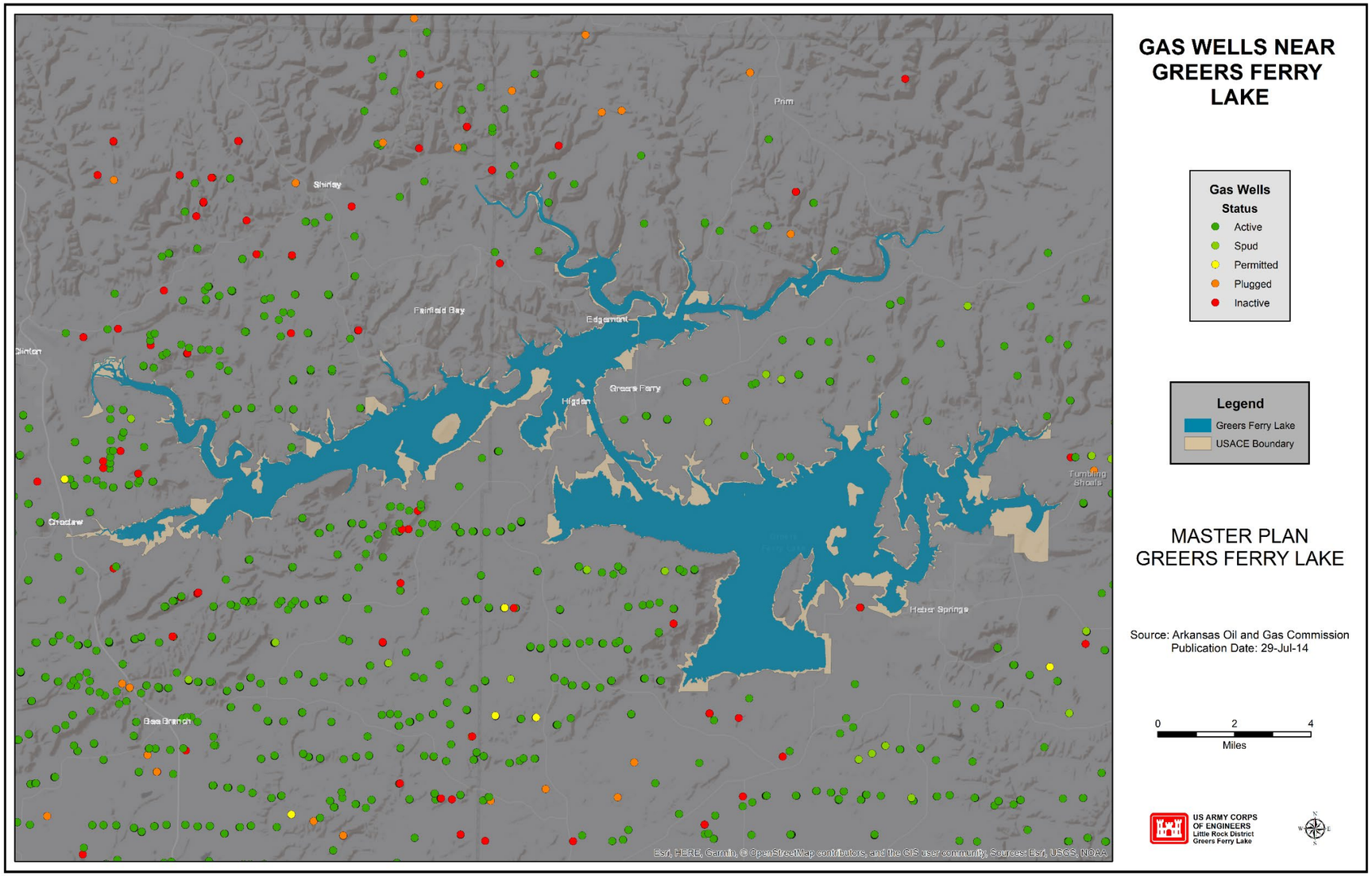


Figure 2.8 Gas Wells near Greers Ferry Lake Study Area



h. Resource Analysis (Level One Inventory Data)

Operational civil works projects administered by USACE are required, with few exceptions, to prepare an inventory of natural resources. The basic inventory required is referred to within USACE regulations (ER and EP 1130-2-540) as a Level One Inventory (https://www.publications.usace.army.mil/Portals/76/Publications/EngineerRegulations/ER_1130-2-540.pdf and https://www.publications.usace.army.mil/Portals/76/Publications/EngineerPamphlets/EP_1130-2-540.pdf, respectively). This inventory includes the following:

- Vegetation in accordance with the National Vegetation Classification System through the sub-class level;
- Assessment of the potential presence of special status species including but not limited to federal and state listed endangered and threatened species, migratory species, and birds of conservation concern listed by the U.S. Fish and Wildlife Service (USFWS);
- Lland (soils) capability classes in accordance with the NRCS criteria; and
- Wetlands in accordance with the USFWS' Classification of Wetlands and Deepwater Habitats of the United States.

This basic inventory information is used in preparing project Master Plans and OMP. An overview of the natural resources and related management actions at the project is provided in the following sections and paragraphs.

(1) Fish and Wildlife Resources

(a) Fisheries

Greers Ferry Lake is fed by the Middle Fork, Devils Fork and South Fork, all tributaries of the Little Red River. Since impoundment was completed in 1962, the few remaining native forests that were submerged provided little structure and forage habitat for fish. Nevertheless, this is a clear, deep, upland lake that is rich with ichthyofauna. The 1,146 square mile watershed is home to 83 of Arkansas' 215 fish species. The predominant game fish species include crappie, largemouth bass, smallmouth bass, spotted bass, walleye, white bass, hybrid striped bass, and catfish. The Little Red River directly below the dam is heavily stocked with rainbow trout on a "put and take" basis.

Trout are provided by a federal fish hatchery operated by the USFWS located just below the dam. Greers Ferry National Fish Hatchery was established to mitigate for fishery resources which were lost due to the construction of federal water development projects in the Southeast. This is accomplished by stocking rainbow and brook trout in waters impacted by federal dams. The hatchery was established in 1965 to produce trout for restocking the cold tail waters below Greers Ferry and in cooperation with State game and fish agencies, the hatchery distributes approximately 200,000 pounds of trout each year to suitable tail waters below USACE dams in Arkansas and eastern Oklahoma. The hatchery's water supply comes from Greers Ferry Reservoir at a depth of more than 100 feet below the water surface.

The Arkansas Game and Fish Commission (AGFC) is responsible for fisheries management on Greers Ferry Lake. The AGFC maintains one nursery pond on the project. At this nursery, alternate crops of forage and game fish are raised and released directly into the lake. Enforcement of state fishing regulations is the sole responsibility of AGFC personnel. The AGFC and USACE have placed over 100 "fish attractor" structures in the lake to provide cover

and habitat. The work was accomplished by in-house labor and volunteers. Artificial and natural types of structures were utilized. In 2008, project staff, in coordination with AGFC, began utilizing Global Positioning Systems (GPS) to map the known structures and now post the coordinates for the sites on the Greers Ferry Lake homepage and AGFC webpage.

The world record walleye and hybrid striped bass, as well as the state record lake trout were caught at Greers Ferry Lake. The state record brown trout (former world record) and chain pickerel were caught out of the Little Red River, which is currently one of the more popular fishing locations in Arkansas.

(b) Wildlife

Diversified wildlife populations are dependent upon the quantity, quality, distribution, and variety of plant communities, food sources and shelter. Greers Ferry is home to various upland game species that include deer, turkey, and black bear. The principal small game species found in the Greers Ferry Lake area are mourning dove, cottontail rabbits, gray and fox squirrel.

Gadwall, mallard, and numerous diving ducks species are the predominant waterfowl species migrating through the Greers Ferry Lake area. Few puddle ducks spend longer than a couple of winter days on Greers Ferry Lake. A lack of vegetation within shallow water limits the suitable puddle duck habitat. Diving ducks fair better with grebes and coots spending longer periods of time on the reservoir before migrating further south. Great and lesser Canada geese are common to the area. Trumpeter swans are known to migrate to the area as well.

According to Cornell Lab of Ornithology eBird checklist (https://ebird.org/home) for Greers Ferry Lake, over the last 50 years, 95 species of birds have been recorded with notable species that includes the bald eagle, northern bobwhite, greater roadrunner, Harris' sparrow, Henslowe's sparrow, Bonaparte's gull, and yellow-bellied sapsucker.

Principal furbearing animals found on the Greers Ferry Lake project area are mink, opossum, coyotes, gray fox, red fox, muskrat, beaver, otter, and raccoon. Greers Ferry has a relatively narrow band of fee land. Wildlife food plots are placed on project lands for wildlife enhancement via contracts, project personnel or cooperative agreements with adjacent landowners. Hunting is allowed on fee land outside park areas within the regulations of the AGFC.

The AGFC has a license for the management of fish and wildlife resources on the 2,016 acres of land and water at Greers Ferry Lake, outside the parks. Other management techniques undertaken by both AGFC and the USACE includes food plots, prescription burns, timber management, and mechanical manipulation such as disking and forestry mulching.

(c) Vegetative Resources

The following information offers a snapshot of what is known at this point and is by no means definitive. A comprehensive vegetative inventory would be needed to make such a determination.

Greers Ferry Lake is split between two ecoregions: the northern half lies on the Boston Mountains and southern portion in the Arkansas Valley Hills (Ozark Province).

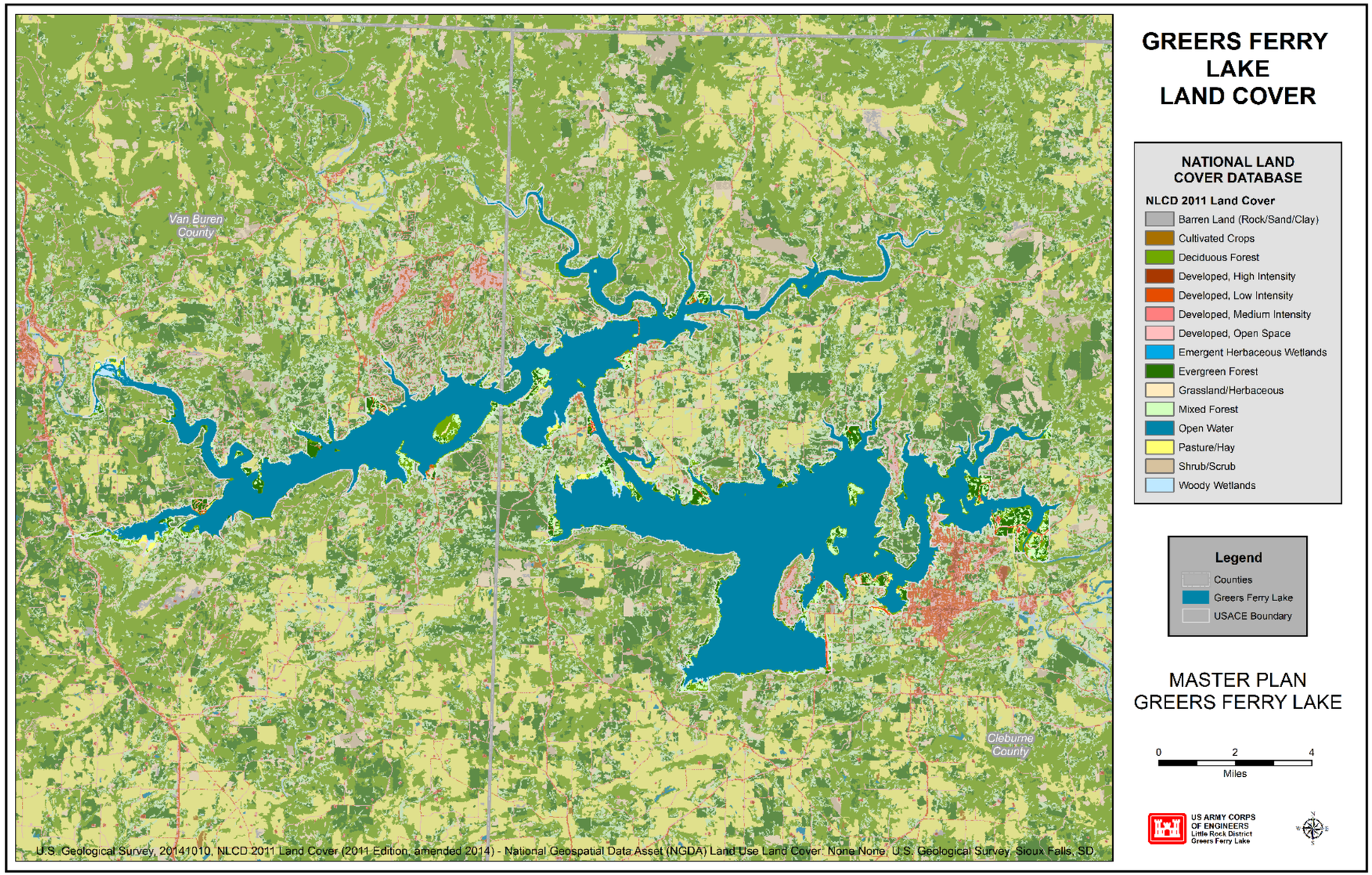
The Lower Boston Mountains ecoregion is a mosaic of woodland, forest, and savanna that contrasts with the denser, moister, and more closed forests of the Upper Boston Mountains. Potential natural vegetation is oak–hickory–pine and oak–hickory forests; short-leaf pine is much more common here than in the Upper Boston Mountains, and is especially widespread on drier, south- and west-facing slopes underlain by sandstone. Both precipitation and forest density decrease toward the west, where oak–pine woodland or savanna become common.

The Arkansas Valley Hills ecoregion is characterized by hills, valleys, and cuestas, with some scattered low mountains. Potential natural vegetation is mainly oak-hickory forest and oak-hickory-pine forest. Common native trees include blackjack oak, post oak, red oak, white oak, and shortleaf pine. Land use in the more rugged areas is primarily forest, though, once the project was completed, many areas were converted from crop lands to plantation style forestry, primarily loblolly pine, and are now being managed as a mixed forest of pine and hardwoods. Less rugged areas are dominated by extensive pastureland (Figure 2.9). For further explanation on ecoregions, please see Chapter 2, h. Resource Analysis, (2) Ecological Setting.

Prior to creation of Greers Ferry Lake, the original forest was a shortleaf pine-hardwood type. Early settlers cleared the rich bottomlands for farming. In 1909, the Missouri and North Arkansas Railway was completed resulting in large scale removal of timber. Since the creation of the lake, the upland vegetation above the normal flood pool has remained relatively unchanged. Those areas below the normal flood pool have been subject to a change in vegetation types. During several high flood pools, those upland species that were not flood tolerant were destroyed. These species included mainly shortleaf pine and upland oaks. Where there is sufficient soil, several plants such as cypress, sweet gum, maple, button bush, black willow, and river birch have become established in place of the original upland vegetation.

Floristic inventory and habitat assessments completed by the Arkansas Natural Heritage Commission (ANHC) establishes that there are four habitat types or plant communities occurring on or immediately adjacent to USACE property at Greers Ferry Lake that are known to support plant species of state conservation concern: 1) sandstone glades, 2) bluffs, 3) upland depression wetlands, and 4) mesic hardwood forests. Of these, sandstone glades and upland depression wetlands are considered communities of state conservation concern.

Figure 2.9 Land Cover at Greers Ferry Lake Study Area



Sandstone glades are naturally open grasslands in forested landscapes where bedrock is exposed or comes close to the surface of the ground. In their natural state, glades are characterized by treeless or very sparsely wooded openings dominated by a variety of drought-tolerant grasses, wildflowers, and shrubs. Glade soils are thin and while they may be wet in the winter and spring (due to bedrock limiting infiltration of water) they are exceedingly dry in the summer and early fall. Glades are widely recognized as habitats of conservation concern and there are many resources available regarding their ecology, restoration, and management. Sandstone glades in the Boston Mountains and Arkansas Valley Hills are a community of conservation concern, support many rare plant and animal species, and have declined range wide due to fire suppression, conversion to pasture, development, mining, and inundation by lakes.

Species of concern occurring on sandstone glades on Greers Ferry Lake are known to support the following species of state conservation concern: Nuttall's pleat-leaf (*Nemastylis nuttallii*) and silky aster (*Symphyotrichum sericeum*). Several other species of state conservation concern are known to occur in sandstone glades nearby and may also occur on USACE lands around the lake but a comprehensive vegetative inventory is needed to make a definitive determination.

Bluffs are common around Greers Ferry Lake and when taken to include the band of steep, rocky slopes at their tops and the band of loose, rocky talus at their bases, represent an ecologically important and biologically diverse habitat. These bluffs support many if not most of the species in adjacent communities (both the drier communities above the bluffs and the more mesic ones often found below them) but also include specialized species not found in other habitats.

Bluffs are also ecologically significant because they serve as important refugia as species migrate over time in response to climate change. In this sense, dry, exposed bluffs can be thought of as having 'caught' various western 'desert species' during past hot and dry periods and given them the needed habitat to persist to the present day. Other species are endemic to a narrow region and grow only in specialized habitats, often associated with bluffs.

Bluffs around Greers Ferry Lake occur on both sandstone and shale bedrock and examples range from extremely dry and exposed to shaded and saturated with groundwater seepage. Several plant species of conservation concern occur on bluffs in the area, including the globally rare Arkansas spring-beauty (*Claytonia arkansana*), which is known only from sandstone bluffs in three counties (Cleburne, Faulkner, and Van Buren) and nowhere else in the world.

Other plant species of state conservation concern on or immediately adjacent to USACE property around Greers Ferry Lake are Arkansas alumroot (*Heuchera villosa var. arkansana*), Virginia (yellow) nail-wort *(Paronychia virginica*), hairy mock orange (*Philadelphus hirsutus*), and Appalachian filmy fern (*Trichomanes boschianum*).

Upland depression wetlands are small, naturally occurring wetlands found in depressions within flat upland areas such as ridge tops, benches, or in saddles. Despite their small size, these depression wetlands are known to harbor a number of plant species associated with bottomlands along larger river systems and that are uncommon to rare in the Interior Highlands. Upland depression wetlands on Greers Ferry Lake are known to support corkwood (*Leitneria floridana*) a species of state conservation concern.

Lastly, mesic hardwood forests, are moderately moist, and are found in cool, shaded landscape positions protected from the drying effects of direct sun and wind. These forests generally have a closed canopy of deciduous, drought-intolerant hardwood trees and species found in the understory are adapted to shaded conditions during the growing season. Many forbs (broadleaf wildflowers) found in mesic forests are spring ephemerals that do most of their growing, and often their flowering, in the early spring before the hardwood trees leaf out and shade the forest floor. Many of these species disappear by summer while others may persist in the shaded understory.

Mesic hardwood forests on Greers Ferry Lake are known to support the following species of state conservation concern: Carey's sedge (*Carex careyana*), hairy sedge *(Carex hirtifolia*), spreading oval sedge (*Carex normalis*), bur-reed sedge (*Carex sparganioides*), blue cohosh (*Caulophyllum thalictroides*), southern running-pine (*Diphasiastrum digitatum*), and Ozark spiderwort (*Tradescantia ozarkana*) (ANHC 2018).

(d) Threatened and Endangered Species

In accordance with the Trust Resources Report generated by the USFWS web-based Information for Planning and Conservation tool (IPAC), there are four federally-listed endangered species and three threatened species that potentially occur at Greers Ferry Lake. These seven species are listed in Table 2.3. The bald eagle (*Halieetus leucocephalus*) is common during the winter months and nests around Greers Ferry Lake and was formerly listed by the USFWS as an endangered or threatened species. Although delisted in 2007, due to recovery of the species, both the Bald and Golden eagles are still protected in accordance with the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668c).

While species become imperiled for a variety of reasons including over-hunting, over-fishing, and habitat loss as a result of human development and pollution; of these, habitat loss is the main contributor that imperils most species. A threatened species is one that is likely to become endangered within the foreseeable future. An endangered species is one in danger of extinction throughout all or a significant portion of its range.

Species that remain listed include transient populations of Gray and Indiana bats. Both are federally endangered species that have been documented on and near the Greers Ferry Lake area, as well as populations of the Northern long-eared bat which is now listed as threatened (Table 2.4).

Table 2.3 Federally Protected, Threatened & Endangered Species for Greers Ferry Lake

Common Name	Federal Status	Biological Opinion
Birds		
Bald Eagle *Halieetus leucocephalus*	*Protected under the Bald Eagle and Golden Eagle Protection Act*	No
Mussels		
Rabbitsfoot *(Theliderma cylindria)*	*Threatened*	No
Speckled Pocketbook *(Lampsilis streckeri)*	*Threatened*	No
Yellowcheek Darter *(Etheostoma moorei)*	*Endangered*	No
Bats		
Gray Bat *(Myotis grisescens)*	*Endangered*	No
Indiana Bat *(Myotis sodalis)*	*Endangered*	No
Northern Long-eared Bat *(Myotis septentrionalis)*	*Threatened*	No

Table 2.4 references the Arkansas Natural Heritage data sets for species of state concern which have been reported on or near project lands. There are other (state-listed) threatened and endangered species that are known to be in the general area but have not been recorded as occurring on USACE lands at Greers Ferry Lake.

Table 2.4 State Species of Concern Occurring at Greers Ferry Lake

Species	State Status	State Rank
Bald Eagle *Halieetus leucocephalus*	Protection provided under The Bald Eagle & Golden Eagle Protection Act	S3B, S4N
Gray Bat *(Myotis grisescens)*	State Endangered	S2S3
Northern long-eared bat *(M. septentrionalis)*	State Endangered	S1S2
Creole Pearly-Eye (Butterfly) *Lethe creola*	Inventory Element (INV)	S3
Little brown bat *Myotis lucifugus*	INV	S1
Carey's sedge *Carex careyana*	INV	S3
Hairy sedge *Carex hirtifolia*	INV	S3
Spreading oval sedge *Carex normalis*	INV	S1
Bur-reed sedge *Carex sparganioides*	INV	S3
Blue cohosh *Caulophyllum thalictroides*	INV	S2

Southern running-pine **Diphasiastrum digitatum*	INV	S1S2
Arkansas alumroot *Heuchera villosa var. arkansana*	INV	S3
Corkwood *Leitneria floridana*	INV	S3
Nuttall's pleat-leaf *Nemastylis nuttallii*	INV	S2
Arkansas spring-beauty *Claytonia arkansana*	INV	S2
Yellow nail-wort *Paronychia virginica*	INV	S2
Hairy mock orange *Philadelphus hirsutus*	State Threatened	S2S3
Silvery aster *Symphyotrichum sericeum*	INV	S2
Ozark spiderwort *Tradescantia ozarkana*	INV	S3
Appalachian filmy fern *Trichomanes boschianum*	State Threatened	S2S3

***S2**: Imperiled: Imperiled in the state because of rarity or because of some factor(s) making it very vulnerable to extirpation from the nation or state (1,000 to 3,000). Typically 6 to 20 occurrences or few remaining individuals (1,000 to 3,000). **S3**: Vulnerable: Vulnerable in the state either because rare and uncommon, or found only in a restricted range (even if abundant at some locations), or because of other factors making it vulnerable to extirpation. Typically 21 to 100 occurrences or between 3,000 and 10,000 individuals; **G3**: Vulnerable: Vulnerable globally either because very rare and local throughout its range, found only in a restricted range (even if abundant at some locations), or because of other factors making it vulnerable to extinction or elimination. Typically 21 to 100 occurrences or between 3,000 and 10,000 individuals; **G5**: Secure: Common; widespread and abundant (although it may be rare in parts of its range, particularly on the periphery). Not vulnerable in most of its range. Typically with considerably more than 100 occurrences and more than 10,000 individuals. **INV:** The Arkansas Natural Heritage Commission is currently conducting active inventory work on these elements. Available data suggests these elements are of conservation concern. **"Q"** in the global rank indicates the element's taxonomic classification as a species is a matter of conjecture among scientists. **T** sub-ranks are given to global ranks when a subspecies, variety, or race is considered at the state level. The sub-rank 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.*

(e) 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 Project is not protected from the spread of invasive species nor native pest species. Locally, USACE personnel work with partners including AGFC, University of Arkansas Extension Services and United States Department of Agriculture, to help stop or minimize the spread of some of the Ozarks most unwanted species. These would include feral hogs, zebra mussels, kudzu, privet, sericea lespedeza, gypsy moth and the emerald ash borer. USACE Rangers also conduct monitoring for emerald ash borer and gypsy moth infestations using traps provided by the State Plant Board on project lands.

(f) Wetlands

Wetlands and other waters of the U.S. are regulated under Section 404 of the Clean Water Act, as amended, and EO 11990, Protection of Wetlands. According to USACE regulations, wetlands are those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

No official wetland delineation has been conducted for the Greers Ferry Project since impoundment.

More detailed descriptions of wetland classes, subclasses, and community types can be found at the Arkansas Multi-Agency Wetland Planning Team homepage.

(2) Ecological Setting

The Natural Resource Management Mission of the USACE (ER 1130-2-550, Chapter 2, Paragraph 2-2.a.(1), dated 15 November 1996) states the following:

"The Army Corps of Engineers is the steward of the lands and waters at Corps water resources projects. Its Natural Resource Management Mission is to manage and conserve those natural resources, consistent with ecosystem management principles, while providing quality public outdoor recreation experiences to serve the needs of present and future generations.

In all aspects of natural and cultural resources management, the Corps promotes awareness of environmental values and adheres to sound environmental stewardship, protection, compliance and restoration practices.

The Corps manages for long-term public access to, and use of, the natural resources in cooperation with other Federal, State, and local agencies as well as the private sector.

The Corps integrates the management of diverse natural resource components such as fish, wildlife, forests, wetlands, grasslands, soil, air, and water with the provision of public recreation opportunities. The Corps conserves natural resources and provides public recreation opportunities that contribute to the quality of American life." (ER 1130-2-550, 1996)

In support of this mission statement, the following paragraphs describe the ecoregion where Greers Ferry Lake is located and the natural resources components found within the project area.

Ecoregions are areas with generally similar ecosystems and with similar types, qualities, and quantities of environmental resources. Ecoregion boundaries are determined by examining patterns of vegetation, animal life, geology, soils, water quality, climate, and human land use, as well as other living and non-living ecosystem components.The purpose of ecological land classification is to provide information for research, assessment, monitoring, and management of ecosystems and ecosystem components. Federal agencies, state agencies, and nongovernmental organizations responsible for different types of resources within the same area use this information to estimate ecosystem productivity, to determine probable responses to land

management practices and other ecosystem disturbances, and to address environmental issues over large areas, such as air pollution, forest disease, or threats to biodiversity.

The ecoregions that encompass Greers Ferry Lake and surrounding areas are listed by the EPA as Omernik Level 4 ecoregions including the "Lower Boston Mountains" and "Arkansas Valley Hills" (Figure 2.10). These ecoregions are defined as follows:

Location: The Lower Boston Mountains region lies immediately north of the Arkansas Valley Hills and south of the Ozark Highlands in northwestern Arkansas and northeastern Oklahoma. The Arkansas Valley Hills region lies in eastern Oklahoma and western Arkansas, just south of the Lower Boston Mountains and north of the Ouachita Mountains.

Vegetation: Mostly oak-hickory forests are found in the Boston Mountains ecoregion: red oak, white oak, post oak, blackjack oak, and hickories remain the dominant tree species in this region, although shortleaf pine and eastern red cedar are found in many of the lower areas and on some south- and west-facing slopes. Mesophytic forests in ravines and on north-facing slopes have sugar maple, beech, red oak, white oak, basswood, and hickory. Natural vegetation included in the Arkansas Valley Hills ecoregion are oak savanna and oak-hickory-pine forests. Post oak, blackjack oak, southern red oak, hickory, shortleaf pine, some planted loblolly pine. Floodplains have bottomland oaks, sycamore, sweetgum, willow, eastern cottonwood, green ash, elm.

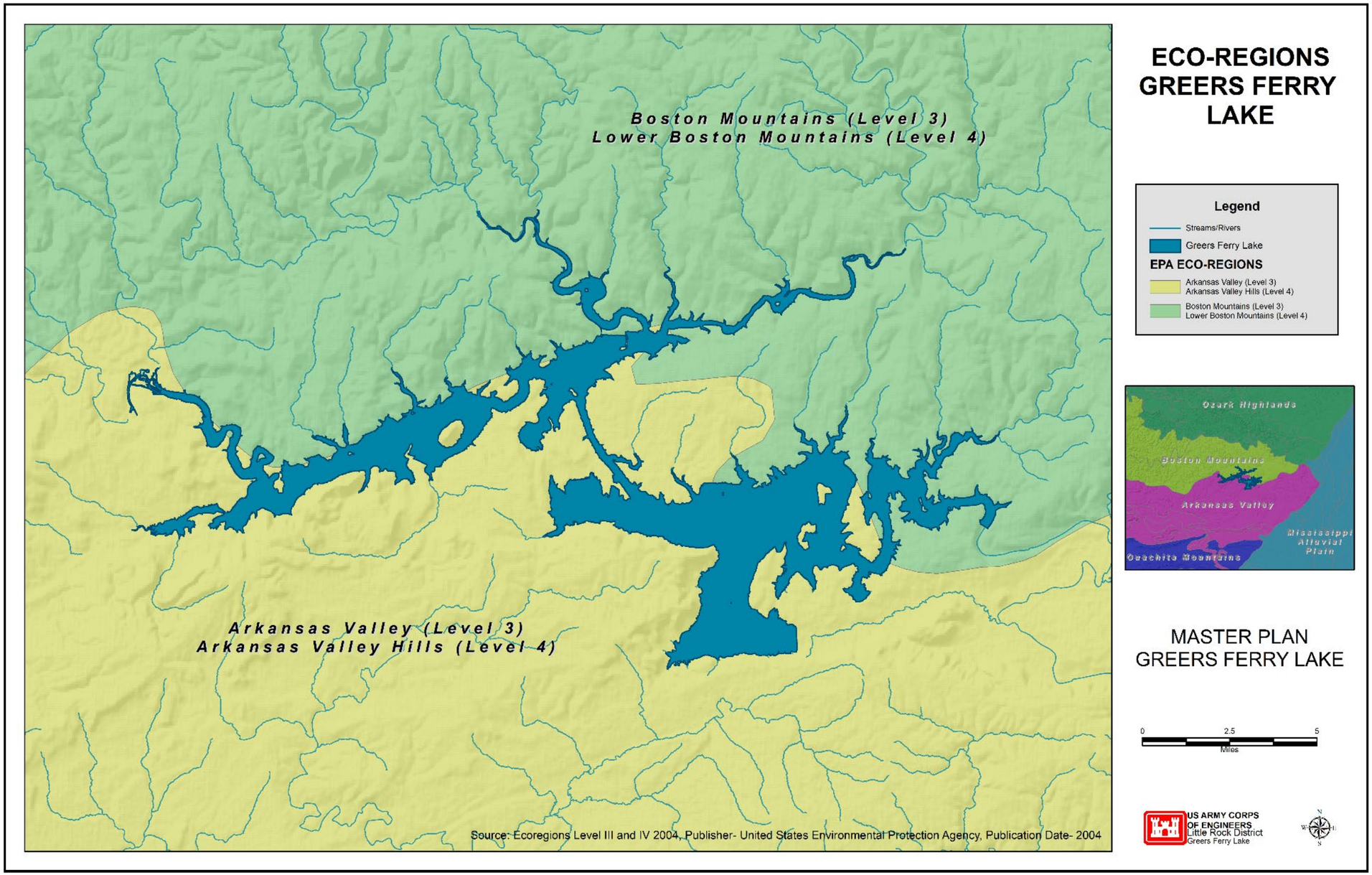
Hydrology: There is a high density of intermittent and perennial streams, of moderate to high gradient. There are fewer springs than in the Ozark Highlands to the north and a moderate density of low to moderate gradient perennial streams and some intermittent streams. Major rivers include the Canadian and the Arkansas and several large reservoirs, including Greers Ferry, occur. Streams have considerably lower dissolved oxygen levels than those of most of the adjacent regions and support different biological communities.

Terrain: The Lower Boston Mountains region is a deeply dissected mountainous plateau, in contrast to the nearby Ouachita Mountains, which comprises folded and faulted linear ridges. Elevations range from 213 feet to 2,798 feet. Geology is mostly sandstone, shale, and siltstone from the Pennsylvanian period, in contrast to the limestone and dolomite of the adjacent Ozark Highlands. Ultisols and Inceptisols are common with a thermic soil temperature regime and udic soil moisture regime. The Arkansas Valley Hills region consists of plains with hills, some open low mountains that level to undulating floodplains and terraces. A region of valleys and ridges, the physiography is much less irregular than that of the Boston Mountains to the north and the Ouachita Mountains to the south, but more irregular than that of the ecological regions to the west and east. Elevations range from 246 feet to 2,752 feet. The rock and mineral formations are mostly sandstone, shale, coal, and limestone from the Pennsylvanian period. Soils are mostly Ultisols and Inceptisols, with a thermic soil temperature regime and udic soil moisture regime.

Wildlife: Black bear, white-tailed deer, coyote, red fox, gray fox, bobcat, beaver, skunk, mink, muskrat, swamp rabbit, raccoon, armadillo, gray squirrel, wild turkey, wood thrush, hooded warbler, mourning dove, bob white quail, a variety of ducks, box turtle, and many fish species occur.

Land Use/Human Activities: The Boston Mountains region is sparsely populated and recreation and forestry are principal land uses, along with some livestock farming. Pasture and hay land occupies some flatter areas, along with a few peach and apple orchards. Some public national forest lands occur. Arkansas Valley land uses include forestry, agriculture, farm pasture and woodlots, and livestock grazing. About one-fourth of the region is grazed and roughly one-tenth is cropland. Crops include soybeans, corn, grain sorghum, wheat, hay, and alfalfa, some orchards and vegetables, and poultry. There is some coal mining and natural gas production. Small areas of public national forest land are also present. Larger towns and cities include McAlester, Sallisaw, Poteau, Fort Smith, Waldron, Clarksville, Russellville, Morrilton, Conway, Heber Springs, and Searcy.

Figure 2.10 Eco-Regions at Greers Ferry Lake Study Area



i. Utilities

Utilities passing through and providing service on project lands include telephone lines, communication cables, electrical transmission and distribution lines, electrical switchyard, water intake and distribution lines, floating restroom facilities, and sewage pipelines.

j. Timber Resources

Greers Ferry Lake is surrounded by forested land managed primarily for its aesthetic value and wildlife habitat, and secondarily for forest products. These forests provide part of the outdoor experience for the recreating public. Forest management on these lands includes prescribed burning, selective thinning, and timber harvesting to enhance wildlife habitat, control eastern red cedar encroachment, restore forest vigor and promote forest health. These activities generate limited revenue which is reinvested in the natural resource management operations at Greers Ferry Lake. The Greers Ferry Lake area is an excellent example of the typical "Arkansas Hill Country". The major forest types are the Upland Hardwood and Shortleaf Pine association. The Bottomland Hardwoods cannot be considered a major forest association although the formation of the Greers Ferry Lake has created a micro-environment that supports species of this forest association. Tree species common to the Bottomland Hardwoods have naturally colonized some coves and tributaries of the lake shoreline. Blackgum (Nyssa sylvatic) Sweetgum (Liguidambar styraciflua), Black Willow (Salix nigra), and American Sycamore (Platanus occidentalis) have become the dominant species along many shorelines because of the fluctuation of the lake pool. A typical characteristic of the Bottomland Hardwood association is their ability to survive with 10 to 20% of their root system covered with water. The Upland Hardwood and Shortleaf Pine associations can partially be attributed to the physiographic variations from stream and river valleys to the steep, rocky slopes and benches created in the flood plain. The vegetation can be classified by its location within these variations. The Shortleaf Pine - Oak- Hickory association is more prominent on the mountainous, rocky slopes, while the Maple-Sycamore-Gum association are found on the lower benches and stream valleys.

k. Cultural Resources

The following is a brief history of the human population of Arkansas:

Paleo-Indian (at least 12,000-8,500 B.C.) – The beginning of the Paleo-Indian period is hotly contested though it is generally accepted that people occupied the Americas by at least 12,000 years ago by coming across Beringia—the land mass across the Bering Strait exposed by the retreating Laurentide Ice Sheet during the Pleistocene. Newer hypotheses suggest that, in addition to the accepted land crossing, an earlier migration or migrations occurred via a maritime/island hopping route from Asia to North America.

Adding to the uncertainty, at least for the time being, is the growing body of knowledge of Paleo sites from a submerged context. As one of the newest sub disciplines of archaeology, the search for submerged Paleo sites results from new technologies in remote sensing and scuba diving. The sites sought are the result of advancing coastlines when the same ice sheets that created Beringia melted during the later Holocene, freeing up an immense amount of water. In some locations, 60 miles or more of what was once dry land is now under the sea. Not only coastlines, but inland

waterways are also prime locations for submerged Paleo sites as the distribution of known Paleo points suggests the use of major river valleys and streams (Anderson 1996, Thurmond 1990). Higher water levels and changing paths, both natural and manmade, affect these waterways, as well. To date, known pre-Clovis sites include Paisley Caves, Oregon; Schaefer and Hebior, Wisconsin; Monte Verde, Chile; Debra L. Friedkin, Texas; and recently the Page-Ladson site, Florida, where artifacts dating to approximately 14,550 calendar years B.P. (before present) were found in a submerged, buried, and well-dated stratified context (Halligan et al. 2016).

Regardless of exactly when the peopling of the Americas took place, certain cultural attributes are associated with this culture period. The namesake for the Clovis culture comes from the finding of a fluted stone point found within the skeletal remains of a mastodon in Clovis, New Mexico in 1932 by Edgar Howard. That initial find summarizes the entirety of Paleo-Indians: small nomadic bands of hunter-gatherers with a heavy emphasis on hunting now-extinct megafauna such as the mastodon, camels, etc. with finely crafted fluted stone points. The small bands of individuals, their nomadic lifestyle, the decomposition of all of their material culture except for stone tools, and their predilection to live near waterways and coastlines, which are now significantly different than they were at the time, all combine to make Paleo-Indians difficult to locate and study (Archaeology Southwest 2018).

In Arkansas, most Clovis sites have been located in the eastern portion of the state indicating that Paleo people were migrating down the Mississippi River from the northern plains. Clovis points tend to occur in regional clusters interpreted as “staging areas” or areas where Paleo people stopped migrating and began to settle and make regional adaptations in response to their environments. Clovis people lived in fairly small groups of one to two dozen members and at the time there may have only been 100-150 people in all of modern Arkansas (Sabo 2008c).

Dalton: Transitional Paleo-Indian/Archaic (8,500-7,900 B.C.): Continuing along the same general hunter-gatherer subsistence strategy, the Dalton (debatably Paleo or Archaic, hence the transitional period) is marked by similarly fluted stone points that lend their name to the period. However, Dalton points were used to hunt smaller animals such as deer rather than the megafauna that the Paleo people hunted until they went extinct with the transition from the Pleistocene to the Holocene. While marked primarily by the presence of Dalton points, the Dalton people also had stone adzes, abraders, and other cutting implements for woodworking as well as bone awls and stone perforators for hide-working, and abrasive grinding stones for processing plant materials. Habitation locations occur in open areas, as well as rock shelters. A relatively diverse array of subsistence is found in association with Dalton sites including terrestrial and riverine fauna as well as wild plants and nuts (Sabo and Early 1990:41-42). The population during the Dalton phase increased substantially from the Paleo period to around 500 people in Arkansas (Sabo 2008b).

One of the, if not the premier collections of Dalton artifacts in the world, was found in the northeast corner of Arkansas at the Sloan Site. The Sloan Site is about a 12x12 meter Dalton-era cemetery that included a large number (n=439) of stone tools including 146 Dalton points, 42 adzes, 95 bifaces, 33 end scrapers, 9 backed unifaces, 59 flaked tools, 3 chert hammers, 5 cores, 35 sandstone abraders, 5 cobble tools, 5 pieces of red ochre, and a

single ironstone object placed as funerary goods with an estimated 28-30 burials (Morrow 2016). The Sloan point, a subtype of Dalton point, is named for this site.

Archaic (8,000-1000 B.C.) - The longest period in the prehistory of North American people, the Archaic, continues the hunting and gathering sustenance strategy, though with, perhaps, a greater reliance on gathering of plant resources than in the previous Paleo and Dalton/Transitional periods. Over the seven millennia that this period covers, localized groups became much more efficient in exploiting local resources and became less nomadic occupying, perhaps seasonal camps. During the Holocene Climatic Optimum, after 7,000 B.C., (also referred to as the Altithermal, Hypsithermal, or "Great Warming"), average temperatures rose as much as 7.2 degrees F (4 degrees C). Along with the increased temperature there was a decrease in annual rainfall. This resulted in hotter, drier conditions that lasted until about 3,000 B.C. Decreased water resulted in reduced vegetation and erosion and diminished the availability of plant and animal resources making life even more difficult for Archaic peoples. Changing environmental conditions resulted in some areas, especially broad river valleys surrounded by uplands that offered shelter, providing better conditions. Unsurprisingly, Archaic communities began to concentrate in those areas.

Early Archaic
As Early Archaic people became more firmly Archaic and less Paleo, their increased sedentism is reflected in the archaeological record, particularly in the rock shelters present in Arkansas. The Archaic Period marks the development of different styles of points in different geographic locations rather than the Clovis type points present throughout North America marking the Paleo-Indian Period. The general trend was towards slightly smaller points, rather than the distinct fluting. As a way to securely haft (attach) the point to a spear or dart shaft, notches and stems became the preferred method to attach the points for use.

Middle Archaic
This stylistic preference is demonstrated in the Tom’s Brook culture people of the Middle Archaic (6000-4000 B.C.). The Tom’s Brook people lived in western Arkansas and occupied, essentially, permanent camps from the Arkansas River to the Red River and are recognized in the archaeological record by the telltale Big Creek projectile points made only by the Tom’s Brook people. This is also the time period when we begin to see construction of earthen and shell mounds. There are some Archaic mounds in southeast Arkansas dating to the late Archaic (around 1200 B.C.) and the far more elaborate Poverty Point site in Louisiana dates to the Late Archaic as well (Sabo 2008a).

Late Archaic
As populations concentrated in fertile river valleys, Archaic people increasingly relied on plant foods such as seeds, grains, and nuts, which could be collected while in season and stored for later use. At the same time, they began to alter the habitats surrounding their settlements. Human activities such as clearing vegetation around the village and foot traffic churned up the soil and exposed it to sunlight, which, in turn, attracted weeds and grasses that prefer disturbed areas. Several of these plants (chenopodium, sumpweed, knotweed,

maygrass, and little barley) provide plentiful, highly nutritious seeds. Many of these ended up as cultigens (Sabo 2008a).

The Poverty Point mound complex also supported a massive trade network that brought a number of products that could not have been obtained locally, shells moved inland, copper arrived from the Great Lakes, and knappable stone was traded. Much of the prestige material was used to construct art for art's sake such as effigy beads and figurines (Sabo 2008a).

With the less transient lifestyle, the population increased, particularly in the Late Archaic. Perhaps due to the population increase, the abundance of resources in the area, or the relative stability of the environment following the Holocene. The Archaic period is well represented in the Greers Ferry Lake project area.

Woodland (1000 B.C. – A.D. 1000) - The Woodland period is characterized by an increasingly sedentary lifestyle, though still relying on hunting and gathering. It is thought that during this time that encouragement, cultivation, and selection of native flora became an important part of the subsistence strategy leading to the increase in sedentism. As populations were staying in one location longer, permanent occupational markers in the form of burial mounds were constructed.
The Woodland period saw great advances in technologically with the transition from the atlatl as a primary weapon and hunting tool to the development of the bow and arrow. As crop raising began to supplant hunting as a primary food acquisition strategy, it began a "container revolution." This lead to the Woodland period development and use of coarse ceramics—tempered with grog or bone. These ceramics were often decorated and, in some cases, the ceramics were pierced in such a way that they were not useful as a vessel and were therefore just decorative or religious. The exterior of the ceramics were often decorated with cord or fabric being impressed, or lines incised, into the pot prior to firing.

Pictographs (painted) and petroglyphs (carved) rock art appears to occur at numerous Woodland sites. They contain both real depictions of people, animals, and insects as well as abstract and geometric designs. Effigies in the form of ceramics, sandstone tablets, and carved stone pipes take the form of people and animals. In many of these cases, the effigies have fantastical features suggesting they were conceived as supernatural. This has been interpreted as the explicit existence that the Woodland people understood—the existence of interaction between the spirit and human worlds, or broadly, a form of religion.

Mound building continued though not necessarily with the purpose of interring the dead. In Arkansas, the Toltec Mounds (errantly attributed to the Toltec culture in the 19th century) near modern-day Scott, Arkansas represent the work of the Plum Bayou culture (A.D. 600-1,000). Several of the mounds here are pyramidal in shape with flattened tops that were used to support buildings at their peaks rather than hold corpses. Many of the mounds and structures (as proven archaeologically) correspond to celestial objects or events. They are believed to have been the houses or temples of important people, indicating a less egalitarian social organization with "elites" and "commoners." The Woodland period is also responsible for a very large number of effigy mounds constructed to emulate animals. The largest and best

known of these is the Serpent Mound in Ohio, though others exist throughout the country (Sabo 2009). It is during the Middle Woodland (A.D. 200-A.D. 400) that the descendants of two of the three primary tribes that historically occupied modern day USACE, Little Rock District can trace their lineage to the Dhegiha Siouan tribes of the Ohio River Valley. The Dhegiha tribes include the Omaha, Ponca, Kaw, Quapaw, and Osage. During this Middle Woodland period, the Dhegiha collectively began migrating down the Ohio River Valley to the confluence with the Mississippi River. During the Late Woodland (A.D. 400-A.D. 500), the Dhegiha began to separate into the modern tribes we see today. The Dhegiha, with the exception of the Quapaw, traveled up the Mississippi River to around modern day St. Louis. The Quapaw remained to the south and were known as U-ga'-qpa or Quapaw, meaning "the down-stream people." The remaining group turned northward and up the Mississippi River above its confluence with the Ohio, so taking the name U-man'-han or Omaha, or "those going against the wind or current" (Dorsey 1886:215; McMillan 2014:15).

Mississippian (A.D. 900 – 1541) - Sometime after the Quapaw broke off from the larger Dhegiha Siouan tribes, the Omaha established themselves at Cahokia (near modern day St. Louis) and then further separated and broke into four tribes, with the Osage being the last to leave Cahokia around A.D.1300 moving to the upper reaches of the Osage and Missouri Rivers. The Kansa had earlier moved to the Kansas River, and the Omaha and Ponca migrated further up the Missouri River. Desoto encountered "Capaha" or Quapaw on the western bank of the Mississippi, though his encounter occurred south of the confluence of the Arkansas River, where they would later occupy. He encountered no other Siouan names further to the interior in areas later held by the Osage. (McMillan 2014:15-16).

"Osage" is a corruption by later French traders of "Wazha'zhe," the name by which the Osage referred to themselves (Hodge 1910:156). By the contact period, the Osage occupied the area south of the Missouri River into the northern half of Arkansas and further west into Kansas and Oklahoma. The Mississippian period is generally characterized by large scale sedentism and a reliance primarily on agriculture of the "holy trinity" of corns, beans, and squash supplemented by hunting and limited foraging. The sedentary lifestyle led to the further refinement of chiefdoms with a central location occupied by a chief and religious leader with numerous outlying villages primarily engaged in agriculture, with the surplus from the outlying villages allowing the chiefs, religious leaders, and craftspeople to engage in increasingly complex trade networks, religious study and iconography, and refinement of crafts such as ceramics, limited metal work, and development of games such as stickball and chunkey. Like the Woodland, ceramics take both a utilitarian role as well as a ceremonial role in the Mississippian period—often pots were interred with a burial. In fact burial practices changed fairly substantially as the locations of burials and the types of funerary objects interred with the dead demonstrate. The Mississippian social distinctions surpassed the status differences represented in Woodland era burials.

Pottery making developed into a specialized craft and art form during the Mississippian period and numerous forms were constructed and elaborately decorated. Some of these were destined for burials or trade as prestige goods. Shell became the preferred temper material during the Mississippian period (Sabo 2013).

The tool assemblage found at Mississippian sites reflects the reliance on agriculture. Tools to work the field, such as hoe blades made from stone, shells, and bison scapulas are found on Mississippian sites. With the need to clear the woods for agriculture and build the buildings and, later, fortifications required wood working tools. Axes, celts, and adzes are all found in association with Mississippian sites.

The refinement of the bow and arrow as a weapon sees the development of very small, true arrowheads. Often called bird points, they were rarely much wider than the arrow shaft.

The elites of many of these chiefdoms claimed descent from culture heroes or gods and were the possessors of the most prestige goods such as copper, marine shells, or other exotic materials. Chiefdoms bred resentment and competition amongst not only the elites and working class, but also between groups competing for resources in an area. This led to warfare between competing chiefdoms. However, Native Americans conducted warfare much differently than the European armies of the time. Rather than massive armies facing off on a large battlefield, Native Americans typically conducted quick skirmishes or raids. This would be met with a retaliatory attack. Towns began having palisades and moats for protection from raids. The Parkin and Nodena sites in Eastern Arkansas are two prime examples of Mississippian chiefdom sites. The Late Mississippian period saw population dispersal and severe social stress put on the populace. Many of the large mound centers were abandoned prior to the arrival of Europeans and archaeological evidence has found numerous defensive structures such as palisades suggesting that warfare was far more prevalent. Generally the large chiefdoms were abandoned in favor of smaller autonomous groups though they still practiced agriculture.

Early European Contact Historic Period (1541-1682): The first entrada of European explorers into Arkansas came from the Hernando de Soto expedition when they crossed the Mississippi River on 18 June 1541. The Spanish stayed until de Soto's death in the state in May of 1542. The exact route is unknown, though several definitive de Soto expedition artifacts have been located in Arkansas. A glass chevron bead, a Clarksdale brass bell and fragments of two more bells, two pieces of lead shot, and a bronze coin have been found at the Parkin Site near the present day town of Parkin along the St. Francis River—roughly 300 miles from the project office at Rogers (Mitchem 2011). There are two professionally prepared/accepted iterations of where modern historians believe de Soto's path travelled through Arkansas (and the rest of his path, for that matter). The first was commissioned by Congress in 1939 as that was the 400th anniversary of the landing of the Spanish entrada. John R. Swanton, of the Smithsonian Institution, compiled the report and map based heavily on four surviving accounts of the expedition, study of the topography of the expedition, and the very little archaeological evidence recovered at that time. The most recent, and more currently accepted, study came from Charles Hudson (1997), an ethnohistorian at the University of Georgia. Hudson's map varies from Swanton's significantly more west of the Mississippi. Hudson looked at Indian villages that were found and examined archaeologically and compared them to the descriptions in the surviving chronicles of the de Soto expedition. According to Mitchem (2011:3) "Several Arkansas Archeological Survey archeologists have studied the Arkansas part of Charles Hudson's proposed de Soto route. They have found that, unlike the Swanton route, it is very consistent with the locations of sixteenth century Native

American sites." Consequently, the Hudson map is much more readily agreed upon today as the likely de Soto route—and one that took them across Arkansas nearly three times. While no de Soto goods have been discovered at Greers Ferry Lake, it is not impossible that artifacts from the expedition could have made their way via trade to the area. Following de Soto's death at Guachoya in southeast Arkansas (or northeast Louisiana, this is still debated) on 21 May 21 1542, per de Soto's will, Luis de Moscoso took command of the expedition. They attempted an overland route to Mexico, but lacking food and water, they turned back and wintered in the settlement of Aminoya (likely at the confluence of the White and Arkansas Rivers) over the 1542-1543 winter. They constructed boats and headed down the Mississippi to the Gulf of Mexico where they were attacked almost constantly. The four year expedition failed (Mitchem 2011:3). There would be no more European interaction in Arkansas until the founding of Arkansas Post by the French explorer Henri de Tonti heading south along the Mississippi River in 1682. However, the diseases the Spaniards introduced to the Native Americans decimated their populations in the interim.

Colonial and Early American Historic Period (1682-1828): The only other notable European occupation occurred at Arkansas Post to the southeast of the Greers Ferry Lake project area by the French in 1682. Established as a fur trading post, some of the trade goods likely made their way to the current Greers Ferry Lake project area via Native American trading networks and even direct trade as the French had known of the Osage by this time. Additionally, the location of the post, along the Arkansas River, would have made trade easier with the Osage to the north and the Quapaw to the south. In 1803, the Louisiana Purchase made the Greers Ferry Lake project area officially United States territory. Shortly after, the Osage relinquished all territory north of the Arkansas River, which includes the Greers Ferry Lake project area. In 1817 a treaty with the Eastern Cherokee of Georgia and South Carolina established a reservation between the White River and the Arkansas River. The eastern boundary of that reservation thus ran directly to the west of Heber Springs and the survey area. Another treaty established by 1828 removed the Cherokee to Indian Country (Oklahoma) opening this area to expansion by white settlers (Bennett and Gettys 1983:10).

Trail of Tears (1828-1858): Several paths through Arkansas were involved in the forced removal of Native Americans in the Southeast in what came to be known as the Trail of Tears. While none are believed to have gone directly through the project location, there were paths to the north and to the south of the project location along the Arkansas River. During the time of the Trail of Tears, white settlers were moving into the area surrounding modern-day Greers Ferry Lake. In the 1820s, John L. Lafferty established a plantation along the Little Red River in an area of Van Buren County known as Big Bottoms. Isaac Hunter settled in the region in the 1830s and established a grist mill and a stand for drovers and their animals on the way from Springfield, Missouri, to Bastrop, Louisiana. The first ferry on the river was operated by John Standlee in 1818. Greers Ferry, from which the Cleburne County community, dam, and lake all take their name, was operated by William V. "Bud" Greer in the 1880s, just above the area then known as Tumbling Shoals. With settlement came appurtenances such as roads, stores, churches, and other man-made niceties associated with settling a frontier area. However, the area didn't develop as a proper town until a German immigrant settled in the 1880s.

Civil War in Cleburne County: Modern day Cleburne County (at the time part of Van Buren County) was not a hotbed of the Civil War but there were a number of bushwhackers in the area that attacked both military and civilian targets. There were also a number of units raised in the area. While there were some northern sympathizers, the bulk of the populace was aligned with the Confederacy. The 10th Arkansas Infantry was organized in Conway County at Springfield in July of 1861. Many of those that fought from the area joined with that unit. Company A was known as "Quitman Rifles" and Company G was known as the "Red River Riflemen." Other companies in the regiment were known as the "Randy Rifles", the "Choctaw Riflemen," "Pemberton's Company," "Muddy Bayou Heroes," "Perry County Mountaineers," "Conway Tigers," and "Springfield Sharpshooters." While no major battles took place in the area, Union forces occupied the nearby areas and were harassed by bushwhackers—mostly local men that resented the Union occupation. In May of 1865, all Confederate forces in Arkansas surrendered and in June, all of the Confederate soldiers, considered prisoners of war, were to be paroled at Jacksonport, Arkansas. While the area suffered from the loss of young men lost to the war (mostly due to disease), the area remained generally untouched compared to the heavy toll taken on the other southern states (Cleburne County Historical Society 2007)

Heber Springs (1881-Present): Heber Springs was founded by Max Frauenthal in 1881 as Sugar Loaf. Sugar Loaf was incorporated on 4 October 4 1882. The springs in the area were thought to be medicinal and would be an excellent area to establish a town that people would travel to for the healing spring water. Frauenthal donated land for the courthouse and Spring Park securing Sugar Loaf as the county seat for the newly formed Cleburne County. Frauenthal named the county for Confederate General Patrick Cleburne who was killed at the Battle of Franklin in 1864. In 1885, the Cleburne County Court designated certain ferries over the Little Red River as public ferries and regulated them. Sugar Loaf's name was changed to Heber Springs in 1910 in order to avoid confusion with another town with a post office named Sugar Loaf. Frauenthal chose the new name to honor John T. Jones's son, Dr. Heber Jones, who was a prominent physician in Memphis, Tennessee, where Frauenthal had since moved and died four years later. The establishment of the Missouri and Northern Arkansas Railroad Line through the area in 1909, thrust the area into the modern era and established the timber business as the railroad could now transport the products away easily. In 1912, work began on three bridges over the river, located at Miller, Tumbling Shoals, and Turney's Ferry. The Greers Ferry Lake project area continued as a relatively rural area engaged in agriculture and timbering until the area was transformed by the USACE (USACE 1975). The Federal Flood Control Act of 1938 authorized USACE to build dams on a number of the nation's rivers for flood risk reduction. One of the rivers designated by the act was the White River in Arkansas. Because nearly annual flooding of the Little Red River could compound flooding on the White River, USACE chose to dam the Little Red near the town of Heber Springs. The construction of Greers Ferry Lake inundated many of the previously established homesteads in the lowlands. It also destroyed the habitat for many of the native warm-water stream fish species. As mitigation, USFWS began stocking trout in the tailwater below the dam leading to the very popular trout fishery that exists at the time this Master Plan was published.

l. Interpretation

Interpretative programs at Greers Ferry Lake are aimed at six areas of emphasis: water and boating safety, natural resources and wildlife management, recreation, historical, and Project authorized purposes. Water and boating safety remains the main focus for the majority of the interpretive efforts. Park rangers provide programs throughout the year at local schools, summer camps, community events, expos, sporting events, and USACE managed parks. The target age group for water safety awareness is males, age 18 to 34, which is the age group where the majority of water-related fatalities occur. The use of life jackets for swimming and boating safety is the area of emphasis for all interpretive programs. Life jacket loaner stations are positioned at all designated swimming areas on Greers Ferry Lake; this initiative allows for swimmers to "borrow" a life jacket for the day while swimming at the lake.

The USACE William Carl Garner Visitor Center located at Greers Ferry Lake, Heber Springs, Arkansas provides a central location for visitors to the area to learn about the history of the lake and activities of interest. Volunteers are available to assist visitors with maps and information about area camping, swimming, hiking (Figure 2.11), boat launching, lodging, activities, and points of interest. Further, a brochure rack can be found at the center that provides visitors with information about local recreation interests, flora and fauna around Greers Ferry Lake and the surrounding area.

The Visitor Center exhibit area begins in prehistoric time and moves through local history to the present. Visitors learn the history of early exploration of the area, the events that led to the building of Greers Ferry Dam, and detailed information on the purpose and history of the Greers Ferry Lake, Dam and Powerplant.

The interactive hand crank generator exhibit, in conjunction with other exhibits, helps visitors understand the relationship and use of water in the production of hydro-electricity.

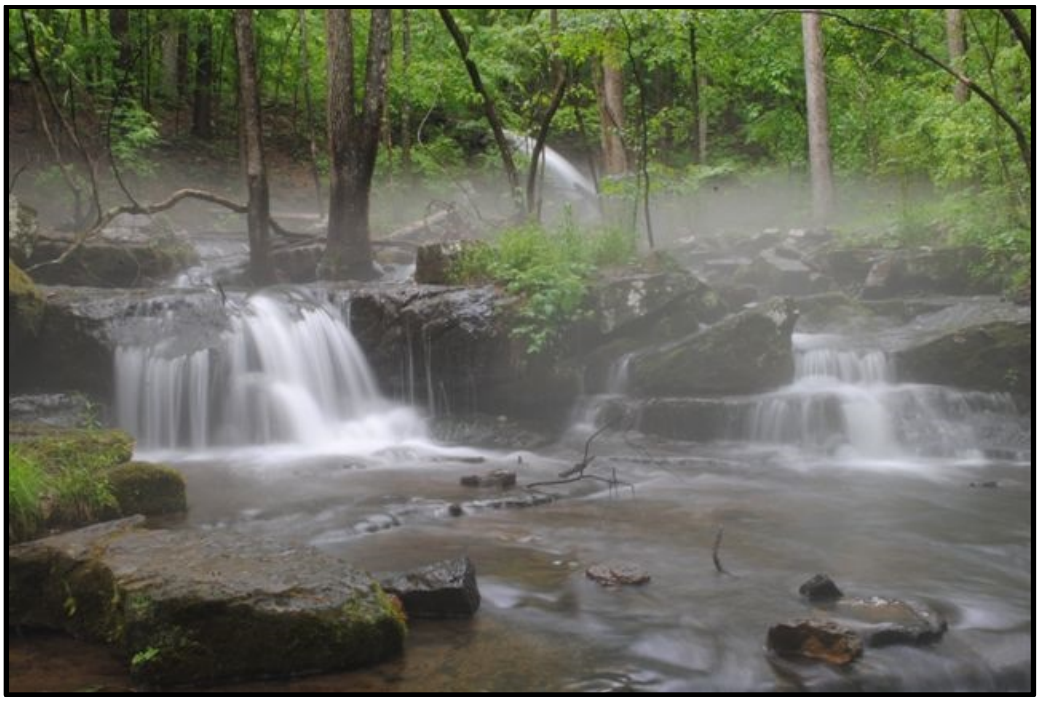
A 20-minute audiovisual program "The Saga of the Little Red: A Tale of Two Centuries," that detailed the history of the USACE in the area and featured excerpts from President John F. Kennedy's 1963 dedication speech was shown at the Visitor Center. A second video, "A Dam Story" by Sheldon Jacobs is also shown at the Visitor Center.

The Mossy Bluff and Buckeye National Nature Trails are also located adjacent to the Visitor Center. Josh Park Memorial and Sugar Loaf Mountain National Nature Trails are also located on Greers Ferry Lake Project lands.

On an annual basis, an average of 10,000 direct contacts are made through interpretive programs. During recreation season, the ranger staff monitors boat ramps and swimming areas specifically for opportunities to provide water and boating safety outreach. Many partners in water safety, such as county law enforcement officials, AGFC, and U.S. Coast Guard Auxiliary also provide outreach in terms of water and boating safety. Rangers meet with the media for television interviews, newspaper articles, and social media comments on a regular basis. Many of the interviews involve current events at the lake such as summer holiday weekend campground status, boating and water safety outreach, lake levels, dam operation, and public accidents.

Within the project office, a small visitor information center offers information and brochures on a host of recreation and natural resource programs.

Figure 2.11 Collins Creek Trail at Greers Ferry Lake



m. Socioeconomics

Set in a bucolic and rural setting, Greers Ferry Lake is a popular water recreation venue nestled in the foothills of the Lower Boston Mountains and Arkansas Valley Hills ecoregions 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 is 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 related to environmental justice as defined by National Environmental Policy Act (NEPA), transportation, and recreation levels and trends. For the purpose 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 2000-2001 carrying capacity recreational study.[2] Twenty one

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

percent originated from within 100 to 150 miles, and only 6 percent came from distances greater than 200 miles. Although the data are based on a 2001 study, it is unlikely that origins of visitors have changed significantly.

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

1) Population

Table 2.5 displays historical and projected population by each county in the Greers Ferry Lake project 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 at Little Rock (UALR) project the same approximate growth rate over the next 50 years, with an annual growth rate 0.65 percent (Table 2.5). 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 2.5 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.

2) 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 more than one half the study areas private employment and payroll (Table 2.6). 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 $25,260 for retail trade workers. Construction workers, on the other hand, earn 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 approximately $65,000 per year (Table 2.7).

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. Both mean ($54,752) and median annual household ($40,821) income for the study area are lower than state averages ($58,850 and $42,336, respectively), and both metrics are lower than national level figures (Table 2.8). 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 2.6 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 2.7 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 2.8 Income Statistics for the Greers Ferry Lake Study Area (2016)

	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

3) 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 2.9 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 2.9 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). Based on the analysis it does not appear that any children would be disproportionally affected.

Table 2.9 Distribution of Racial Groups and Proportion of Children under the Age of 17 in the Greers Ferry Lake 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

4) Recreation

Greers Ferry Lake has a variety of recreational facilities (Table 2.10). Paved access roads wind through 18 public use areas with 1,159 campsites. Other facilities include numerous swimming areas, hiking trails, boat launching ramps, sanitary dump stations, and picnic shelters. There are also 9 commercial marinas providing year-around service with 4,061 boat slips, and stores selling grocery items, fuel, boat rental and storage, fishing guides and other supplies, and related services. Figure 2.12 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

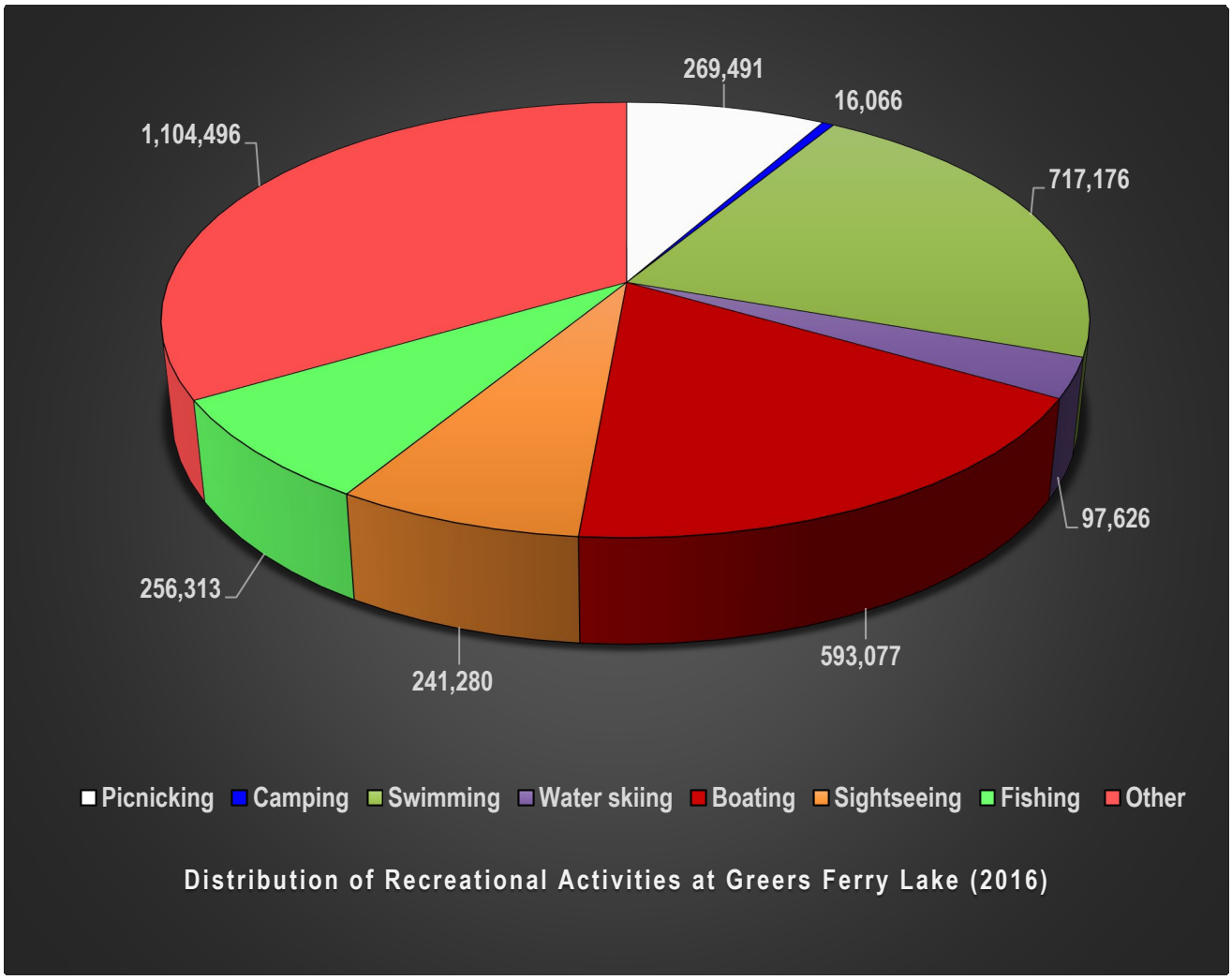
very popular at Greers Ferry Lake. In addition to water sports, people engage in many land based sports and activities including camping, picnicking, hiking and sightseeing.

Table 2.10 Recreation Facilities at Greers Ferry Lake, Arkansas

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

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

Figure 2.12 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 2.11 displays historical data regarding annual visitation to Greers Ferry Lake from 1972 to 2012 and 2014 to 2016. The distinctions in periods are necessary given that the USACE changed the way it counts the number of visitors after 2012. Before 2012, a recreation "visit" to a USACE

project was defined as entry by one person to a USACE project for recreation for any length of time – 15 minutes to 14 days. After 2012, the USACE began to measure a visits in terms of "person days" where one visit reflected one person spending at least one day at a given project. 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 is 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. Recreational carrying capacity for some forms of recreation could be reached, and if so, lake management would need to carefully evaluate any increase or decrease in recreational amenities.

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

Table 2.11 Annual Number of Person Trips to Greers Ferry Lake Arkansas (2000 through 2012) and Annual Number of Visitor Days (2014 through 2016)*

Year	Number of visitors
1972	3,598,700
1979	4,548,000
1984	5,265,000
1989	4,420,700
1994	5,438,000
1999	5,646,800
2000	6,020,100
2001	6,720,421
2002	7,967,464
2003	7,594,327
2004	6,497,354
2005	6,833,030
2006	7,529,575
2007	7,461,133
2008	6,612,294
2009	7,341,244
2010	7,283,258
2011	6,193,155
2012	7,391,579
Annual average (2000 through 2012)	**6,020,100**
2014	1,950,229
2015	1,873,041
2016	1,917,652
Annual average (2014 through 2016)	**1,913,641**

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

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 2.12 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 Lake.

Table 2.12 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 2.13 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, respectively). 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 (visitation) has the added advantage in that UALR demographers develop and publish county and state population projections for Arkansas over a 50-year period (Table 2.14). Another adjustment involved normalizing or indexing regression variables to a base of 100 as shown in Figure 2.13. Indexing is particularly useful for dealing with variables in different scales of measurement including pre-2012 and post 2012 recreation visitation counts.

Figure 2.13 Historical Recreational Visitation to Greers Ferry Lake, Arkansas State Population, and Arkansas per capita Income (normalized to an index of 100, 1974 through 2012)

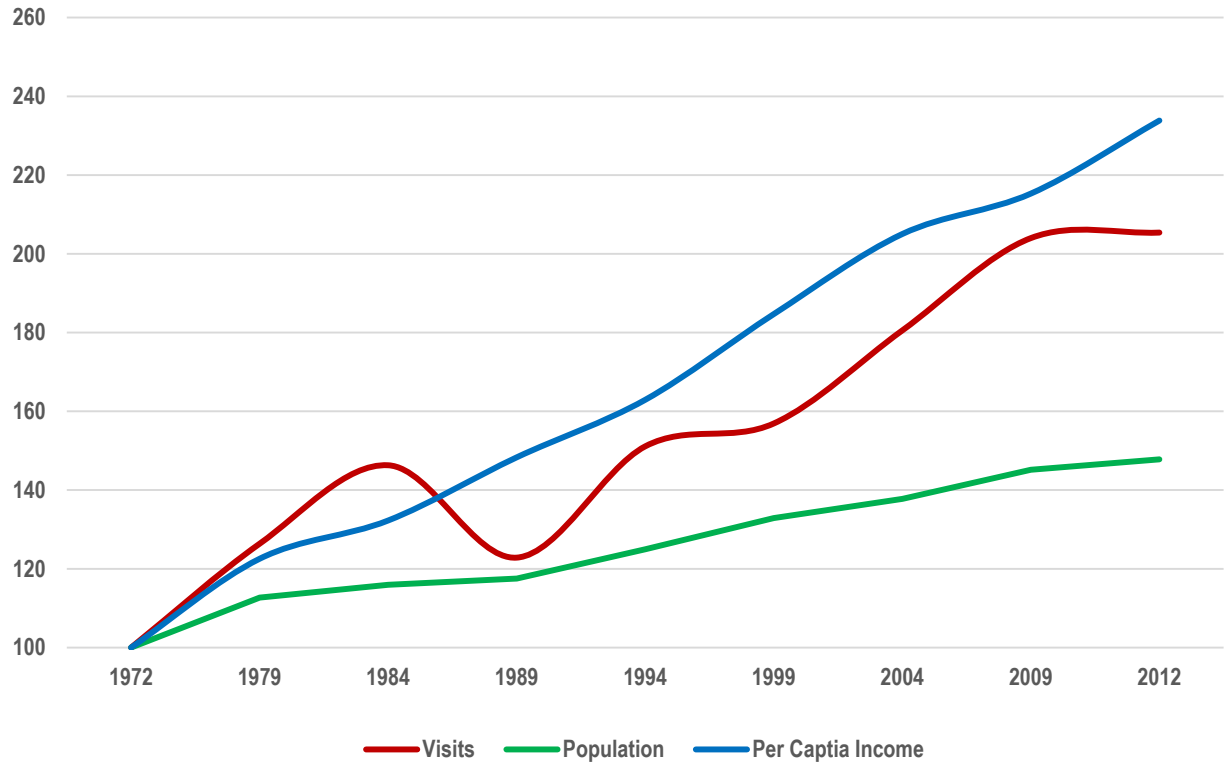


Table 2.14 Regression Results for Visitation and Population Index

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 on dispersion of historical data from 1999 through 2000. Using deviation of 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. 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 2.14). Variation for annual visitation captured by the Beta distribution was applied to predicted ranges of population growth from UALR to develop a stochastic range of projections.

Table 2.15 and Figure 2.15 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 of 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).

Figure 2.14 Simulation Results based on Beta Frequency Distribution for Variation in Historical Annual Visitation to Greers Ferry Lake (FY 1999-2013, millions of visitors)

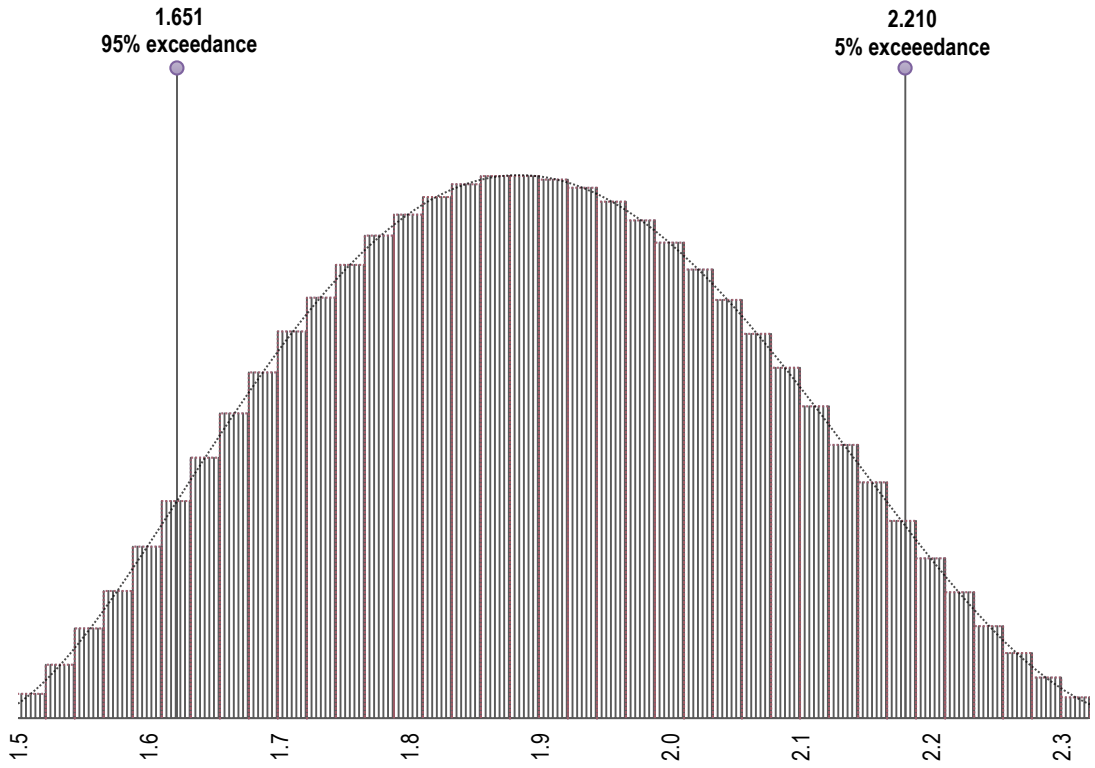
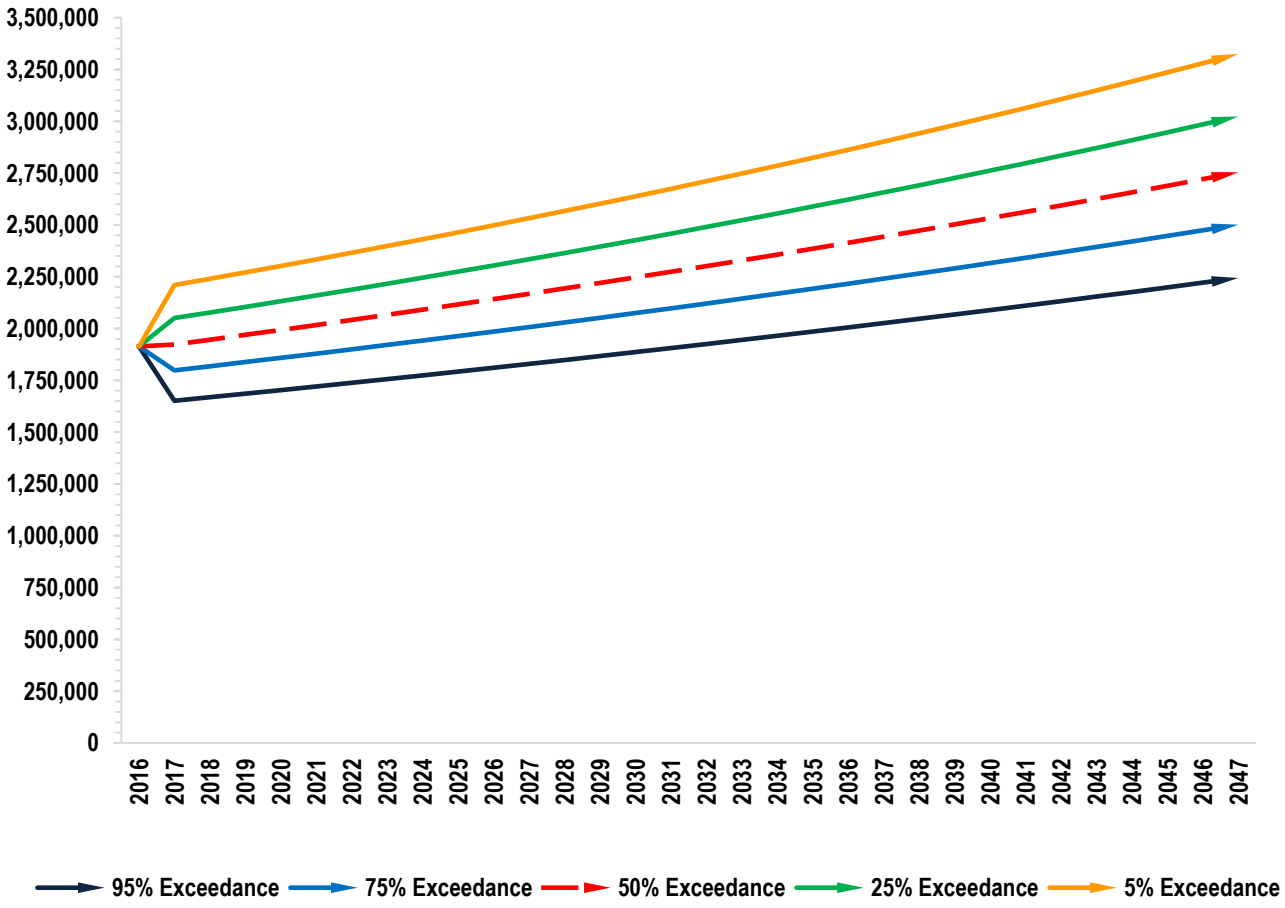


Table 2.15 Projected Visitation to Greers Ferry Lake (person days, 2017 through 2047)

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 2.15 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 2.16), 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 2.16 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.

n. Recreation Facilities, Activities, and Needs

The recreational resource of Greers Ferry Lake Project is considered to be of great importance to Arkansas. USACE has taken advantage of the natural and scenic beauty and constructed a variety of recreational facilities around the lake. The 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 (Figure 2.16). There are 18 designated recreation areas on Greers Ferry Lake, 15 of which are operated by the USACE. 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 agreements. 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 USACE, consistently ranking in the top 10.

Figure 2.16 Visitors Fishing Little Red River, Arkansas

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 as stated in the Arkansas 2014-2018 Statewide Comprehensive Outdoor Recreation Plan (SCORP). 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.

1) Facility Information

The future development of parks and design/layout of facilities should consider the following criteria: high-quality engineering, public safety, environmental sustainability, and promotion of the health, welfare, and aesthetic satisfaction of the public. The location of each facility should result in a compromise between conserving the natural resource and meeting the demands for providing public use. New facilities should only be placed on the most adaptable terrain, with consideration to preserving the majority of the natural features, in order to maintain the scenic significance for other visitors. Facility design and placement should consider minimizing grading and clearing for site preparation to safeguard existing environmental features.

2) Recreation Areas

****Conceptual park maps/plates are not included during this Master Plan revision. Anticipated recreation improvements are described below each recreation area description. See Recreation Overview map in Figure 2.17 for location of recreation areas.**

a. Cherokee Park – Located on the northeastern section of the upper lake between the towns of Drasco and Greers Ferry, Arkansas. Recreation facilities constructed within the area include: 33 campsites (17 with electricity, 16 without), vault toilet, dump station, potable water, and launch ramp. (139 acres)

Anticipated park improvements for the future include (pending receipt of funds):

- Addition of waterborne restroom with showers.
- Addition of 1 camp loop.
- Convert all campsites to current industry standards.
- Addition of swim beach.
- Addition of playground.
- Increase size of current boat ramp and parking area.
- Install high water ramp.
- Addition of picnic sites.
- Addition of trail.
- Addition of gatehouse and volunteer area.

b. Choctaw Park – Located on the western end of the upper lake south of the town of Clinton, Arkansas. Choctaw Park includes: 146 campsites (91 with electricity, 55 without), flush and vault toilets, showers, potable water, trailer dump station, launch ramp, swimming area, playground, picnic shelter, and commercial marina. (111 acres)

Anticipated park improvements for the future include (pending receipt of funds):

- Addition of two waterborne restrooms with showers.
- Reconfigure existing camp loops.
- Convert all campsites to current industry standards.
- Reconfigure existing swim beach.
- Relocate pavilion and playground.
- Separate marina traffic from park traffic.
- Increase size of current boat ramp and parking area.
- Additional high water lanes to boat ramp.
- Addition of picnic sites.
- Addition of trail.
- Relocate park attendant sites.
- Replace gatehouse and update entrance complex.

c. Cove Creek – Located on the south end of the lower lake, southwest of Heber Springs, Arkansas. Recreation facilities include: 63 campsites (31 with electricity, 32 without), leased commercial marina site, flush and vault toilets, showers, potable water, trailer dump station, launch ramp, swimming area, and picnic shelter. (124 acres)

Anticipated park improvements for the future include (pending receipt of funds):

- Addition of waterborne restroom with showers.
- Addition of 1 camp loop.
- Convert all campsites to current industry standards.
- Increase size of current boat ramps and pave parking area.
- Construct shelter and playground.
- Addition of picnic sites.
- Install high water ramp.
- Addition of a trail.
- Replace gatehouse and update entrance complex.
- If current marina lessee returns lease area, will develop day use facilities, camping sites, and picnic sites.

d. Dam Site Campground – Located at Greers Ferry Dam at the foot of Round Mountain. Recreation facilities include: 241 campsites (148 with electricity, 93 without), flush and vault toilets, showers, potable water, trailer dump station, launch ramp, swimming area, playground, picnic shelter, and commercial marina. (331 acres)

Anticipated park improvements for the future include (pending receipt of funds):

- Reconfigure entrance complex and replace gatehouse for day use area.
- Addition of 4 new waterborne restroom with showers.
- Addition of camp loops.
- Reconfigure and convert all campsites to current industry standards.
- Extend boat ramps for low water use and pave parking area.
- Pave Volunteer Village.
- Construct shelter and playground.
- Addition of picnic sites.
- Addition of a trail.
- Reconfigure marina access for additional day use parking.

e. Devils Fork Campground – Located on the upper lake near the town of Greers Ferry, Arkansas. Recreation facility includes: 55 campsites with electricity, flush and vault toilets, showers, potable water, trailer dump station, launch ramps, swimming areas, playground, and picnic shelter. (122 acres)

Anticipated park improvements for the future include (pending receipt of funds):

- Addition of waterborne restroom with showers.
- Additional camp loops.
- Convert all campsites to current industry standards.
- Construct shelter near fish tournament center.
- Addition of picnic sites.
- Addition of a trail.
- Reconfigure gatehouse and update entrance complex.

f. Eden Isle – Located on the lower lake near the town of Heber Springs, Arkansas. This area is leased by private entity. Recreation facility includes: marina, marina parking, pump out station, boat ramp. (24 acres)

g. Fairfield Bay (formerly known as Van Buren Park) – Located on the upper lake near the town of Fairfield Bay, Arkansas. This area is leased by the city of Fairfield Bay. Recreation facility includes: 66 campsites (49 with electricity, 17 without), commercial marina, flush and vault toilets, showers, potable water, trailer dump station, launch ramp, swimming area, playground, trail, and 2 picnic shelters. (123 acres)

Anticipated park improvements for the future include:

- Additional high water parking for marina.
- Convert all campsites to current industry standards.
- Additional waterborne restroom with showers.
- Relocate swim beach area.
- Additional campsites.
- Additional high water boat ramp.
- Provide tiny homes/cabin rentals.
- Addition of a trail.

h. Heber Springs Campground – Located on the lake shoreline adjacent to Heber Springs, Arkansas. Recreation facility includes: 118 campsites (98 with electricity, 20 without), flush and vault toilets, showers, potable water, trailer dump station, launch ramp, swimming area, playground, picnic shelter, and commercial marina. (207 acres)

Anticipated park improvements for the future include (pending receipt of funds):

- Addition of waterborne restroom with showers.
- Additional camp loops.
- Convert all campsites to current industry standards.
- Separate access for marina.
- Develop day use area off marina access.
- Addition of picnic sites.
- Addition of trail.
- Reconfigure gatehouse, park attendant sites, and update entrance complex.

i. Hill Creek Campground – located on the upper lake shoreline near Greers Ferry, Arkansas. Recreation facilities include: 40 campsites (30 with electricity, 10 without), flush and vault toilets, showers, potable water, trailer dump station, launch ramps, swimming area, picnic shelter, and commercial marina. (112 acres)

Anticipated park improvements for the future include (pending receipt of funds):

- Addition of waterborne restroom with showers.
- Additional camp loops.
- Convert all campsites to current industry standards.
- Addition of picnic sites.
- Addition of trail.
- Reconfigure gatehouse, park attendant sites, and update entrance complex.
- Add new shelter at day use area.
- Separate marina traffic from park traffic.

j. John F. Kennedy Park – located on the left, descending bank of the Little Red River just below Greers Ferry Dam. Recreation facility includes: 68 campsites with electricity (44 have water hook ups), flush toilets, showers, potable water, trailer dump station, launch ramp, playground, and picnic shelter. National Fish Hatchery operated by the U.S. Fish & Wildlife Service is located within park boundary. A perennial stream (Collins Creek) and associated hiking trail were constructed in this park as an environmental restoration project and are currently leased to and operated by the Arkansas Game and Fish Commission. JFK memorial overlook located within park boundary. (233 acres)

Anticipated park improvements for the future include (pending receipt of funds):

- Additional boat ramp and steps for river access.
- Addition of waterborne restrooms with showers.
- Add outdoor recreation opportunities.
- Additional camp loops.
- Convert all campsites to current industry standards.
- Addition of picnic sites.
- Additional trails.
- Reconfigure gatehouse, park attendant sites, and update entrance complex.

k. Mill Creek Campground – Located in the middle area of the upper lake southwest of Greers Ferry, Arkansas. Recreation facility includes: 36 non-electric campsites, vault toilet, launch ramps, and a picnic shelter. (186 acres)

Anticipated park improvements for the future include (pending receipt of funds):

- Addition of waterborne restrooms with showers.
- Additional camp loops.
- Convert all campsites to current industry standards.
- Addition of dump station.
- Addition of picnic sites.
- Addition of swim beach and playground.
- Addition of pavilion.
- Addition of trail.
- Addition of gatehouse, park attendant sites, and entrance complex.
- Addition of water and electric to campground.

l. Narrows Park – Located near the center of the lake, adjacent to Greers Ferry, Arkansas. Recreation facilities include: 60 campsites with electricity, flush and vault toilets, showers, potable water, trailer dump station, launch ramp, picnic shelter and commercial marina. (56 acres)

Anticipated park improvements for the future include (pending receipt of funds):

- Addition of waterborne restrooms with showers.
- Reconfigure camp loops.
- Convert all campsites to current industry standards.
- Addition of picnic sites.
- Reconfigure gatehouse, park attendant sites, and update entrance complex.

m. Old Highway 25 – Located on the lake shoreline near Tumbling Shoals. Recreation facilities include: 116 campsites (79 with electricity, 37 without) group camp area, flush and vault toilets, showers, potable water, trailer dump station, launch ramp, swimming area, playground, and picnic shelters. (251 acres)

Anticipated park improvements for the future include (pending receipt of funds):

- Addition of waterborne restrooms with showers.
- Additional camp loops.
- Convert all campsites to current industry standards.
- Addition of picnic sites.
- Addition of trails.
- Reconfigure gatehouse, park attendant sites, and update entrance complex.
- Add new shelter and playground at day use area.
- Additional parking for day use.
- Expand boat ramp.
- Add outdoor recreation areas.
- Add a 400-person group shelter with kitchen and restroom facilities.
- Add shelter parking lots.

n. Sandy Beach – Located in Heber Springs, Arkansas. Recreation Facilities include: Swim beach, volleyball court, vault toilet, shower, boat ramp, walking trail, and picnic sites. (64 acres)

Anticipated park improvements for the future include (pending receipt of funds):

- Addition of waterborne restroom with showers.
- Additional day parking.
- Addition of outdoor recreation areas.
- Addition of picnic sites.
- Addition of a trail.
- Add gatehouse, park attendant sites, and entrance complex.
- Add new shelter at day use area.
- Add courtesy docks.

o. Shiloh Park – Located on the mid-lake shoreline south of Greers Ferry, Arkansas. Recreation Facilities include: 116 campsites (60 with electricity, 56 without), flush and vault toilets, showers, potable water, trailer dump station, 3 launch ramps, swimming area, playground, picnic shelter and commercial marina. (161 acres)

Anticipated park improvements for the future include (pending receipt of funds):

- Addition of waterborne restroom with showers.
- Additional camp loops/relocate away from marina.
- Convert all campsites to current industry standards.
- Addition of playground.
- Addition of picnic sites.
- Addition of a trail.
- Reconfigure gatehouse, park attendant sites, and update entrance complex.
- Add new shelter at day use area.
- Separate marina traffic from park traffic.

p. Sugar Loaf Park – Located on the upper lake 4 miles west of Greers Ferry, Arkansas. Recreation facilities include: 75 campsites (57 with electricity, 18 without), flush and vault toilets, showers, potable water, trailer dump station, launch ramp, swimming area, playground, picnic shelter, and commercial marina. (62 acres)

Anticipated park improvements for the future include (pending receipt of funds):

- Addition of waterborne restroom with showers.
- Additional camp loops/ relocate campsites away from marina.
- Convert all campsites to current industry standards.
- Addition of picnic sites.
- Addition of a trail.
- Reconfigure gatehouse, park attendant sites, and update entrance complex.
- Add new shelter at day use area.
- Separate marina traffic from park traffic.

q. Sugarloaf Mountain – Located in Greers Ferry Lake near Sugar Loaf Park. Recreation facilities include: trail, steps/stairs, benches, courtesy dock. (255 acres)

Anticipated park improvements for the future include (pending receipt of funds):

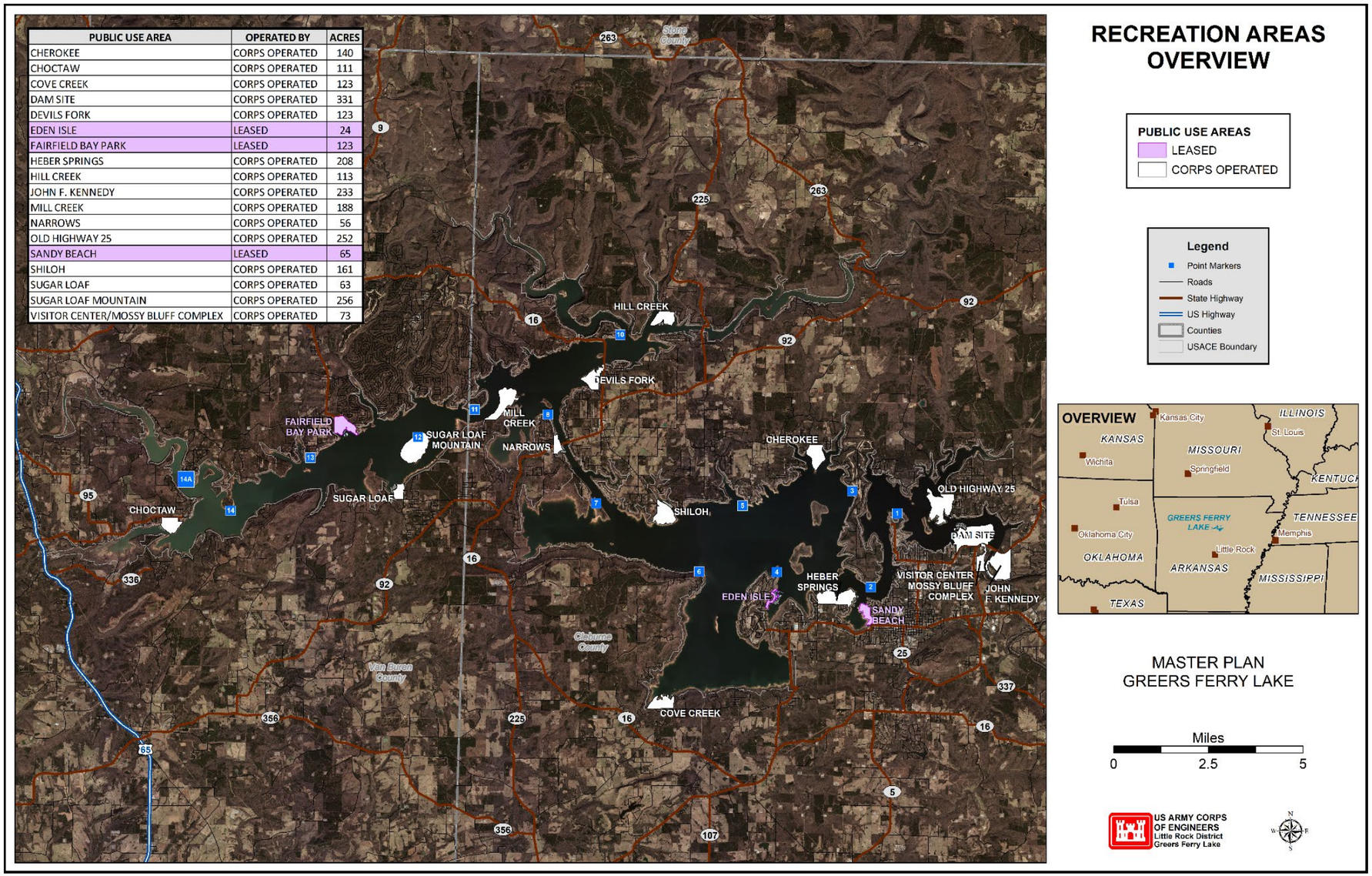
- Addition of picnic sites.
- Addition of a trail.
- Replace/repair steps/stairs.

r. Visitor Center/Mossy Bluff Complex – Located near the Greers Ferry Lake Dam. Recreation facilities include: Visitor center, trails, disc golf course, overlook, and picnic sites. (73 acres)

Anticipated park improvements for the future include (pending receipt of funds):

- Addition of waterborne restrooms.
- Additional parking.
- Exhibit/program updates (AV equipment updates).
- Rehabilitate auditorium.
- Convert visitor center to current industry standards.
- Add shelter near disc golf course.
- Addition of picnic sites.
- Addition of trails.
- Add outdoor amphitheater.

Figure 2.17 Greers Ferry Lake, Arkansas, Recreation Area Overview



3) Visitation Profiles (Operations and Maintenance Business Information)

Table 2.17 Greers Ferry Lake Project Visitation, 2003-2018

Project Visitation 2003-2012	
2003	7,594,327
2004	7,827,554
2005	6,833,026
2006**	13,969,125
2007	8,027,226
2008	6,612,295
2009	7,246,688
2010	7,272,343
2011	6,193,155
2012*	7,391,579
2013***	
2014	1,950,229
2015	1,873,041
2016	1,917,652
2017	1,983,345
2018	1,916,794

*New visitation program was launched
**System error appeared to have doubled Visitation
***Visitation Unavailable for this year due to new system/program

4) Recreation Analysis

The SCORP is an integral part of capturing the history and popular activities to enhance recreation opportunities in Arkansas. The SCORP ties together voices from the users of recreation sites, planners and developers, government officials, agency managers and elected officials. This collaboration effort is in place to lay out a plan to guide recreation development in a useful, beneficial, and sustainable manner.

5) Arkansas SCORP Data (2014-2018):

Over the past 25 years the top 10 recreational activities that Arkansans prefer has not changed substantially. Two activities have exchanged popularity from year to year, walking for pleasure and exercise, and driving for pleasure. According to a recent survey, walking, jogging or hiking tops the list, with nature viewing ranking second. Burgeoning interest in healthy lifestyles helps hold these timeless activities at the top. For driving, higher gasoline prices may be one factor that influences driving habits, but this activity remains very popular as a way to view and enjoy the beauty of the natural landscape.

Table 2.18 Popular Outdoor Activities

Recent Poll	2009	1993
Walking, jogging or hiking	Jogging or walking	Driving for pleasure
Nature viewing	Driving for pleasure	Walking for Pleasure
Driving or motorcycling	Swimming	Picnicking
Picnicking	Nature Viewing and Outdoor Photography	Fishing
Visiting a children's playground	Boating	Swimming
Fishing	Picnicking	Visiting Historical Sites
Swimming or going to a water park	Visiting Historical and Ecological Sites	Wildlife Observation
Boating activities	Camping	Short Hikes
Historical and archeological sites	Bicycling	Pleasure Boating
ATV Riding	Playing Tennis	Bicycling
Camping		Camping/Developed Sites
Hunting		Basketball
Bicycle Riding		Jogging/Running
Playing Basketball		Baseball/Softball
Playing baseball or softball		Photography
Playing Golf		Hunting
Horseback riding		Other Outdoor Games
Playing soccer or rugby		ORV Driving
Playing tennis		Canoeing/Floating
Skateboarding or playing Frisbee golf		Camping/Undeveloped Sites

Along with walking and driving, other core interests involve access to water (swimming, boating), or common leisure time gatherings (picnics and camping). People often use trails as part of their activities, especially for bicycling, walking, hiking or nature viewing and

photography, which makes trails an important type of facility in terms of planning for outdoor recreation. Access to parks, trails and other facilities is primarily through automobiles and roadways. With the steady interest in driving for pleasure (or total demand increasing with population growth), and general access by car to most sites, the public roadways are becoming ever more important to the broader functioning of recreational sites and facilities.

For a copy of the entire Arkansas SCORP it can be found at the Outdoors grants website (http://www.recpro.org/assets/Library/SCORPs/ar_scorp_2014.pdf).

6) Future Park Development Areas

There are currently no project land areas classified for future park development and none has been added through this Master Plan revision. If future recreation development is needed, development will be accommodated within the existing High Density classified land areas or the reopening of previously closed camping loops where road systems and park facilities have previously occurred.

Engineering and Design Recreational Facility and Customer Service Standards can be referenced in EM 1110-1-400 https://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_1110-1-400.pdf

7) Zones of Influence

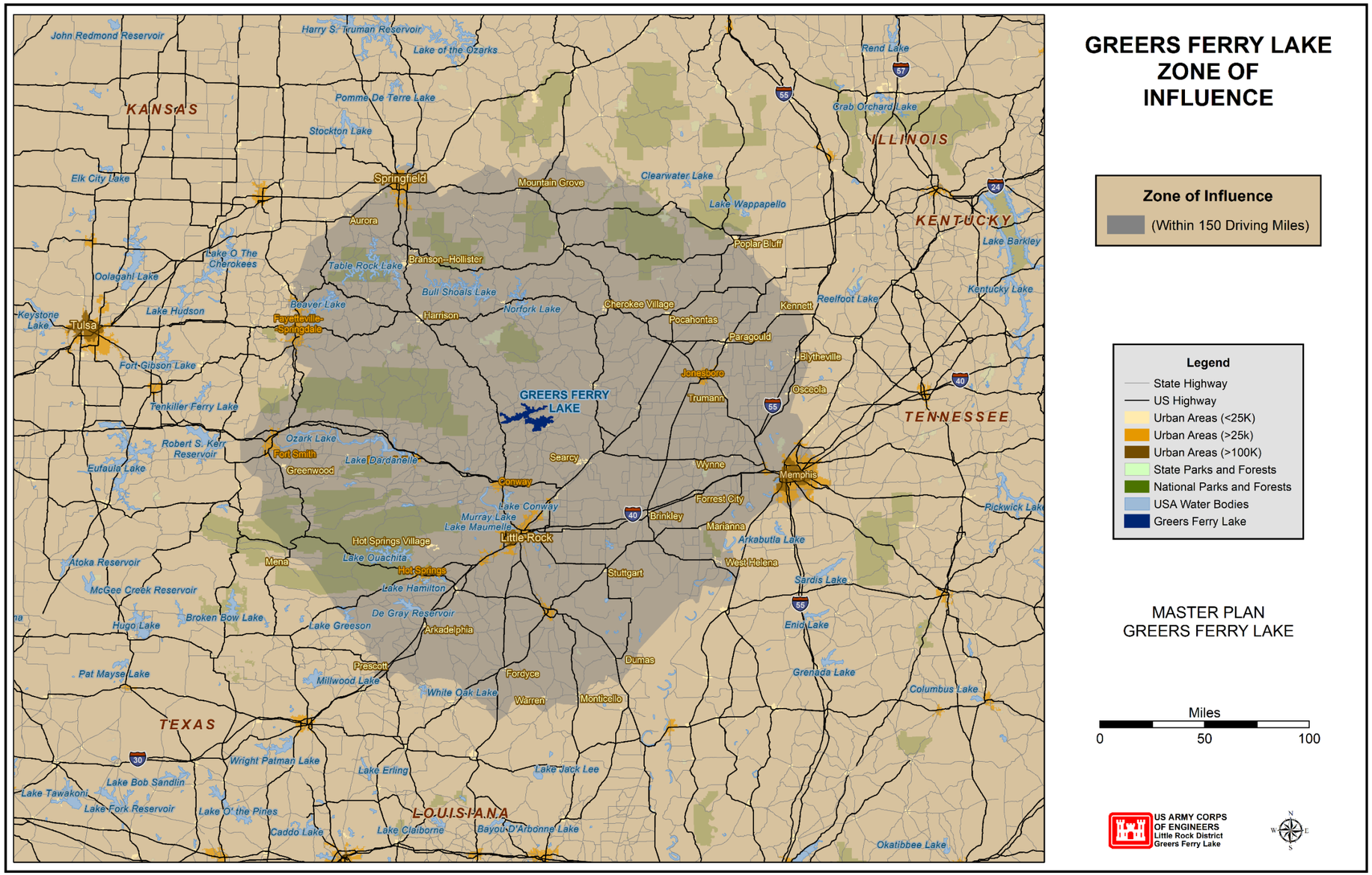
As discussed in the Socioeconomics Section, roughly three fourths of visitors to the lake come from counties within 75 to 100 miles. Twenty one percent originated from within 100 to 150 miles, and only 6 percent came from distances greater than 200 miles. Thus, a reasonable zone of influence in terms of societal impacts includes counties within about a 100-mile radius. Beyond this area, the radius begins to overlap significantly with other major recreational lakes in the region. In northwest and north central Arkansas and southern Missouri, there a several high use recreational lakes and parks including Beaver Lake, Table Rock Lake (adjacent to Branson Missouri), Bull Shoals Lake, the Buffalo River National Scenic River in the Ozark National Forest and the White River in Arkansas. East of the project, there is Sardis Lake in Mississippi slightly south of Memphis, Tennessee, and to the south there are Lake Maumelle and Lake Ouachita (Ouachita National Forest). Table 2.19 and Figure 2.18 shows the counties included in the zone of influence. The zone comprises about 43 percent of Arkansas's total population.

Table 2.19 Counties and Respective Populations in Greers Ferry Lake, Arkansas, Zone of Influence

County	Population
Baxter	41,355
Cleburne	25,183
Conway	20,916
Faulkner	115,514
Garland	95,184
Grant	17,829
Hot Spring	31,364
Independence	37,504
Izard	13,686
Jackson	17,135
Jefferson	69,115
Lawrence	16,525
Lonoke	72,898
Pope	63,835
Prairie	8,170
Pulaski	386,191
Saline	119,323
Searcy	7,938
Sharp	17,393
Stone	12,537
Van Buren	16,506
White	79,016
Woodruff	6,734
Total Zone of Influence	1,291,851
Total Arkansas	3,004,279

Source: U.S. Census Bureau

Figure 2.18 Zone of Influence for Greers Ferry Lake, Arkansas



o. Real Estate

(1) Acquisition Policy

The Flood Control Act of June 28, 1938, (Public Law 761, 75th Congress, 3d Session) approved a comprehensive plan for flood control and other purposes in the White River Basin. This comprehensive plan was modified by the Flood Control Act approved August 18, 1941, (Public Law 228, 77th Congress, 1st Session) to include authorization of the project for flood control and generation of hydroelectric power. A Design Memorandum was completed identifying all land and interests in land that would be necessary for the operation, maintenance and control of the reservoir. The fee acquisition line, as a general rule, was blocked out in increments of 2.5 to 0.625 acre tracts along regular subdivision section lines, property ownership lines or natural boundaries to include all lands below elevation 461 feet above msl or to include the lands required for public access areas. In areas where the acquisition did not encompass lands needed for occasional flooding, flowage easements were typically acquired between the fee acquisition line and elevation 491 feet above msl.

(2) Management and Disposal Policy

The Real Estate Management and Disposal program for Greers Ferry is administered by the Little Rock District Real Estate Division in accordance with all applicable laws, regulations, and policies. All requests for real estate related actions must be received via a written request made to the Greers Ferry Lake Operations Manager, who makes a recommendation through the Little Rock District Chief of Operations to the Chief of Real Estate.

(3) Explanation of Flowage Easement and Total Fee Acreage on Greers Ferry Lake

Table 2.20 Acreage differences on Greers Ferry Lake, Arkansas

Type of Acreage	LiDAR	Deeded Language	1976 Master Plan
Flowage Easement	3,770.6 acres	4,630.7 acres	4,634 acres
Total Fee	41,194.5 acres	40,904.0 acres	40,914 acres

Note: A small difference in acreage values exists (Table 2.20) throughout this document due to the use of newer technologies, like LiDAR, to generate data. LiDAR is a snapshot of the conditions at the time the LiDAR was completed, and therefore, conditions may slightly change over time. Because of this, the USACE recommends that adjacent landowners obtain a survey prior to taking any action that might impact federal property rights. Where flowage or other easements belonging to the United States are located, adjacent landowners should reference the relevant deed language for specific locations and rights. Generally, adjacent landowners must contact the USACE for approval prior to beginning any action that may impact federal property rights.

p. Pertinent Public Laws

(1) Application of Public Laws

Development and management of Federal reservoirs are regulated by a number of statutes and guided by USACE documents. The following sections provide a summary of the relevant policies and Federal statutes.

(2) Recreation

The policies and public laws listed below address development and management of recreational facilities on public lands and are pertinent to the Greers Ferry Lake project:

- PL 78-534, Flood Control Act of 1944 (22 December 1944), authorized the Chief of Engineers to provide facilities in reservoir areas for public use, including recreation and conservation of fish and wildlife.
- PL 79-526, Flood Control Act of 1946 (24 July 1946), amends PL 78-534 to include authority to grant leases to nonprofit organizations at recreational facilities in reservoir areas at reduced or nominal charges.
- PL 83-780, Flood Control Act of 1954 (3 September 1954), further amends PL 78-534 and authorizes the Secretary of the Army to grant leases to Federal, State, or governmental agencies without monetary considerations for use and occupation of land and water areas under the jurisdiction of the Department of the Army for park and recreational purposes when in the public interest.
- PL 87-874, Flood Control Act of 1962, broadened the authority under PL 78-534 to include all water resource projects.
- Joint Land Acquisition Policy for Reservoir Projects (Federal Register, Volume 27, 22 February 1962) allows the Department of the Army to acquire additional lands necessary for the realization of potential outdoor recreational resources of a reservoir.
- PL 88-578, Land and Water Conservation Fund Act of 1965 (1 September 1964), prescribes conditions under which USACE may charge for admission and use of its recreational areas.
- PL 89-72, Federal Water Project Recreation Act of 1965 (9 July 1965), requires sharing of financial responsibilities in joint Federal and non-Federal recreational and fish and wildlife resources with no more than half of the cost borne by the Federal Government.
- PL 90-480, Architectural Barriers Act of 1968 (12 August 1968), as amended, requires access for persons with disabilities to facilities designed, built, altered, or leased with Federal funds.
- PL 101-336, Americans with Disabilities Act of 1990 (ADA) (26 July 1990), as amended by the ADA Amendments Act of 2008 (PL 110-325), prohibits discrimination based on disabilities in, among others, the area of public accommodations and requires reasonable accommodation for persons with disabilities.
- PL 102-580, Water Resources Development Act of 1992 (31 October 1992), authorizes the USACE to accept contributions of funds, materials, and services from non-Federal public and private entities to be used in managing recreational facilities and natural resources.

- PL 103-66, Omnibus Budget Reconciliation Act–Day Use Fees (10 August 1993), authorized the USACE to collect fees for the use of developed recreational sites and facilities, including campsites, swimming beaches, and boat ramps.
- PL 104-333, Omnibus Parks and Public Lands Management Act of 1996 (12 November 1996), created an advisory commission to review the current and anticipated demand for recreational opportunities at lakes and reservoirs managed by the Federal Government and to develop alternatives to enhance the opportunities for such use by the public.

(3) Water Resource Protection and Flood Risk Management

A number of public laws address water resources protection and flood risk management and integration of these goals with other Project purposes such as recreation. The following are pertinent to Greers Ferry Lake:

- PL 75-761, *Flood Control Act of 1938* (28 June 1938), authorizes the construction of civil engineering projects such as dams, levees, dikes, and other flood risk management measures through the USACE.
- PL 77-228, *Flood Control Act of 1941*(18 August 1941), amended the Flood Control Act of 1938 and appropriated $24M to support construction of multiple-purpose reservoir projects in the White River Basin.
- PL 78-534, *Flood Control Act of 1944* (22 December 1944), specifies the rights and interests of the states in water resources development and requires cooperation and consultation with State agencies in planning for flood risk management.
- PL 79-14, *Rivers and Harbors Act of 1945* specifies the rights and interests of the states in watershed development and water utilization and control, and the requirements for cooperation with state agencies in planning for flood control and navigation improvements.
- PL 85-500, *Water Supply Act of 1958* (3 July 1958), authorizes the USACE to include municipal and industrial water supply storage in multiple-purpose reservoir projects.
- PL 87-88, *Federal Water Pollution Control Act Amendments of 1961* (20 July 1961), requires Federal agencies to address the potential for pollution of interstate or navigable waters when planning a reservoir project.
- PL 89-80, *Water Resources Planning Act of 1965* (22 July 1965), provides for the optimum development of the Nation's natural resources through coordinated planning of water and related land resources. It provides authority for the establishment of a water resources council and river basin commission.
- PL 89-298, *Flood Control Act of 1965* (27 October 1965), authorizes the Secretary of the Army to design and construct navigation, flood risk management, and shore protection projects if the cost of any single project does not exceed $10 million.
- PL 92-500, *Federal Water Pollution Control Act (Clean Water Act)* (October 18, 1972) Establishes a national goal of eliminating all discharges into U.S. waters by 1985 and an interim goal of making the waters safe for fish, shellfish, wildlife and people by July 1, 1983. Also provides that in the planning of any USACE reservoir consideration shall be given to inclusion of storage for regulation of streamflow.

- PL 95-217, Clean Water Act of 1977 (15 December 1977), amends PL 87-88 and requires the Environmental Protection Agency (EPA) to enter into written agreements with the Secretaries of Agriculture, the Army, and the Interior to provide maximum utilization of the laws and programs to maintain water quality.
- PL 99-662, *Water Resource Development Act of 1986* (17 November 1986), establishes cost sharing formulas for the construction of harbors, inland waterway transportation, and flood risk management projects.

(4) Fish and Wildlife Resources

A number of public laws address protection and maintenance of fish and wildlife resources. The following are pertinent to the Greers Ferry Lake project:

- PL 79-732, Fish and Wildlife Coordination Act (10 March 1934), provides authority for making project lands available for management by interested State agencies for wildlife purposes.
- Title 16 U.S. Code (U.S.C.) §§ 668-668a-d, Bald and Golden Eagle Protection Act of 1940 (8 June 1940) as amended, prohibits anyone, without a permit issued by the Secretary of the Interior, from taking Golden eagles (*Aquila chrysaetos)* and Bald eagles (*Haliaeetus leucocephalus)*, including their nests or eggs.
- PL 85-624, Fish and Wildlife Coordination Act (12 August 1958), states that fish and wildlife conservation will receive equal consideration with other project purposes and be coordinated with other features of water resources development programs.
- PL 89-72, The Federal Water Project Recreation Act of 1965 requires consideration of opportunities for fish and wildlife enhancement in planning water resources projects. Non-Federal bodies are encouraged to operate and maintain the project fish and wildlife enhancement facilities. If non-Federal bodies agree in writing to administer the facilities at their expense, the fish and wildlife benefits are included in the project benefits and project cost allocated to fish and wildlife. Fees may be charged by the non-Federal bodies to repay their costs. If non-Federal bodies do not so agree, no facilities for fish and wildlife may be provided.
- PL 91-190, National Environmental Policy Act of 1969 (NEPA) (1 January 1970), establishes a broad Federal policy on environmental quality stating that the Federal government will assure for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings, and preserve important historic, cultural, and natural aspects of our national heritage.
- PL 93-205, Conservation, Protection, and Propagation of Endangered Species (28 December 1973), requires that Federal agencies will, in consultation with the U.S. Fish and Wildlife Service (USFWS), further conservation of endangered and threatened species and ensure that their actions are not likely to jeopardize such species or destroy or modify their critical habitat.
- PL 95-632, Endangered Species Act Amendments of 1978 (10 November 1978), specifies a consultation process between Federal agencies and the Secretaries of the Interior, Commerce, or Agriculture for carrying out programs for the conservation of endangered and threatened species.

- PL 101-233, North American Wetland Conservation Act (13 December 1989), directs the conservation of North America wetland ecosystems and requires agencies to manage their lands for wetland/waterfowl purposes to the extent consistent with missions.
- PL 106-147, Neo-tropical Migratory Bird Conservation Act (20 July 2000) promotes the conservation of habitat for neo-tropical migratory birds.

(5) Forest Resources

The following law pertains to management of forested lands and is pertinent to the Greers Ferry Lake project:

- PL 86-717, Conservation of Forest Land Act of 1960 (6 September 1960), provides for the protection of forest cover in reservoir areas and specifies that reservoir areas of projects developed for flood risk management or other purposes that are owned in fee and under the jurisdiction of the Secretary of the Army and the Chief of Engineers will be developed and maintained so as to encourage, promote, and ensure fully adequate and dependable future resources of readily available timber through sustained yield programs, reforestation, and accepted conservation practices.
- PL 86-717, The stewardship management concept derives primarily from the Forest Cover Act, which was written specifically to address the conservation and management of trust resources at USACE projects. Section 1 of the Act states in part… ”reservoir areas…owned in fee and under the jurisdiction of the Secretary of the Army and Chief of Engineers, shall be developed and maintained so as to encourage, promote, and assure fully adequate and dependable future resources of readily available timber, through sustained yield programs, reforestation, and accepted conservation practices, and to increase the value of such areas for conservation, recreation, and other beneficial uses: Provided, that such development and management shall be accomplished to the extent practicable and compatible with other uses of the project.” Section 2 of the Act further states in part that, “…the Chief of Engineers, under the supervision of the Secretary of the Army, shall provide for the protection and development of forest or other vegetative cover and the establishment and maintenance of other conservation measures on reservoir areas under his jurisdiction, so as to yield the maximum benefit and otherwise improve such areas.”

(6) Cultural Resources

A number of public laws mandate protection of cultural resources on public lands. The following are pertinent to USACE project lands at the Greers Ferry Lake project:

- PL 59-209, Antiquities Act of 1906 (8 June 1906), applies to the appropriation or destruction of antiquities on federally owned or controlled lands and has served as the precedent for subsequent legislation.
- PL 74-292, Historic Sites Act of 1935 (21 August 1935), declares that it is a national policy to preserve for public use historic sites, buildings, and objects of national significance for the inspiration and benefit of the people of the United States.

- PL 86-523, Reservoir Salvage Act of 1960 (27 June 1960), provides for the preservation of historical and archaeological data that might otherwise be lost as the result of the construction of a dam and attendant facilities and activities.
- PL 89-665, National Historic Preservation Act of 1966 (NHPA) (15 October 1966), establishes a national policy of preserving, restoring, and maintaining cultural resources. It requires Federal agencies to take into account the effect an action may have on sites that may be eligible for inclusion on the National Register of Historic Places.
- PL 93-291, Archaeological and Historic Preservation Act of 1974 (24 May 1974), amends PL 86-523 and provides for the Secretary of Interior to coordinate all Federal survey and recovery activities authorized under this expansion of the Reservoir Salvage Act of 1960. The Federal construction agency may expend up to 1 percent of project funds on cultural resource surveys.
- PL 96-95, Archaeological Resources Protection Act of 1979 (31 October 1979), updates PL 59-209 and protects archaeological resources and sites on public lands and fosters increased cooperation and exchange of information among governmental authorities, the professional archaeological community, and private individuals.
- PL 101-601, Native American Graves Protection and Repatriation Act (16 November 1990), requires Federal agencies to return Native American human remains and cultural items, including funerary objects and sacred objects, to their respective peoples.

(7) Leases, Easements, and Rights-of-Way

A number of laws and regulations govern the granting of leases, easements, and rights-of-way on Federal lands. The following are pertinent to USACE project lands at the Greers Ferry Lake project:

- 16 U.S.C. § 663, Impoundment or Diversion of Waters (10 March 1934), for wildlife resources management in accordance with the approved general plan.
- 10 U.S.C. § 2667, Leases: Non-excess Property of Military Departments and Defense Agencies (10 August 1956), authorizes the lease of land at water resource projects for any commercial or private purpose not inconsistent with other authorized project purposes.
- U.S.C. Titles 10, 16, 30, 32, and 43 address easements and licenses for project lands; 16 U.S.C. § 460d authorizes use of public lands for any public purpose, including fish and wildlife, if it is in the public interest.16 U.S.C. §§ 470h-3, Lease or Exchange of Historic Property (15 October 1966), for historic properties.
- PL 91-646, Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (2 January 1971), establishes a uniform policy for fair and equitable treatment of persons displaced as a result of Federal or federally assisted programs.

Chapter 3 Goals and Objectives

a. The Greers Ferry Lake Master Plan Revision Statement

The Greers Ferry Lake Master Plan Revision Project Delivery Team (PDT) developed the following vision statement to help guide the process of revising the Greers Ferry Lake Master Plan:

"Promote and enhance quality outdoor recreation experiences and carry out other authorized USACE missions while protecting and managing the natural resources for future generations."

b. Policy and Master Plan Revision Schedule

Recreation and natural resource management policy and guidance are set forth in USACE regulations ER and EP 1130-2-550 and EP 1130-2-540. Included in these guidance documents is the process by which Master Plans are revised as well as broadly stated management principles for recreation facilities and programs, and stewardship of natural and cultural resources. Of particular importance in the formulation of recreation goals and objectives are the policies governing the granting of park and recreation and commercial concession leases (outgrants) which dictate that such outgrants must serve recreational needs and opportunities created by the project and are dependent on the project's natural or other resources. Other important guidance for management of all resources is the policy governing non-recreational outgrants such as utility easements as well as the guidance in ER and EP 1130-2-540 to adhere to ecosystem management principles. The ER and EP 1130-2-540 can be found at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerRegulations/ER_1130-2-540.pdf and https://www.publications.usace.army.mil/Portals/76/Publications/EngineerPamphlets/EP_1130-2-540.pdf, respectively. The ER and EP 1130-2-550 can be found at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerRegulations/ER_1130-2-550.pdf and https://www.publications.usace.army.mil/Portals/76/Publications/EngineerPamphlets/EP_1130-2-550.pdf, respectively.

The Master Plan is implemented in five phases: Phase 1, Initiate Master Plan Revision Process; Phase 2, Develop Draft Master Plan; Phase 3, Develop Final Master Plan; Phase 4, Receive Approval of Final Master Plan; and Phase 5, Implement Final Master Plan. For more information regarding details of each phase and project schedule, please reference the Greers Ferry Lake Project Management Plan, dated June 2017.

Assumptions: unlimited resources (i.e. contracting), this Master Plan revision is everyone's 1st priority ("no other 'items' on our plate"), and shoreline moratorium in place throughout the revision process.

c. Goals and Objectives

(1) Goals

The terms "goal" and "objective" are often defined as synonymous, but in the context of this Master Plan, goals express the overall desired end state of the Master Plan whereas resource objectives are the specific task-oriented actions necessary to achieve the overall Master Plan goals. The following excerpt from EP 1130-2-550 (https://www.publications.usace.army.mil/Portals/76/Publications/EngineerPamphlets/EP_1130-2-550.pdf), Chapter 3, express the goals for the Greers Ferry Lake Master Plan.

GOAL A. Provide the best management practices to respond to regional needs, resource capabilities and suitabilities, and expressed public interests consistent with authorized project purposes.
GOAL B. Protect and manage project natural and cultural resources through sustainable environmental stewardship programs.
GOAL C. Provide public outdoor recreation opportunities that support project purposes and public demands created by the project itself while sustaining project natural resources.
GOAL D. Recognize the particular qualities, characteristics, and potentials of the project.
GOAL E. Provide consistency and compatibility with national objectives and other State and regional goals and programs.

(2) Objectives

Resource objectives are defined as clearly written statements that respond to identified issues and that specify measurable and attainable activities for resource development and/or management of the lands and waters under the jurisdiction of the Little Rock District, Greers Ferry Lake Project Office. The objectives stated in this Master Plan support the goals of the Master Plan, Environmental Operating Principles (EOPs), and applicable national performance measures. They are consistent with authorized project purposes, Federal laws and directives, regional needs, resource capabilities, and take public input into consideration. Recreational and natural resources carrying capacities are also accounted for during development of the objectives found in this Master Plan. The Arkansas State SCORP was considered as well. The objectives in this Master Plan to the best extent possible aim to maximize project benefits, meet public needs, and foster environmental sustainability for Greers Ferry Lake (Table 3.1).

Table 3.1 Resource Objectives, Greers Ferry Lake Project

Recreational Objectives	Goals				
	A	B	C	D	E
Evaluate the demand for improved recreation facilities and increased public access on USACE-managed public lands and water for recreational activities (i.e. camping, walking, hiking, biking, boating, swimming, scuba diving, hunting, fishing, wildlife viewing, etc.) and facilities (i.e. campsites, picnic facilities, scenic overlooks, all types of trails, boat ramps, courtesy docks, interpretive signs/exhibits, and parking lots).	*		*	*	
Assess current public use levels (i.e. with focus on boating, camping, and day use trends) and evaluate impacts from overuse and crowding. Take action to prevent overuse, conflict, and public safety concerns.	*		*		
Evaluate recreational activities (public and private use) for natural resource protection, quality recreational opportunities, and public safety concerns.	*	*	*	*	*
Follow the Environmental Operating Principles (EOP) associated with recreational use of waterways for all water-based management activities and plans.		*	*		*
Increase universally accessible facilities on Greers Ferry Lake.	*		*		*
Evaluate the demand for commercial facilities on public lands and waters.	*		*		*
Consider flood/conservation pool and hydropower operations to address potential impact to recreational facilities (i.e. campsites, docks, etc.). Note that water level management is not within the scope of the Master Plan.	*	*	*	*	
Ensure consistency with USACE Recreation Strategic Plan.			*		*
Reference the Arkansas Statewide Comprehensive Outdoor Recreation Plan (SCORP) to ensure consistency in achieving recreation goals.			*		*

Natural Resource Management Objectives	Goals				
	A	B	C	D	E
Consider flood/conservation pool levels to optimize habitat conditions, as long as there is no interference with the Project's other authorized purposes, i.e. flood risk management and hydroelectric power generation. Note that water level management is not within the scope of the Master Plan.	*	*		*	
Actively manage and conserve forest, fish, and wildlife resources, special status species, by implementing ecosystem management principles and best management practices to ensure sustainability and enhance biodiversity.	*	*		*	*
Consider watershed approach during decision-making process.	*	*		*	*
Optimize resources, labor, funds, and volunteers/partnerships for protection and restoration of fish and wildlife habitats.		*			*
Optimize resources, labor, funds, and partnerships for the management and prevention of invasive species in Greers Ferry Lake.		*			*
Minimize activities which disturb the scenic beauty and aesthetics of the lake.	*	*	*	*	*
Continually evaluate erosion control and sedimentation issues at Greers Ferry Lake.	*	*			*
Manage project lands and water to support threatened and endangered species and their habitat.	*	*		*	*
Identify and protect unique or sensitive habitat areas.	*	*		*	*
Stop unauthorized activities and uses of public lands such as timber trespass, unpermitted docks and other structures, clearing of vegetation, unauthorized roadways, off-road vehicle (ORV) use, trash dumping, and placement of personal property that create negative environmental impacts.	*	*	*	*	*
Promote forest health through timber resource management actions to create diverse and sustainable forest habitat.	*	*		*	
Evaluate and determine appropriate non-statutory mitigation for adverse environmental impact actions.	*	*			

Environmental Compliance	Goals				
	A	B	C	D	E
Manage project lands and water to avoid negative effects to public water supply, ensuring public health and safety.	*	*	*	*	*
Consider both point and non-point sources of water pollution during decision making.	*	*		*	*
Continue coordination, communication, and cooperation between regulating agencies and non-governmental organizations to resolve and/or mitigate environmental problems.	*	*		*	*
Ensure compliance with Environmental Review Guide for Operations (ERGO) at all Greers Ferry Lake facilities and outgrants (i.e. marinas, resorts, etc.).	*	*			*
Ensure compliance with regulations prohibiting Privately Owned Domestic Sewer Systems on Federal lands.	*	*			

Visitor Information, Education and Outreach Objectives	Goals				
	A	B	C	D	E
Continue coordination and communication between agencies, special interest groups, and the general public.	*			*	*
Provide educational and outreach programs on the lake. Topics to include USACE missions, water quality, history, cultural resources, water safety, recreation, nature, and ecology.	*	*	*	*	*
Maintain a network among local, state, and federal agencies concerning the exchange of lake-related information for public education and management purposes.	*			*	*
Increase public awareness of special use permits or other authorizations required for special activities, organized special events, and commercial activities on public lands and waters of the lake.	*		*	*	*
Capture trends concerning incidents and accidents on public property and coordinate data collection with other public safety officials.	*		*	*	*
Promote USACE Water Safety message.	*		*	*	*

Visitor Information, Education and Outreach Objectives	Goals				
	A	B	C	D	E
Educate adjacent landowners on public land and shoreline use policies.	*	*	*	*	*
Continue to educate the public on the White River Water Control Plan, along with other management and operation plans (i.e. Shoreline Management Plan, Operation Management Plan, etc.).	*		*	*	*

Economic Impacts Objectives	Goals				
	A	B	C	D	E
Balance economic and environmental interests involving Greers Ferry Lake	*	*	*	*	*
Evaluate the type and extent of additional development that is compatible with national USACE policy on both recreation and non-recreational outgrants that may be sustained on public lands.	*	*	*	*	*
Work with local communities to promote tourism and recreational use of the lake.	*	*	*	*	*

General Management Objectives	Goals				
	A	B	C	D	E
Maintain the public land boundary lines to ensure it is clearly marked and recognized in all areas.	*	*		*	
Evaluate and assess adequacy of public lands to achieve USACE missions.			*	*	
Secure and adapt to sustainable funding for business line programs such as water supply, flood risk management, recreation, hydropower, and environmental stewardship.	*	*	*	*	*
Ensure consistency with USACE Campaign Plan (national level), Implementation Plan (regional level), and Operations Plan (District level).					*
Ensure consistency with Executive Order 13148, ‘Greening the Government Through Leadership in Environmental Management’ (21 April 2000).					*

General Management Objectives	Goals				
	A	B	C	D	E
Ensure consistency with Executive Order 13693, "Planning for Federal Sustainability in the Next Decade" (19 March 2015) to guarantee compliance with Leadership in Energy and Environmental Design (LEED) criteria for government facilities.					*
Manage non-recreation outgrants, such as utility easements for the benefit of the public, in accordance with national guidance set forth in ER 1130-2-550.	*	*		*	*

Cultural Resources Management Objectives	Goals				
	A	B	C	D	E
Monitor and coordinate lake development and the evaluation of cultural resources with State Historic Preservation Offices and federally recognized Tribes.	*	*		*	*
Continue to inventory cultural resources on the project.	*	*		*	*
Increase public awareness of Greers Ferry Lake history.		*		*	*
Maintain compliance with Section 106 and 110 of the National Historic Preservation Act; the Archeological Resources Protection Act; and the Native American Graves Protection and Repatriation Act on public lands surrounding the lake.		*		*	*
Prevent unauthorized or illegal excavation and removal of cultural resources on project lands.		*		*	*

Chapter 4 Land Allocations, Land Classifications, Water Surface Classifications, and Project Easement Lands

a. Introduction

Greers Ferry Lake is a multipurpose project constructed primarily for flood control and generation of hydroelectric power. Recreation is a third project purpose resulting primarily from the impoundment of water and the presence of public land. Management of recreational resources must not conflict with the regulation of the lake for the two primary purposes for which it was authorized. Environmental stewardship of project lands and waters is also an important project purpose and must be taken into consideration in all project management activities. The principal concept in planning Greers Ferry Lake was for public use and benefit. This concept has been implemented, and first among priorities for public use are stringent standards for public health, safety and sanitation. The Resource Plan in Chapter 5 considers these standards in land use classification and in planning for the recreational activities and stewardship of the lands and waters associated with the project. This chapter purely defines, in general terms, each category of land allocation, land classification, water surface classification, and project easement lands that can be found at USACE water resource projects.

Ownership of land adjacent to Government-owned land does not convey any rights to the adjacent landowner(s) that would allow private and exclusive access to the lake across Government-owned land. (Note: A small difference in acreage figures exists throughout this document due to the use of newer technologies, like LiDAR, to generate data. LiDAR is a snapshot of the conditions at the time the LiDAR was completed, and therefore, conditions may slightly change over time. Because of this, the USACE recommends that adjacent landowners obtain a survey prior to taking any action that might impact federal property rights. Where flowage or other easements belonging to the United States are located, adjacent landowners should reference the relevant deed language for specific locations and rights. Generally, adjacent landowners must contact the USACE for approval prior to beginning any action that may impact federal property rights.).

Project land and water total 41,194.5 acres. There is an additional 3,770.6 acres of flowage easement lands. Flowage easements were acquired to elevation 491feet above msl or up to elevation 498 feet above msl on the Little Red River and are indicated by the purple color on the land classification maps in Appendix C.

Land Allocation is a term used by USACE to describe the purpose for which lands at a project were acquired. The four possible allocations include: Operations, Recreation, Fish and Wildlife and Mitigation. At Greers Ferry Lake, all lands are allocated as Operations lands. No lands were specifically acquired for Recreation, Fish and Wildlife or Mitigation. The four land allocations used by USACE are fully described below in the following paragraphs.

b. Land Allocations

Lands are allocated by their congressionally authorized purposes for which the project lands were acquired. There are four land allocation* categories applicable to USACE projects:

(1) Operations. These are the lands acquired for the congressionally authorized purpose of constructing and operating the project. Most project lands are included in this allocation. At Greers Ferry Lake, 23.9 acres were acquired for the Operations land allocation.

(2) Recreation. These lands were acquired specifically for the congressionally authorized purpose of recreation. These lands are referred to as separable recreation lands. Lands in this allocation can only be given a land classification of "Recreation".

(3) Fish and Wildlife. These lands were acquired specifically for the congressionally authorized purpose of fish and wildlife management. These lands are referred to as separable fish and wildlife lands. Lands in this allocation can only be given a land classification of "Wildlife Management".

(4) Mitigation. These lands were acquired specifically for the congressionally authorized purpose of offsetting losses associated with development of the project. These lands are referred to as separable mitigation lands. Lands in this allocation can only be given a land classification of "Mitigation".

* Land allocations are not to be confused with shoreline allocations set forth in a project's SMP.

c. Land Classifications

USACE further divides land allocations through a system of land classification which designates the primary use for which project lands are managed. Project lands are classified for development and resource management consistent with authorized project purposes and the provisions of the National Environmental Policy Act (NEPA) and other Federal laws. Land classifications also take into account recreational trends, regionally important natural resources, and cultural resources. The land classifications at Greers Ferry Lake are depicted on the land classification maps in Appendix C and are described as follows:

(1) Project Operations. This category includes those lands required for the dam, spillway, switchyard, levees, dikes, offices, maintenance facilities, and other areas that are used solely for the operation of the project.

Current acreage: 377.3 acres

(2) High Density Recreation. Lands developed for intensive recreational activities for the visiting public including day use areas and/or campgrounds. These also include areas for commercial marina concessions, quasi-public development, and comprehensive resorts.

Current acreage: 2,645.2 acres

(3) Mitigation. This classification will only be used for lands with an allocation of Mitigation and that were acquired specifically for the purposes of offsetting losses associated with development of the project.

Current acreage: none

(4) Environmentally Sensitive Areas. Areas where scientific, ecological, cultural or aesthetic features have been identified. Designation of these lands is not limited to just lands that are otherwise protected by laws such as the Endangered Species Act, the National Historic Preservation Act or applicable State statues. These areas must be considered by management to ensure they are not adversely impacted. Typically, limited or no development of public use is allowed on these lands. No agricultural or grazing uses are permitted on these lands unless necessary for a specific resource management benefit, such as prairie restoration. These areas are typically distinct parcels located within another, and perhaps larger, land classification, area.

Current acreage: 487.6 acres

(5) Multiple Resource Management Lands. This classification allows for the designation of a predominate use as described below, with the understanding that other compatible uses described below may also occur on these lands (e.g. a trail through an area designated as Wildlife Management). Land classification maps must reflect the predominant sub-classification, rather than just Multiple Resource Management.

(a) Low Density Recreation. Lands with minimal development or infrastructure that support passive public recreational use (e.g. primitive camping, fishing, hunting, trails, wildlife viewing, etc.)

Current acreage: 688.8 acres

(b) Wildlife Management. Lands designated for stewardship of fish and wildlife resources.

Current acreage: 2,080.7 acres

(c) Vegetative Management. Lands designated for stewardship of forest, prairie, and other native vegetative cover.

Current acreage: 3,726.0 acres

(d) Future/ Inactive Recreation Areas. Areas with site characteristics compatible with potential future recreational development or recreation areas that are closed. Until there is an opportunity to develop or reopen these areas, they will be managed for multiple resources.

Current acreage: Salt Creek Future Park (113.9acres); South Fork Park (91.3 acres)

d. Water Surface Classifications

If the project administers a surface water zoning program, then it should be included in the Master Plan.

(a) Restricted. Water areas restricted for project operations, safety, and security purposes.

Current acreage: 49.1 acres

(b) Designated No-Wake. To protect environmentally sensitive shoreline areas, recreational water access areas from disturbance, and for public safety.

Current acreage: none

(c) Fish and Wildlife Sanctuary. Annual or seasonal restrictions on areas to protect fish and wildlife species during periods of migration, resting, feeding, nesting, and/or spawning.

Current acreage: none

(d) Open Recreation. Those waters available for year round or seasonal water-based recreational use.

Current acreage: 31,139.7 acres

e. Project Easement Lands

All lands for which the USACE holds an easement interest, but not a fee title. Planned use and management of easement lands will be in strict accordance with the terms and conditions of the easement estate acquired for the project. Easements were acquired for specific purposes and do not convey the same rights or ownership to the USACE as other lands.

(1) Operations Easement. USACE retains rights to these lands necessary for project operations.

Current acreage: 23.9 acres

(2) Flowage Easement. USACE retains the right to inundate these lands for project operations.

Current acreage: 3,770.6 acres

(3) Conservation Easement. USACE retains rights to lands for aesthetic, recreation and environmental benefits.

Current acreage: none

Chapter 5 Resource Plan

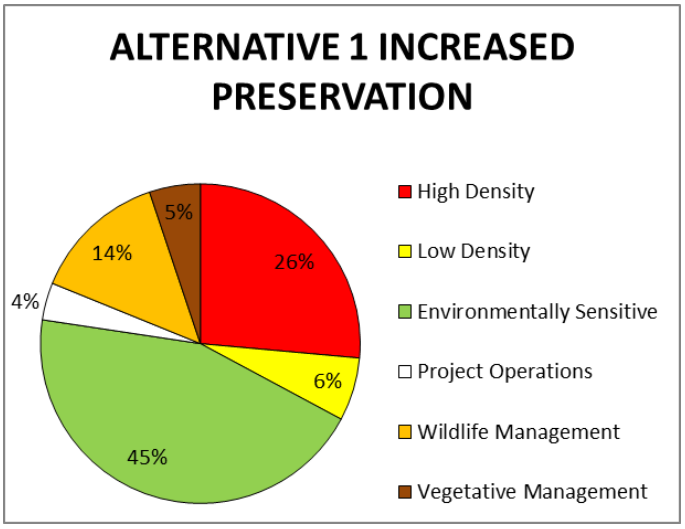
This chapter describes in broad terms how project lands and water surface will be managed. For Greers Ferry Lake, the PDT chose the Management by Classification approach as set forth in EP 1130-2-550 (https://www.publications.usace.army.mil/Portals/76/Publications/EngineerPamphlets/EP_1130-2-550.pdf).

In addition, the initial section contains a brief description of each alternative developed during the Master Plan revision process. A more detailed description is provided in the accompanying EA, Appendix A, to this document. All alternatives are compared against the No Action alternative (in this revision process, Alternative 3 is the No Action alternative).

a. Alternatives Developed during the Master Plan Revision Process

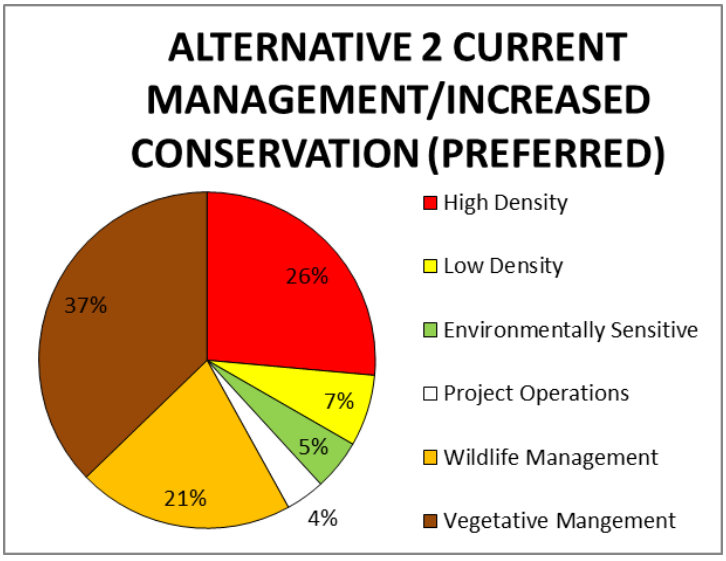
(1) Alternative 1 INCREASED PRESERVATION

- Increase acreage of Environmentally Sensitive Areas (ESA) and Wildlife Management.
  - Vegetative management land classification where no shoreline use permits are currently located convert to ESA, all islands ESA.
- Leave Low Density land classification at ramps and historical access areas.
  - Island, bluffs, scenic areas to ESA.
  - Convert entire park buffer to ESA, grandfather permits
- Not viable alternative because:
  - This alternative would not allow for balancing the use of the resource with conservation efforts.
  - It would also not allow for working with adjacent landowners on vegetation modifications to improve the resource.
  - Additional Wildlife Management Areas are not feasible due to topography at Greers Ferry Lake.



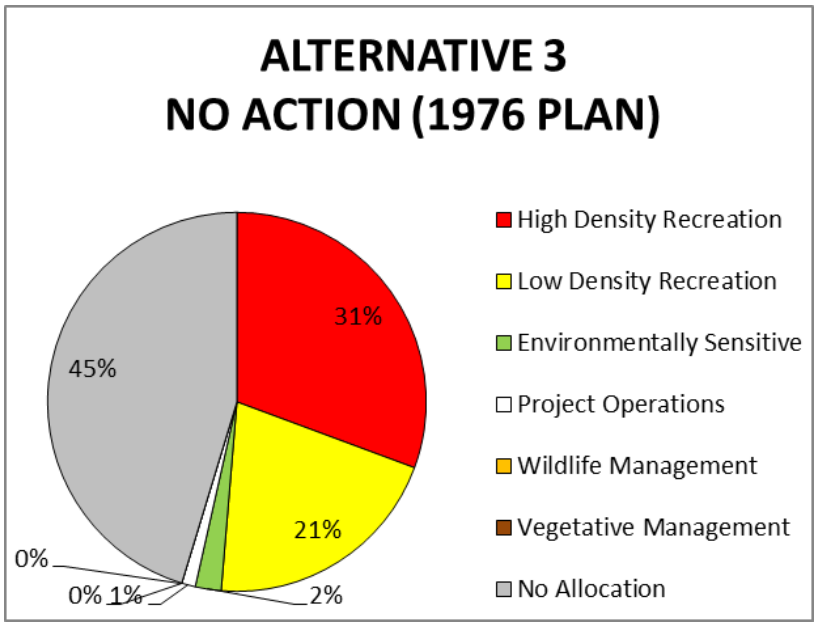
(2) Alternative 2 CURRENT MANAGEMENT/INCREASED CONSERVATION (SELECTED)

- This alternative recognizes public comment and preferences collected during Scoping; recognizes regional Natural Resource Management priorities.
- Recognizes USACE historical management at Greers Ferry Lake.
- The alternative has no negative effect on current or projected use.
- No negative effect on the current 2004 SMP (there will be areas where zoning will be shifted to correct past errors); however, it is expected there will be future changes as a result of an updated Master Plan (i.e. additional mowing permits, landscape plans).
- 100-feet vegetative buffer already in existence from 2004 SMP.
- The increase in Wildlife Management land classification: Salt Creek and South Fork USACE parks from the 1976 Master Plan have been reclassified from High Density to Wildlife Management because this is how those areas are currently managed. This also includes the areas of the Fish Hatchery, Nursery Pond, and Agriculture Lease.
- Would allow adjacent landowners to work with USACE to manage invasive species to improve vegetative resources (not necessarily the traditional sense of a 'veg mod' permit; it will be a benefit to the area, not just a blanket mowing permit); work can be done within the 100-feet buffer area, but not necessarily just 'mowing' in the buffer area.
- Helps to maintain existing "High Scenic Areas" set during 2004 SMP update.



(3) Alternative 3 NO ACTION

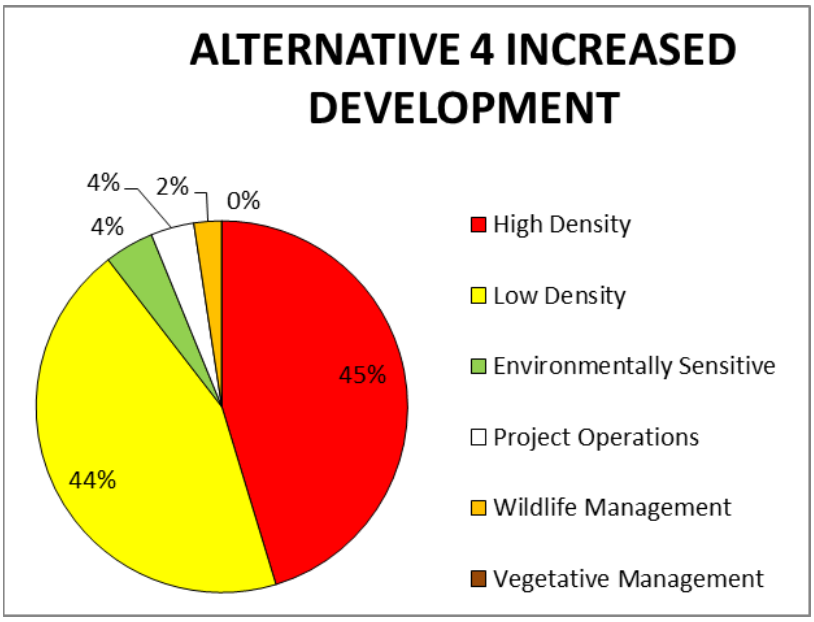
- This is not a viable alternative because:
  - 45 percemt of Federal lands are not classified.
  - This alternative does not recognize public comment or regional trends (recreation and resource management).
  - This alternative does not address resource management laws, policies, and regulations that were implemented after the 1976 Greers Ferry Lake Master Plan.



(4) Alternative 4 INCREASED DEVELOPMENT

- More Low Density and High Density to allow to for more development. Islands reclassified to High Density, more High Density for commercial activity; more Low Density for docks, resorts, trails, etc.
- Areas like Salt Creek and South Fork would remain High Density to allow for development (they are currently managed as Wildlife Management Areas).
- Convert all Resorts (i.e. Cabins on the Cove)/Future Destination Resorts to High Density (Fairfield Bay)
- Change these areas to High Density land classification: Near Narrows (South), Across the Narrows, Higden Bay, Fairfield Bay, Point 14, Eden Isle, Choctaw, Jansen's, Choctaw Bay (Kid Island), Crow's Feet
- 3 areas would become Wildlife Management Areas: Fish Hatchery, Agriculture Lease, Nursery Pond
- This is not a viable alternative because:
  - This alternative could negatively impact actions already implemented from the 2004 SMP and subsequent court rulings.
  - Does not reflect public scoping comments.

- Current land base not sufficient for High Density development.
- No demand for development of High Density areas (current High Density have adequate space to meet current and future demand).
- This alternative does not protect the resource for future generations to use.



b. Classification and Justification

The PDT made some general assumptions during the land classification process. Those assumptions include:

- All valid boat dock permits are located in the Low Density land classification.
- Valid vegetation modification permits could be located in the Low Density and/or Vegetative Management land classifications.
- There may be some existing vegetation modifications located in ESA, these permits may be allowed to remain, but not improved.
- Past classification lines, legal access point to the Limited Development Area (LDA), edges of zoning and shoreline use permits/outgrants/roads, USACE boundary monuments and corners, and terrain such as drainage inlets were used as boundaries between classifications.
- Specific features were identified based upon 2010 LiDAR data.
- Unimproved walking paths may be located in Environmentally Sensitive Areas.
- GIS/various dated imagery and hard copy permit information was used to identify dock locations and vegetation modification (mowing).

In addition, the PDT considered what the land classification was before (from the 1976 Master Plan), the feasibility of keeping or changing the land classification with the Master Plan revision, potential future development needs around the lake, and all agency and public scoping comments received during the public comment period during the scoping phase and draft release phase.

(1) Project Operations

Land classification includes those lands required for the dam, spillway, switchyard, levees, dikes, offices, maintenance facilities, and other areas that are used solely for the operation of the project.

Justification: On Greers Ferry Lake, the lands classified as Project Operations have been classified by definition. The Little Dike (toe and embankments) was reclassified from Low Density to Project Operations. Portions of the dam area were reclassified from either High Density/no classification to Project Operations. The Project Office area and associated facilities (i.e. storage compound) were reclassified from either High Density/no classification to Project Operations. Areas around water intake structures were reclassified from either ESA/no classification to Project Operations.

Resource Objectives: General Management
(Acreage = 377.3 acres or 4 % of USACE land)

(2) High Density Recreation

Land classification is for those lands intended to be developed or are currently developed for intensive recreational activities for the visiting public including day use areas and/or campgrounds. These could include areas for commercial marina concessions and quasi-public development.

Justification: There were various areas on Greers Ferry Lake that have been reclassified from High Density to Wildlife Management. Those areas include:

a. Salt Creek (113.9 acres)
b. South Fork (91.3 acres)
c. Fish Hatchery lease area at JFK (19.9 acres)
d. Nursery pond area at Mill Creek (14.1 acres)

High Density additions and expansions were made at the following areas:

a. Devils Fork and Heber Springs were expanded to incorporate all of the campgrounds.
b. Multiple parks had pieces of land that were not classified (Cherokee, Choctaw, Dam Site, Devils Fork, Fairfield Bay, Heber Springs, JFK, Mill Creek, Narrows, Sandy Beach, Shiloh) and were reclassified to High Density.
c. Eden Isle and the Visitors Center were reclassified from no land classification to High Density.

No new future public requests for LDA in a High Density classification will be granted based upon guidance received to keep private/community use separated from commercial use activities.

Resource Objectives: Recreation, Economic Impacts, General Management

(Acreage = 2,645.2 or 26% of USACE land)

(3) Mitigation

Land classification allows for lands with an allocation of Mitigation and that were acquired specifically for the purposes of offsetting losses associated with development of the project.

When Greers Ferry Lake was created, no mitigation lands were purchased because it was not a requirement at that time. Therefore, there are currently no lands classified as mitigation land at the Greers Ferry project.

(4) Environmentally Sensitive Area (ESA)

Land classification is for those land areas where scientific, ecological, cultural or aesthetic features have been identified. Designation of these lands is not limited to just lands that are otherwise protected by laws such as the Endangered Species Act, the National Historic Preservation Act or applicable State statutes. These areas must be considered by management to ensure they are not adversely impacted. Typically, limited or no development of public use is allowed on these lands currently; examples of permits that could be issued are walking paths, specific erosion control measures, and removal of invasive species. Public right-of-ways in the ESA land classification will be considered on a case-by-case basis.

At Greers Ferry Lake, approximately 5% of ESA lands have permitted residential amenities that will be considered for renewal on a case-by-case basis. These areas include shoreline use permits (path permits) and outgrants.

No agricultural, grazing, or mowing for residential/commercial uses are permitted on these lands unless necessary for a specific resource management benefit, such as prairie restoration.

Justification: ESA lands are classified as such to preserve the scenic, historical, archaeological, scientific, water quality, or ecological value of the overall project.

Classification of lands as ESAs took into consideration the location or habitat of threatened, endangered, and state species of concern at Greers Ferry Lake. The classification of ESA also considered locations of significant cultural or historic resource sites, as well as resource protection (i.e. glade restoration areas, fragile habitats) and aesthetics. The ESA classification is also responsive to public comment seeking to keep the lake natural, scenic and to ensure that water quality is maintained for future generations. There were areas of High Density, Low Density, and no classification that were reclassified to ESA. These areas include scenic buffers for campgrounds, cultural resource/historic sites, waterfalls, threatened or endangered species/species of concern habitat, and scenic areas.

Criteria for existing vegetation modification permits (paths) in ESA: If there is an existing path in ESA, the permit may remain, but the path may not be improved. Unimproved walking paths may be located in Environmentally Sensitive Areas.

There are public utilities (i.e. power lines, telephone lines, water lines, etc.) that are found in ESA land classifications; this is taken into account under the “limited development for public

use" in ESA. As stated previously, future right-of-ways for public utilities in ESA will be considered and reviewed on a case-by-case basis.

Resource Objectives: Environmental Compliance, Cultural Resource Management, Natural Resource Management

(Acreage = 487.6 or 5% of USACE land)

(5) Multiple Resource Management

Land classification allows for the designation of a predominant use as described below, with the understanding that other compatible uses described below may also occur on these lands (e.g. a trail through an area designated as Wildlife Management). Land classification maps must reflect the predominant sub-classification, rather than just Multiple Resource Management. Right-of-ways for public utilities in Multiple Resource Management land classifications will be considered and reviewed on a case by case basis.

(a) Low Density Recreation

Land classification includes lands with minimal development or infrastructure that support passive public recreational use (e.g. primitive camping, fishing, hunting, trails, wildlife viewing, shoreline use permits etc.). Low Density Recreation lands may contain LDA within the context of the SMP (Note: Distribution of shoreline areas to Limited Development status requires revision of the SMP).

Justification: In areas which had active boat dock permits, various outgrants, LDA, trails, or historic access/use areas, these areas were classified as Low Density. All resort lease areas were placed in Low Density land classification. Limited motel/resorts lease areas are quasi-private recreational facilities located on public land, but owned and operated by individuals for commercial purposes. Resorts are located on private property and are operated along with the supporting facilities on outgranted public land. The facilities on public land are open to registered overnight resort guests only. Therefore, all current activities related to limited motel/resorts must comply with the lease and follow the Project's approved SMP and Master Plan to the maximum extent possible. For more information on this type of lease, please refer to SWLR 405-1-16, Real Estate Outgrants, Limited Motel/Resort Leases.

Resource Objectives: Recreation, Economic Impact, Natural Resource Management, Environmental Compliance, Cultural Resource Management, Visitor Information and Education

(Acreage = 688.8 or 7% of USACE lands)

(b) Wildlife Management

Land is designated for stewardship of fish and wildlife resources.

Justification: On Greers Ferry Lake, areas which have been classified as wildlife management lands are larger tracts of land and shoreline areas where food plots and other wildlife

management activities can be established to supplement and enhance the existing wildlife forage. The areas classified have been determined to contain suitable habitat for native wildlife and will be protected for this purpose. There were no areas classified as Wildlife Management under the 1976 Master Plan.

Specific areas reclassified to Wildlife Management include: Fish Hatchery lease area at John F. Kennedy park; Nursery pond at Mill Creek; South Fork and Salt Creek parks; Agriculture & Grazing lease; and various islands.

Resource Objectives: Natural Resource Management, Recreation, Environmental Compliance

(Acreage = 2,080.7 or 21% of USACE lands)

(c) Vegetative Management

Land is designated for stewardship of forest, prairie, and other native vegetative cover.

Justification: On Greers Ferry Lake, Low Density, High Density, ESA land classifications and areas with no classifications from the 1976 Master Plan have been reclassified to Vegetative Management except those locations with LDA, trails, USACE parks, Project Operations, or areas identified as unique or special for passive recreation.

The recommendation to classify a majority of the lands around Greers Ferry Lake as Vegetative Management results from having a limited amount of government land adjacent to the shoreline with an existing 100-feet vegetative buffer (from the 2004 SMP), which is the way the shoreline is currently being managed. Approximately 57 percent of land proposed to be classified as Vegetative Management is a direct result of the 2004 SMP and what was mandated by court ruling. Vegetative management classification will allow the USACE to work closely with adjacent landowners in protecting water quality, aquatic resources, wildlife, aesthetics, and soils to reduce long term adverse impacts to the ecosystem.

The main difference between the Low Density and Vegetative Management land classification at Greers Ferry Lake is that adjacent landowners will be unable to apply for and acquire a shoreline use permit for a boat dock in Vegetative Management. Until the SMP update is completed, there will be 9 docks in limited LDA shoreline allocations located in Vegetative Management (0.14 miles or 736 feet of LDA in Vegetative Management). The LDA allocations will be updated during the SMP update to correct these sites. Similar to prior Master Plan revisions, this allows us to correct past mapping mistakes where docks were placed outside of LDA zoning. Vegetation modification permits (mowing/path) may be issued in this land classification.

Resource Objectives: Natural Resource Management, Environmental Compliance

(Acreage = 3,726.0 or 37% of USACE lands)

(d) Future or Inactive Recreation Areas

Land classification is for those land areas with site characteristics compatible with potential future recreational development or recreation areas that are closed. Until there is an opportunity to develop or reopen these areas, they will be managed for multiple resources.

The project has no developed recreation areas that have been completely closed, however 2 areas have been reclassified to Wildlife Management lands (Salt Creek and South Fork). This plan suggests that if future recreation development is needed, this development will be accommodated either within the existing High Density classified land areas or on private property.

(6) Water Surface

Waters classified for particular purposes when the project administers a surface water zoning program. Greers Ferry Lake did not have water surface classifications in prior MPs.

(a) Restricted

Surface waters are restricted for project operations, safety, and security purposes.

Justification: Restricted water surface classifications are areas restricted due to USACE policy for safety and security. These areas include immediately above and below the dam and areas around water intake structures. In addition, it is generally understood that areas near designated swim beaches are considered 'restricted' for swimmer safety.

Resource Objectives: General Management

(Acreage = 49.1)

(b) Designated No Wake

Surface waters are established to protect environmentally sensitive shoreline areas, recreational water access areas from disturbance, and for public safety.

Greers Ferry Lake has no water surface area in this classification category; however, it is generally understood (i.e. posted and/or buoyed) and in accordance with state laws that areas near designated boat ramps, bridges, marinas, docks, and other supporting structures are considered 'no wake' for boater safety.

(c) Fish and Wildlife Sanctuary

Surface waters are areas where annual or seasonal restrictions on areas to protect fish and wildlife species during periods of migration, resting, feeding, nesting, and or spawning are present.

Greers Ferry Lake has no water surface areas in this classification category.

(d) Open Recreation Areas

Classification is for those waters available for year round or seasonal water based recreation use.

Justification: On Greers Ferry Lake all water surface acres are classified as open recreation, with the exception of restricted areas immediately above and below the dam and areas near water intake structures.

Resource Objectives: Recreation, Natural Resources Management, Economic Impact, General Management

(Acreage = 31,139.7)

(7) Project Easement

Land classification is for those lands for which the USACE holds an easement interest, but not fee title. Planned use and management of easement lands will be in strict accordance with the terms and conditions of the easement estate acquired for the project. Easements were acquired for specific purposes and do not convey the same rights or ownership to the USACE as other lands. The following types of easements were acquired for the Greers Ferry Project:

(a) Operations Easement

The USACE retains rights to these lands necessary for project operations (access, etc.).

Justification: Greers Ferry Lake Project operations easements are generally for road rights-of-way that provide access to project facilities. Road rights-of-way purchased for the relocation of roads inundated by the creation of the project have been disposed of to the appropriate operating authority.

Operation easements exist for roadway entrances to the Cherokee park, South Fork, and Mill Creek.

Resource Objectives: General Management, Recreation, Economic Impact, Natural Resource Management

(Acreage: 23.9 Acres)

(b) Flowage Easement

The USACE retains the right to inundate these lands for project operations.

Justification: The flowage easement estate grants the Government the perpetual right to occasionally overflow the easement area, if necessary, for the operation of the reservoir; and specifically provides that, “No structures for human habitation shall be constructed or maintained on the land […]”; and provides further that, “No other structures of any other type shall be

constructed or maintained on the land except as may be approved in writing by the representative of the United States in charge of the project."

The flowage easements acquired for the operation of Greers Ferry Lake Project are typically applicable to that portion of the described property lying between the GFTL and elevation 491 feet above msl or up to elevation 498 feet above msl on portions of the Devils Fork, South Fork, and Middle Fork arms of the lake.

Resource Objectives: General Management

(Acreage: 3,770.6 Acres)

(c) Conservation Easement

The USACE retains the rights to lands for aesthetic, recreation, and environmental benefits.

There are currently no known lands classified as conservation easement lands on Greers Ferry Lake.

Chapter 6 Special Topics/Issues/Considerations

This chapter discusses the special topics, issues, and considerations the PDT identified as critical to the future management of Greers Ferry Lake. Special topics, issues, and considerations are defined in this context as any problems, concerns, and/or needs that could affect or are affecting the stewardship and management potential of the lands and waters under the jurisdiction of the Little Rock District, Greers Ferry Lake Project Office Area of Responsibility (AOR). For simplicity, the topics are discussed below under generalized headings.

a. Water Supply Reallocations

The issue with water supply reallocations concerns where the water is reallocated from flood pool, conservation pool, or a combination of both. Flood pool reallocations raise the conservation pool (and 'seasonal pool'), which impacts recreation facilities, reduces flood storage capabilities, increases the probability of releasing water sooner and at potentially higher volumes, and potentially impacts threatened and endangered species habitat. Conservation pool reallocations impact calculations for hydropower generation. A reallocation combination of both pools have impacts as described above.

b. Greers Ferry Water Garden

The water garden concept originated in the 1960's and was proposed in the 1976 Master Plan. A portion of the water garden location has already been developed by the USACE (Camp Loops B, C, and D; picnic shelter; and playground). Additionally, a large portion of the creek has been leased to the State of Arkansas for a restoration project and trail. The Little Rock District has informed proponents of the water garden that lands will not be made available for this project because it does not meet the requirements for the Recreation Development Policy for Outgranted USACE Lands (Chapter 16, ER 1130-2-550).

c. Overcrowding/Overuse of USACE parks (Dam Site, Sugarloaf, Heber Springs, Choctaw, Old Hwy 25); need for more launch areas/parking

The number of visitors to these parks exceed the design capacity (i.e. designated parking areas). Day use facilities are over-extended. Non-electric campsites are not being used. Existing campsites are not up to date with water and electricity amenities—we are not able to meet industry needs.

d. Dog parks

Designate areas of existing USACE land as "dog parks" or dog friendly areas to accommodate for visitors bringing service animals to USACE parks and land.

e. Natural Gas Impacts

To date, no drilling activity has taken place on USACE lands or under Greers Ferry Lake. Mineral rights for the Federal Government are managed by the Bureau of Land Management.

f. Vegetative Land Classification

As noted in Chapter 5 under the justification for change in land classification, the recommendation to classify a majority of the lands around Greers Ferry Lake as Vegetative

Management results from having a limited amount of government land adjacent to the shoreline with an existing 100-feet vegetative buffer (from the 2004 SMP), which is the way the shoreline is currently being managed. Approximately 57 percent of land proposed to be classified as Vegetative Management is a direct result of the 2004 SMP and what was mandated by court ruling.

Vegetative management classification will allow the USACE to work closely with adjacent landowners in protecting water quality, aquatic resources, wildlife, aesthetics, and soils to reduce long term adverse impacts to the ecosystem.

The main difference between the Low Density and Vegetative Management land classification at Greers Ferry Lake is that adjacent landowners will be unable to apply for and acquire a shoreline use permit for a boat dock in Vegetative Management. Until the SMP update is completed, there will be 9 docks in limited LDA shoreline allocations located in Vegetative Management (0.14 miles or 736 feet of LDA in Vegetative Management). The LDA allocations will be updated during the SMP update to correct these sites. Similar to prior Master Plan revisions, this allows us to correct past mapping mistakes where docks were placed outside of LDA zoning. Vegetation modification permits (mowing/path) may be issued in this land classification.

g. Sandy Beach Project

The Sandy Beach project is a proposal from a local developer to establish a waterfront attraction from Sandy Beach to Heber Springs Park. Under the 1976 Master Plan, the entire area is currently not classified to support this proposal. Only a portion of the proposal could be considered under the selected alternative due to the land classifications.

h. Water Management and Flood Risk Management

Six White River Basin lakes are operated together as a system to reduce the frequency and severity of floods. These lakes are Greers Ferry, Table Rock, Bull Shoals, Norfork, Beaver and Clearwater. Greers Ferry Lake is on the Little Red River near Heber Springs, Arkansas. The Little Red's confluence with the White River is near Georgetown, Arkansas.

Beaver, Table Rock and Bull Shoals lakes are in a row along the main stem of the White River in Arkansas and Missouri. Norfork Lake is on the North Fork River, which empties into the White River near the town of Norfork in north central Arkansas. Clearwater Lake is on the Black River near Piedmont, Missouri. The Black River's confluence with the White River is near Jacksonport, Arkansas.

Flood Risk Management is a primary purpose of the White River Basin lakes. These lakes were among dozens Congress authorized the USACE to build in the Mississippi River Valley to reduce flood damage and loss of life. This was primarily in response to the great flood of 1927, which swelled rivers across the entire Mississippi River Valley. That year incessant rainfall soaked 31 states and two Canadian provinces. This and subsequent floods in the 1930s and 1940s prompted legislation that led to construction of the USACE dams in the White River Basin. These lakes also work in conjunction with a system of levees, which provide additional reduction

in flood damages. Since they were constructed, the White River Basin lakes and levees have prevented an estimated $1 billion in flood losses.

Flood risk management lakes work by capturing runoff in their ‘flood pools’ during heavy rain. After rivers downstream begin receding, water is released in a controlled fashion following pre-determined ‘operating plans’. Without the lakes, all that water would roll downriver at one time. Flood crests would rise higher and spread over more land, thus causing more damage and possibly loss of life. The water stored in the flood pool must be evacuated in preparation for the next storm as quickly as downstream conditions permit without creating additional flooding. The difficulty with repeated rain is engineers are not always able to release all the water captured in the flood pool between rains. This can cause lake levels to rise with each new rainfall. When that occurs, it can sometimes take many months to empty the huge volumes of water from the flood pools and return all the lakes to their ‘conservation pools’. It is worth noting the lakes are not intended to prevent all flooding. The lakes have limitations that Mother Nature can exceed, and from time to time does. Therefore, downstream property owners should be judicious in how they develop land within the flood plains. Floods are not as frequent because of the dams, and when they do occur, they are typically not as severe as they were before the dams were built. But there will still be occasions when significant floods occur downstream of these dams. Planting crops on land that floods on occasion might be profitable in the long run. Building a home or business on that same land might not be. Farming, running a business, or having a home in the flood plain of a river is a risk that each landowner accepts.

When Congress instructed the USACE to build the White River Basin lakes, they also told the USACE to include storage for hydroelectric power generation at five of them; Clearwater Lake does not have hydropower. Water supply storage was also included at Greers Ferry Lake, and Congress gave the USACE authority to reallocate limited amounts of storage in each lake for additional water supply. The storage space that holds water for hydropower generation and water supply primarily comprises what is referred to as the ‘conservation pool’. Basically, the conservation pool creates the lakes and provides the ancillary recreational opportunities. In recognition of these opportunities, Congress also instructed the USACE to provide public access at each lake, which led to the construction of USACE parks.

While Congress and the USACE recognize the value in recreation, the White River Basin lakes were built to store water for hydropower and water supply during average weather and to store floodwater during wet weather. Therefore, the lake levels are weather dependent. Levels can range from very high during abnormally wet weather to very low during drought. This is how the lakes were designed, and it is how they provide benefits to repay the taxpayer investment in them. Just this decade, weather patterns have created both drought (2005-2007, 2012) and flood conditions (2008, 2009, 2011, 2015 and 2017).

The USACE has had many requests to keep the lake levels more steady during the recreation season, but the USACE does not have the legal authority to manage lake levels for recreation. The USACE is bound under the law to follow the White River Water Control Plan, which dictates how the system is operated.

The White River Water Control Plan has a lengthy history. In 1942, the Basis of Design for Definite Project Report was developed, which included the original studies for the method of operation for Bull Shoals and Norfork. This report helped establish the size of the flood and conservation pools in each lake. In 1952, the Plan of Flood Regulation for Bull Shoals and Norfork Reservoirs was developed. This report described the proposed plan of regulation for Bull Shoals and Norfork. In 1954, the Master Manual for Reservoir Regulation of the White River Basin was first developed. This described the operating criteria for Bull Shoals, Norfork, and Greers Ferry. In 1963, the Reservoir Regulation Manual for Beaver, Table Rock, Bull Shoals, and Norfork Reservoirs was developed. This was revised in 1966. In 1993, the Master Manual for Reservoir Regulation for White River Basin was developed. No changes to the Water Control Plan were made, only basin conditions were updated. The economic analysis showed that changing the allocation of storage for purposes other than flood control, hydropower, or water supply was not economically justified. After years of additional study, a revision was made in 1998 to the water control plan that lowered the regulating stages on the White River during the growing season.

Rainfall amounts and consumer electricity demand are the keys that dictate the releases from a White River dam, which are made primarily through power generation, and, if needed, through spillway gates, or conduits. At times, water may be released through all three. In 2005, 2006, 2007, and again in 2012, the basin had below normal rainfall resulting in significant drought. Because there was less water coming into the lakes, there was less water released from the dams, but some power generation was still necessary to meet consumer demands for electricity. Therefore, most lakes experienced lower lake levels. By comparison2008, 2009, 2011, 2015 and 2017
were wet, flood-producing years, and with so much water coming into the lakes, lake levels remained high much of the time until all the stored floodwater could be released in a controlled fashion according to the Water Control Plan.

Conditions in the lake and conditions downstream of the dam also help dictate releases. When a lake is in its conservation pool, Southwestern Power Administration (SWPA) determines the releases within certain limits. They are subjected to 7-day and 28-day drawdown limits, along with having a minimum release requirement to ensure survival of fish species downstream during the warm months. SWPA is also subject to maximum release limits based on downstream conditions during high water. The maximum release is determined by the USACE Water Control Plan. Since the lakes are operated as a system, it gets still more complex. For instance, Beaver Lake releases are determined by conditions in Table Rock and Bull Shoals lakes downstream. Below Bull Shoals, Norfork and Greers Ferry lakes, releases are determined based on river levels miles downstream of the dams. The USACE will release water stored in the flood pools of Bull Shoals and Norfork based on the White River stage at Newport, Arkansas to empty the lakes as quickly as possible. Both the USACE and SWPA are following the missions entrusted to them under the law.

The water control plan, simply stated, says releases from Beaver are dependent upon the elevation in Table Rock and Bull Shoals Lakes; releases from Table Rock are dependent upon the elevation in Bull Shoals Lake; and releases from Bull Shoals and Norfork are dependent upon the seasonal regulating stage at White River at Newport, Arkansas. Release criteria for the

lakes were developed more specifically based upon the pool elevation, pool elevation of downstream lakes, the time of year, and downstream river conditions. Bull Shoals and Norfork releases are sized based on the following criteria:

- From 1 December through 14 April - Regulate to 21 feet except, if a natural rise exceeding 21 feet occurs, regulate to the lesser of the observed crest or 24 feet.
- From 15 April through 7 May - Regulate to 14 feet except, regulate to 21 feet, from 15 April through 30 April, and 18 feet, from 1 May through 14 May, if the four-lake system storage exceeds 50 percent full.
- From 8 May through 30 November - Regulate to 12 feet except, regulate to 14 feet from 15 May through 30 November, if the 4-lake system storage exceeds 70 percent full.
- Release a minimum of firm power and in extreme cases zero if a significant reduction in critical immediate downstream flood conditions is possible.
- Prorate the flood control releases between Bull Shoals and Norfork to maintain equal percentages of available flood control storage in Norfork and the Beaver-Table Rock-Bull Shoals.
- Release a maximum of 32,500 cubic feet per second (cfs) from Bull Shoals and 10,500 cfs from Norfork subject to a 50,000 cfs flow limit at White River at Batesville, Arkansas.

Curtail secondary power generation ‘releases exceeding firm power’ until six days after the crest at White River at Newport, Arkansas. Secondary power releases should provide that stages above the regulating stage continue to recede until the regulating stage is reached. While lowering lake levels in the winter to prepare for spring rains does in effect increase the size of the flood pool, at the same time it takes away from hydropower and water supply storage. The USACE does not have legal authority to do this. The current allocation of storage for flood risk management was approved by Congress. Changing that allocation would require Congressional action. Also, that is a very risky action because there is no way to forecast long-range how much or how little rain will fall. If the USACE artificially lowered lake levels in the winter and spring rains did not come, a shortage of water to generate electricity, meet the needs of water utilities or provide viable recreation opportunities could ensue. The water supply and power users pay for that storage. If the drought progressed, instead of recovering, lake levels could continue to drop and cause an extreme water shortage.

Regulation during storm periods is based on runoff predicted from the rain that has occurred and can be measured. Rainfall forecasts are not sufficiently accurate to base operational decisions on them. Because rainfall forecasts are inaccurate, pre-releasing would put downstream users at risk if rain developed in the uncontrolled areas instead of upstream of the dam. Conversely, we are also asked by some users to stop releases from the dams before a rainfall begins. This can also cause issues since we would be holding water in the flood pool, which lessens our ability to reduce peak downstream flows from large rainfall events.

Analysis of over 60 years of hydrologic data has proven that major floods develop from the accumulation of storage in the lakes from persistent, repeated rain storms that do not allow enough time in between to evacuate flood storage. In other words, flood storage is most always

filled at the lakes by several smaller storms rather than by one large storm. So using that long-term perspective, the USACE prepares for the future by making releases whenever possible any time flood storage is in use.

As the White River basin has developed, the request for operations keyed to specific interests has intensified, and at times these requests are for conflicting operations. Farmers request lower river stages; navigation interests request sustained rivers stages; downstream fisheries want sustained cold water releases; hydropower interests would like sustained high pool levels; those concerned with downstream flood control would like low pool levels; still others would like constant pool levels. The water control plan managed by the USACE is a compromise to distribute the benefits fairly among all stakeholders.

It is a matter of balancing flood storage among the lakes in this interconnected system to best prepare for a variety of scenarios if more rain falls. This is a key part of the water control plan. It helps to understand that Bull Shoals Lake has more than twice the flood storage capacity of Beaver and Table Rock combined. The flood pool at Bull Shoals is 41 feet deep. By comparison, the flood pool at Table Rock is only 16 feet deep, and Table Rock Lake is much smaller than Bull Shoals. For example, if there has been heavy rain and Bull Shoals is 15 feet high. It still has more than two-thirds of its flood storage capacity available to capture more rain runoff than Table Rock. When Table Rock Lake is 15 feet high, it is 99 percent full and a fairly small rain event could cause it to spill and flood homes and businesses downstream. So we would allow Table Rock Lake to release some of its flood pool first.

The USACE attempts to balance the percentage of flood storage available in the three lakes on the main stem of the White River (Beaver, Table Rock, and Bull Shoals) with the percentage of flood storage available in Norfork. This better ensures the full use of available flood storage when needed. Computer simulations of 60 years of river data show that maintaining equal percentages of available flood storage between the 3-lake sub-system and Norfork Lake best provides flood risk management to the lower White River valley. What is meant by balance? If Norfork is using 85 percent of its flood storage capacity, the USACE makes releases trying to balance the average flood storage capacity in use at 85 percent across Beaver, Table Rock and Bull Shoals. This does not mean that each of the three lakes are held at 85 percent full, it is the average among these three lakes. Keep in mind, Beaver provides supplemental storage for Table Rock and is much smaller. Table Rock protects homes and businesses immediately downstream of the dam. Bull Shoals Lake is larger than Beaver and Table Rock combined and has more than double the flood storage capacity. Bull Shoals works with Norfork Lake to reduce flood peaks in the lower White River Valley. For example, holding flood water in Beaver's flood pool when there is flood control storage in use at Table Rock and/or Bull Shoals provides the additional flood storage for Table Rock. The result is generally that Beaver Lake fills first and empties last. The releases from Beaver Lake are limited to 1,000 cfs daily average release when either Table Rock or Bull Shoals is more than 2 feet into the flood pool. Once the current pool elevations for both Table Rock and Bull Shoals are within 2 feet of their conservation pool elevation, releases can be increased from Beaver Lake. Evacuating storage from Table Rock provides the maximum downstream protection and ensures that if rain continues, Table Rock and Bull Shoals will be in balance as both begin reaching their maximum capacities.

The USACE has a water management Website at www.swl-wc.usace.army.mil. Real-time data, project operating data, and daily reports are a few of the items available. Also, the White River Water Control Plan is available on this site. In addition, our personnel make annual presentations to local elected officials and emergency managers from jurisdictions along the rivers. At other times, presentations are made to various stakeholder groups at their request. The Reservoir Control staff also fields numerous phone calls from the general public, media, and congressional staffs throughout the year.

During the large floods in 2008 and 2011, the six lakes working in conjunction with levees downstream in the river basins prevented an estimated $230 million in flood damage, working exactly as they were designed. Even though some of the lakes filled to record levels during either of both events, peak discharges downstream were actually tempered by operating the spillway gates. When the spillway gates were opened, they temporarily created or induced additional flood storage because water could be stored to a higher level. Since the flow coming into the lake was greater than the amount released, the lake rose while the downstream flood peak was reduced. For instance at Beaver Lake in 2008, the peak flow coming into the lake was 110,000 cfs, but the peak flow released at the dam was only 92,400 cfs. During the flooding in 2011 at Table Rock, the flow coming into the lake was over 200,000 cfs for 36 consecutive hours. The peak flow released from Table Rock was 69,000 cfs. The 2011 event set a couple of records at Bull Shoals Lake with record pool of 696.5 feet and a record release rate of 53,000 cfs. Maximum inflow into Bull Shoals for 6 hours was over 340,000 cfs and maximum 1 hour inflow was over 436,000 cfs. Norfork Lake made a large spillway release in 2008. Peak inflow to Norfork was about 115,000 cfs and the peak flow released was 81,700 cfs. Although the releases from each dam were many more times larger than the 'typical' hydropower release, the dams performed exactly as designed by reducing the peak flow released into the White River basin, which lessened the extent of downstream flooding and undoubtedly contributed to saving lives.

i. Encroachments and Trespasses

Encroachments and trespasses, are a long-standing issue in the management of Greers Ferry Lake. The relatively small land base acquired for project construction (note: the land base is small when compared to other comparably sized lakes) allows for home and other structures to be constructed near the water. This proximity of development to the water's edge has resulted in buildings frequently being constructed on Federal lands and easements as well as frequent acts of trespass involving unauthorized removal of trees, mowing, trail construction, and placement of personal property on public land. The USACE will continue to pursue removal of all encroachments and to potentially prosecute those engaged in acts of trespass.

For the purpose of this Master Plan revision, and following existing encroachment and trespass policies and regulations, no individual permits will be issued to adjacent landowners that have active encroachments or trespass concerns.

j. Shoreline Moratorium

The Little Rock District implemented a moratorium on shoreline activity requests, including private dock and vegetation modification requests, in July 2017. The moratorium was put into place so that a baseline number of permits and docks could be determined for the Master Plan

revision. During the process of the revision, new facilities/permits were not allowed on the project so that the number of permits would remain constant, allowing the team to complete the new revision without changing conditions on the lake and to prevent processing actions which may not align with the revised Master Plan. The moratorium was a necessary element of the process and enabled the team to perform shoreline activity analysis of the lake while it was in a static condition.

Chapter 7 Agency and Public Coordination

a. 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 waters 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 will position Greers Ferry Lake to aggressively leverage project financial capability and human resources in order to identify and satisfy customer expectations, protect and sustain natural and cultural resources and recreational infrastructure, and programmatically bring USACE management efforts and outputs up to a justified level of service.

Public involvement and extensive coordination within USACE and with other affected agencies and organizations is a critical feature required in developing or revising this Master Plan. In accordance with NEPA, ER 200-2-2 (https://www.publications.usace.army.mil/Portals/76/Publications/EngineerRegulations/ER_200-2-2.pdf), and ER and EP 1130-2-550 (https://www.publications.usace.army.mil/Portals/76/Publications/EngineerRegulations/ER_1130-2-550.pdf and https://www.publications.usace.army.mil/Portals/76/Publications/EngineerPamphlets/EP_1130-2-550.pdf, respectively), USACE initiated the environmental compliance and review process for the Greers Ferry Lake Master Plan revision project. The following sections contain brief summaries of each phase of the public involvement and review process for the Greers Ferry Lake Master Plan revision.

b. Scoping

The process of determining the scope, focus, and content of a NEPA document is known as "scoping." Scoping is a useful tool to obtain information from the public and governmental agencies (Figures 7.1-7.4). As part of the initial phase of the environmental process, two public

scoping workshops were hosted on 19 and 21 September 2017 to gather public comments on the Master Plan revision process and issues that should be examined as part of the environmental analysis. The workshops also provided the public an opportunity to ask questions and get more information about the current Master Plan and the revision process.

In particular, the scoping process was used as an opportunity to get input from the public and agencies about the vision for the Master Plan update and the issues that the Master Plan should address.

Workshop attendees were provided a comment card that asked for responses to specific questions in addition to providing general comments about the plan and the environmental review (Figure 7.5). The specific questions included:

- How would you like to see Greers Ferry Lake in 20 years?
- What about Greers Ferry Lake is most important to you?
- What about Greers Ferry Lake is least important to you?
- What changes, if any, would you like to see at the lake?

USACE published notice of the scoping workshops through an email blast, press releases made available to several regional and local papers, and announcements on the Greers Ferry Lake Master Plan webpage and the Little Rock District Facebook page. The email blast was sent to adjacent landowners, dock permit holders, marina and resort owners, dock builders, and those with reservations from the past couple years that camped at Greers Ferry Lake campgrounds. Flyers were posted on bulletin boards at campgrounds and recreational facilities around the lake. Agency coordination letters were sent to potentially interested agencies.

The comment period was posted from 8 September to 13 October 2017. The comment period was announced on 7 September 2017, on the USACE webpage, Facebook, and through a news release.

A total of 78 people signed in at two public workshops. Fifty three comment forms and letters were received during the comment period. A full breakdown of comments and analysis is available in the Scoping Report, which is Appendix A to the EA.

Figure 7.1 Scoping Workshop, September 2017

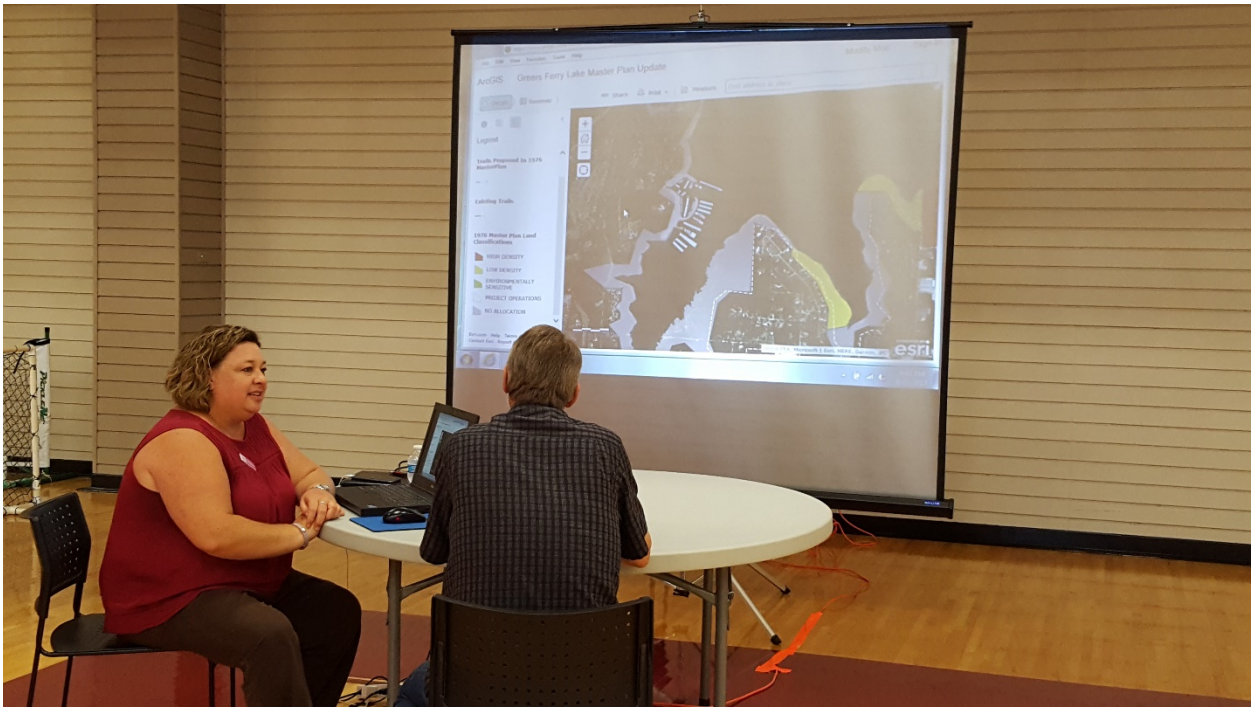


Figure 7.2 Scoping Workshop, September 2017

c. Draft Master Plan/Draft Environmental Assessment

The draft release of the Greers Ferry Lake Master Plan and associated documents occurred February 2019. Notification of the public review period began 25 January 2019 and ran through

25 February 2019. Two public workshops were held 4-5 February 2019 in Heber Springs and Fairfield Bay, Arkansas, respectively. A total of 204 people attended the workshops. Seventy-six public comments and 9 agency comments were received during the public comment period.

Figure 7.3 Draft Release Workshop, February 2019

Figure 7.4 Draft Release Workshop, February 2019

d. Final Master Plan/Final Environmental Assessment

The final Master Plan and EA was presented to the Little Rock District Commander and Senior Leadership on 13 May 2019. The FONSI was signed after the presentation of final documents. The FONSI can be found accompanying the EA. The final release of the Greers Ferry Lake Master Plan and associated documents to the public is scheduled for summer 2019.

Figure 7.5 View of Greers Ferry Dam

Chapter 8 Summary of Recommendations

a. Summary Overview

The proposals made in previous chapters of this Master Plan are for the courses of action necessary to manage Greers Ferry Lake's current and future challenges. Actions set forth in this plan can ensure the future health and sustainability of Greers Ferry Lake's natural resources while still allowing for continued use and development. The factors considered cover a broad spectrum of issues including, but not limited to public use, environmental, socioeconomic, and manpower. Information on each one of these topics was thoroughly researched and discussed before any proposals were made.

This Master Plan is considered to be a living document, establishing the basic direction for development and management of the Greers Ferry project consistent with the capabilities of the resource and public needs. The plan is also flexible in that supplementations can be achieved through a process to address unforeseen needs. The Master Plan will be periodically reviewed to facilitate the evaluation and utilization of new information as it becomes available.

This Master Plan for Greers Ferry Lake will continue to provide for and enhance recreational opportunities for the public, improve the environmental quality and create a management philosophy more conducive to existing staffing levels at the Greers Ferry Project.

b. Land Classifications

As described in detail in Chapter 5, the PDT strived to achieve a balanced resource management in making the land classification decisions. The team took numerous factors and expressed public concerns into consideration when determining land classification for the 2018 Greers Ferry Lake Master Plan revision, which included but are not limited to: how lands were previously classified in 1976; what kind of development or non-development was taking place adjacent to USACE property; if there were existing shoreline use permits and what SMP zoning existed in the prior land classification; and what kinds of activities were taking place in those areas.

Tables 8.1 and 8.2 provide overview information on what the land classifications were in the 1976 Master Plan and what changes took place to the new land classifications.

Table 8.1 Summary Overview—Land and Water Surface Acreages in Alternative 3 (1976 Master Plan)

Land Classification	**Acres**
Project Operations	117.1
High Density Recreation	3,066.1
Environmentally Sensitive Areas	221.1
Low Density Recreation	2,069.5
Wildlife Management	0
Vegetative Management	0
No Allocation	4,532.0
Total Land Acreage	**10,005.7**
Water Surface:	
Restricted	49.1
Designated No-wake	0
Fish and Wildlife Sanctuary	0
Open Recreation	31,139.7
Total Water Acreage	**31,188.8**
Note: Acreages are approximate and are based on GIS data. Totals vary depending on changes in lake levels, sedimentation, and shoreline erosion.	

Table 8.2 Summary Overview—New Land and Water Surface Acreages (Current Master Plan)

Land Classification	Acres
Project Operations	377.3
High Density Recreation	2,645.2
Environmentally Sensitive Areas	487.6
Low Density Recreation	688.8
Wildlife Management	2,080.7
Vegetative Management	3,726.0
Total Land Acreage	**10,005.7**
Water Surface:	
Restricted	49.1
Designated No-wake	0
Fish and Wildlife Sanctuary	0
Open Recreation	31,139.7
Total Water Acreage	**31,188.8**
Note: Acreages are approximate and are based on GIS data. Totals vary depending on changes in lake levels, sedimentation, and shoreline erosion.	

c. Recommendation

This revised Master Plan presents an inventory of land resources and how they are classified, existing park facilities, an analysis of resource use, anticipated influences on project operation and management, and an evaluation of existing and future needs (required to provide a balanced management plan for cultivating the value of the land and water resources). It is recommended that this Master Plan be approved as the basis for future development and management of the Greers Ferry land and water resources. Approval of the Master Plan is conveyed by the signing of the FONSI, located within the EA.

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