SECTION 3.0: AFFECTED ENVIRONMENT

3.1 INTRODUCTION

This section describes current environmental and socioeconomic conditions at the Greers Ferry Lake Project and in the surrounding area. It describes each resource or topical area that could be affected by implementing the proposed action. This section also provides information that serves as a baseline from which to identify and evaluate environmental and socioeconomic changes resulting from implementation of the proposed action and alternatives. The information has been provided in only enough detail to understand the effects of the alternatives on the environment. It depicts conditions as they currently exist or in accordance with the most recent available data. The effects of the proposed action and alternatives are discussed in Section 4.0.

3.1.1 Regional Geographic Setting and Location

The Greers Ferry Lake Project area is in the foothills of the Ozark Mountains in north-central Arkansas (see Figure 1-1). The area is located in the interior highlands south of the Ozark Plateau and west of the Mississippi embayment. The area is generally wooded and rugged, with interesting geological formations overlooking the winding Little Red River. The lake has an irregular shape, with numerous arms and coves. The lake is split into two large sections connected by an approximately 3-mile stretch called the Narrows. The steep bluff formations on both sides of the central portion of the lake form a straight channel (the Narrows) that joins the two bodies of water. Prominent scenic topographic features of the area include oddly shaped buttes and ledge outcrops that rise above the river valley. At some of the coves in the upper end of the lake, the terrain is less steep and the waters are subject to rapid dewatering with only a moderately lower pool stage. Beyond the lake the area is principally rural in character. More than 80 percent of the land in the watershed is forested, and 12 percent is agricultural. The counties that mainly contribute to the watershed are Cleburne and Van Buren Counties, along with large portions of Stone and Searcy Counties and small portions of Pope and Conway Counties. The lake lies within Cleburne and Van Buren Counties.

The project area is approximately 65 miles from Little Rock, Arkansas, and 130 miles from Memphis, Tennessee. Principal towns on the lake include Heber Springs, Greers Ferry, and Clinton. The town of Searcy is approximately 30 miles to the southeast. The area around Greers Ferry Lake is a popular vacation and retirement area. Greers Ferry Lake is a deep, clear lake that is home to native and introduced fish species. More than 200 subdivisions adjoin government-owned lands.

Approximately 30 percent of the lots in these subdivisions have been developed (USACE, Little Rock District, 1994). Two of the largest communities are Fairfield Bay and Eden Isle.

The Greers Ferry Lake Project was authorized by the Flood Control Act of June 28, 1938 (Public Law 761, 75th Congress, 3rd Session), as modified by the Flood Control Act approved on August 18, 1941 (Public Law 228, 77th Congress, 1st Session), including authorization of the project for flood control and generation of hydroelectric power. USACE began construction of the dam in 1959, and it was completed in December 1964 (USACE, Little Rock District, 1994).

The Greers Ferry Project contains 45,548 acres of land and water: 40,914 acres are owned in fee[1] and 4,634 acres are managed by flowage easement. The acreage managed by flowage easement is located within the flood control pool. Approximately 40,500 acres of the total project acreage are within the flood control pool. A portion of this acreage is dually allocated as Project Operations/Recreation-Intensive Use. There are 2,864 acres allocated exclusively for Recreation-Intensive Use, and 66 acres are allocated exclusively for management of fish and wildlife above the flood control pool elevation (USACE, Little Rock District, 1994).

The waters of Greers Ferry Lake are easily accessible to recreational boaters and adjoining property owners. In addition to the 59 boat launching lanes located in the parks, residents and sports enthusiasts use 78 severed roads around the lake for boat launching. Twenty-six rights-of-way have been granted to local county governments for the construction of public launching ramp complexes. Many of these complexes, consisting of an access road, a parking area, and a launching ramp, are adjacent to subdivision developments. Rights-of-way have been granted to another 20 adjoining landowners for the construction of tramways to provide access to the waters of the lake. A total of 181 path-only permits, 44 combination mow/path permits, and 219 combination dock/path permits for pedestrian access paths have been issued (USACE, Little Rock District, 1994).

3.1.2 Climate

Greers Ferry's climate is moderate, with approximately 50 inches of rainfall per year. Most of the rain occurs during the spring growing season. The snowfall average for the area is 3 inches per year. The minimum temperature in winter is 30 degrees Fahrenheit (ºF), with a daytime average of 50 ºF. The minimum summer temperature is 75 ºF, with a daytime average of 90 ºF.

[1] Property owned in fee is real property for which the United States has all right, title, and interest rather than a partial interest.

3.2 GREERS FERRY LAKE WATERSHED

3.2.1 Watershed Characterization

3.2.1.1 Location and Description

The Greers Ferry Lake watershed is a portion of the Little Red River watershed as defined in U.S. Geological Survey Hydrologic Unit Code (HUC) 11010014. Construction of the Greers Ferry Dam split the Little Red River watershed in two: the northern portion drains to Greers Ferry Lake, and the remainder drains to the Little Red River below the dam. Figure 3-1 outlines the Little Red watershed and its contributing counties—Van Buren, Cleburne, Searcy, Stone, White, Independence, and Pope Counties. The total area of the Little Red River watershed is 1,147,100 acres, with a total of 732,900 acres draining to the lake and 414,200 acres draining below the dam. Much of the water that flows into Greers Ferry Lake comes from Van Buren and Cleburne Counties; minor contributions come from Searcy, Stone, Independence, and Pope Counties. The portion of the Little Red watershed within White County drains below the dam.

The primary towns in the Greers Ferry Lake watershed are Greers Ferry and Heber Springs, upstream of the Greers Ferry Dam on the lake, and the town of Clinton, on the South Fork of the Little Red River. In addition, there are a number of large development areas, including the town of Greers Ferry, which sits immediately east of the northern end of the Narrows; Fairfield Bay, which sits to the north of the upper portion of Greers Ferry Lake; Eden Isle, a developed peninsula on the Lower Lake west of Heber Springs; Higden, which is immediately above the Narrows; and Edgemont, east of Fairfield Bay. The remainder of the Greers Ferry Lake watershed consists primarily of forest and agricultural areas.

3.2.1.2 Greers Ferry Lake

Greers Ferry Lake is a main-stem reservoir created by the damming of the Little Red River (Figure 3-1). At conservation pool elevation (461 feet mean sea level [MSL]), the reservoir covers a total area of 31,500 acres, with inundation extending up the Little Red River's three primary branches, the South Fork, the Middle Fork, and the Devils Fork. At flood pool elevation (487 feet MSL), the reservoir covers a total area of 40,500 acres.

The lake is divided into two distinct water bodies connected by a straight, deep channel called the Narrows. This connection is approximately 3 miles in length and less than 0.5 mile wide. The area of the lake north of the Narrows, termed the Upper Lake for this report, covers 12,900 acres and receives the bulk of the watershed drainage. The Upper Lake, which is long and narrow, runs in an east-west direction for about 25 miles. The average width of the Upper Lake is 0.66 mile.

The area of the lake south of the Narrows, termed the Lower Lake for this report, covers 18,200 acres and ends at Greers Ferry Dam. It consists of a large open area on the western side with three primary embayments, Salt Creek, Cove Creek, and Sulphur Creek. The Narrows connects to the Lower Lake on its western side near the Salt Creek embayment. The Lower Lake consists of an open area on its western side and then becomes narrower moving east. This narrow area flows past the town of Heber Springs, winding north and south until it reaches the dam. High, rocky bluffs and peninsulas characterize this section of the lake.

3.2.1.3 Tributaries

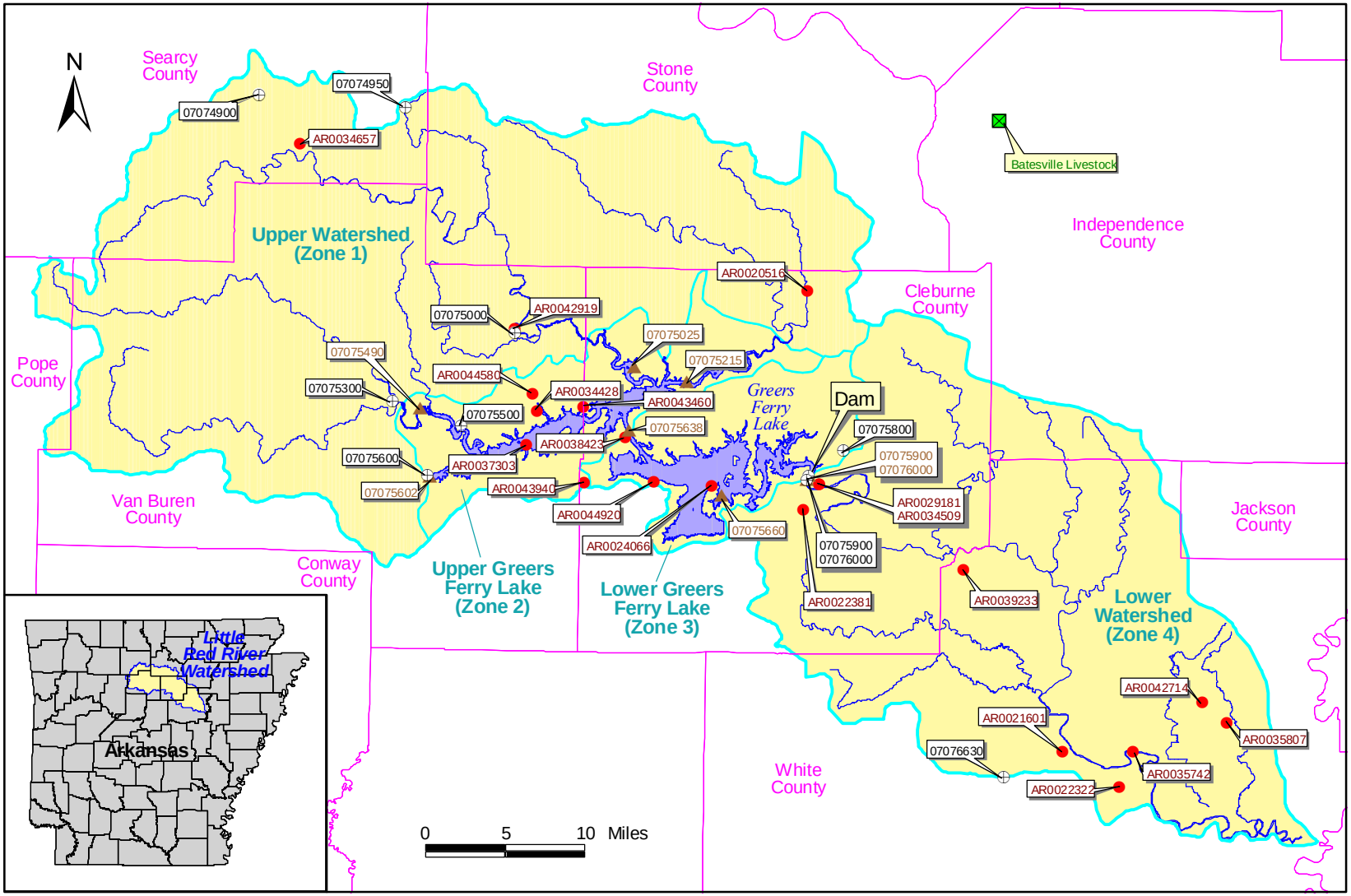
As discussed earlier, three major tributaries flow into the Upper Lake and drain approximately 77 percent of the Greers Ferry Lake watershed: the South Fork of the Little Red River, the Middle Fork of the Little Red River, and the Devils Fork of the Little Red River (Figure 3-2). The South Fork drains into the western side of the Upper Lake, while the Middle Fork and the Devils Fork drain into the eastern side.

Various smaller tributaries also drain into the Upper Lake. Moving west to east, these include Choctaw Creek, Cove Creek, Bailey Hollow, Thompson Creek, Green Creek, Lazy Creek, Lynn Creek, Dave Creek, and Wagon Branch. These minor tributaries generally have small watershed areas that reside close to the lake.

No major tributary watersheds flow into the Lower Lake. As with the Upper Lake, various minor tributaries drain small watersheds lying adjacent to the lake. Moving west to east, these include Salt Creek, Shiloh Creek, Cove Creek, Budd Creek, Rocky Branch, Drip Creek, Aaron Creek, Spring Hollow, Little Peter Creek, and Peter Creek.

3.2.1.4 Topography

The topography of the Little Red River watershed is relatively steep in the areas draining to the Upper Lake. Elevations in the watershed range from more than 1,500 feet (450 meters) National Geodetic Vertical Datum (NGVD) to 461 feet (140 meters) at lakeside. The terrain varies from steep hills northwest of the lake that drain down to the lake area to flatter land at and below Greers Ferry Lake.



LEGEND

- Gaging Station
- Meteorological Station
- Point Source Discharge
- Water Quality Station
- River
- Subwatershed Boundary
- Little Red Watershed Boundary
- County Boundary

Little Red River Watershed

Source: USEPA, 2001a.

Figure 3-1

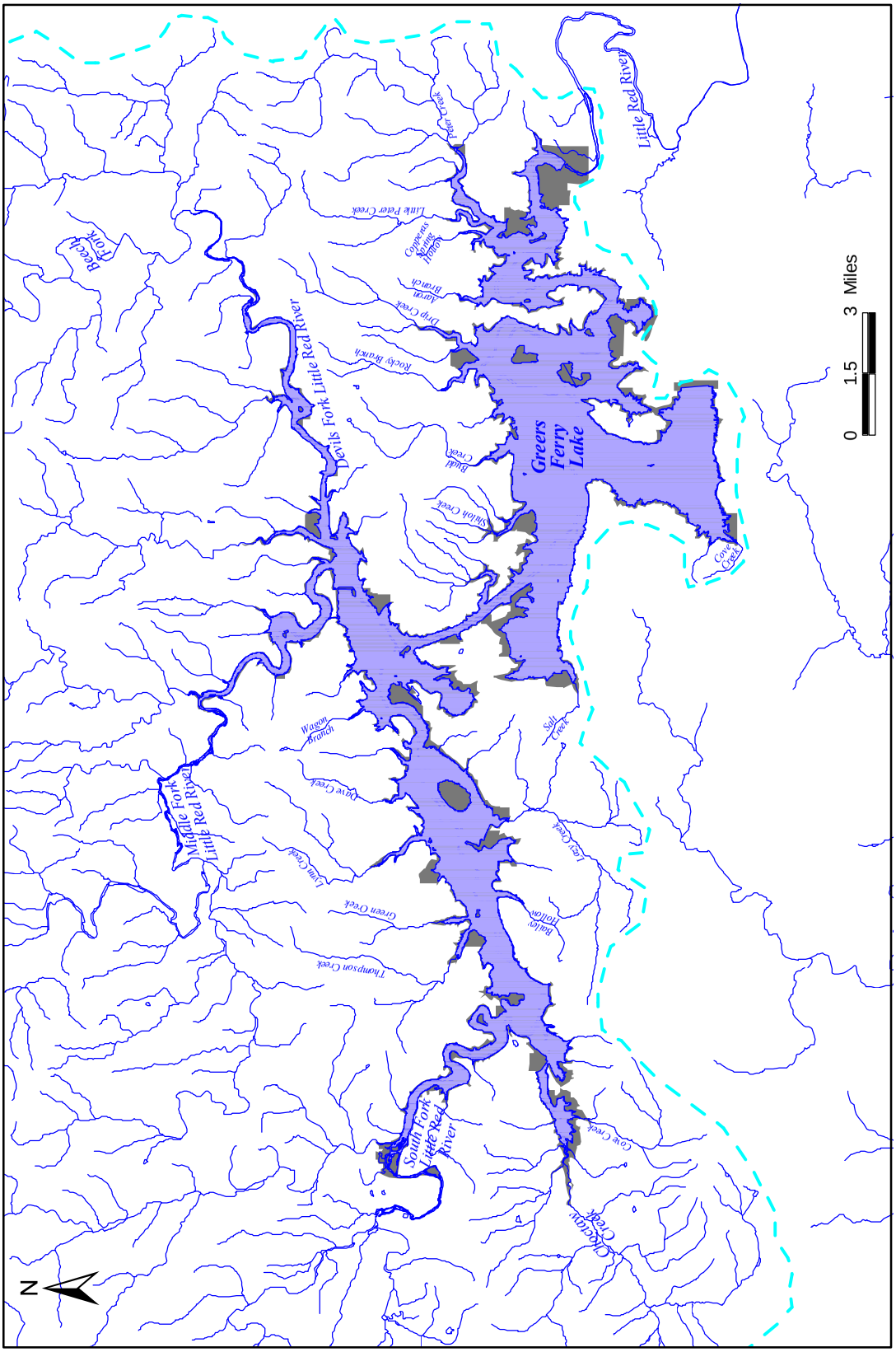

Surface Water Features
Greers Ferry Lake
Devils Fork Little Red River
Middle Fork Little Red River
South Fork Little Red River
Little Red River
Beech Fork
Rocky Branch
Blue Creek
Sullivan Creek
Wagon Branch
Dave Creek
Lynn Creek
Green Creek
Thompson Creek
Cove Creek
Choctaw Creek
Salt Creek
Levi Creek
Baker Hollow
Peter Creek
Little Peter Creek
Copperas Springs Hollow
Jarrett Branch
Drip Creek
Gover Creek
0
1.5
3 Miles
N
LEGEND
Stream
Greers Ferry Lake Watershed Boundary
Corps Property
Sources: USACE, Little Rock District, 2001; USEPA, 2001a.

Figure 3-2

In the immediate vicinity of the lake, the topography ranges from steep cliffs and bluffs extending to the water's edge to relatively flat, sloping shorelines in various coves. Figure 3-3 presents the distribution of slope along the shoreline of the lake. Steep bluffs and cliffs can be seen in the narrow sections near Heber Springs and north of the Narrows.

3.2.1.5 Flows and Exchanges

Historically, the U.S. Geological Survey (USGS) has maintained flow gages at various locations throughout the Little Red River watershed. Figure 3-1 presents the locations and numbers of those gages (see also Appendix F, Table F-2). Where data were available, the historical flow records were analyzed to determine the range of flow conditions and the average flows in the various tributaries and out of the dam.

Table F-3 in Appendix F presents the results of statistical analyses performed on those stations for which data were available. Station 07076000, immediately downstream of Greers Ferry Dam, reflects the discharge out of the dam. Comparison of the measured flows below the dam with tributary inflows from the South Fork and Middle Fork of the Little Red River (stations 07075500 and 07075000, respectively) shows the damping effects of Greers Ferry Lake storage on the hydrograph of the Little Red River. The flows measured in the South Fork and Middle Fork range from 0 to 75,000 cubic feet per second (cfs) and 0 to 29,400 cfs, respectively, with median flows of 466 and 579 cfs, respectively. In contrast, the flows measured immediately downstream of the dam range from 22 to 7,940 cfs, an order of magnitude reduction in the peak hydrograph of the inflowing tributaries. The median flow from the dam reflects the total median flow entering from the tributaries at 1,240 cfs.

As shown in Table F-3 (Appendix F), the median flow out of the dam for the period of analysis was 1,240 cfs. Using this average flow rate, along with the volume of Greers Ferry Lake at conservation pool (2,844,000 acre-feet), the average exchange rate of Greers Ferry Lake is 520 days.

3.2.2 Hydrogeology/Groundwater

The Western Interior Plains Confining System, a surficial aquifer system, is a minor aquifer that occurs beneath Greers Ferry Lake. The system is part of a widespread, thick, geologically complex, poorly permeable, sedimentary sequence. In northern Arkansas, the confining system underlies a wide area that extends southward between 60 and 80 miles from its northern margin at the Boston Mountains Escarpment to the Ouachita Mountains. On a regional scale, the rocks that compose the confining system are poorly permeable and function as a confining unit. However, individual geologic units or parts of units within the confining system yield as much

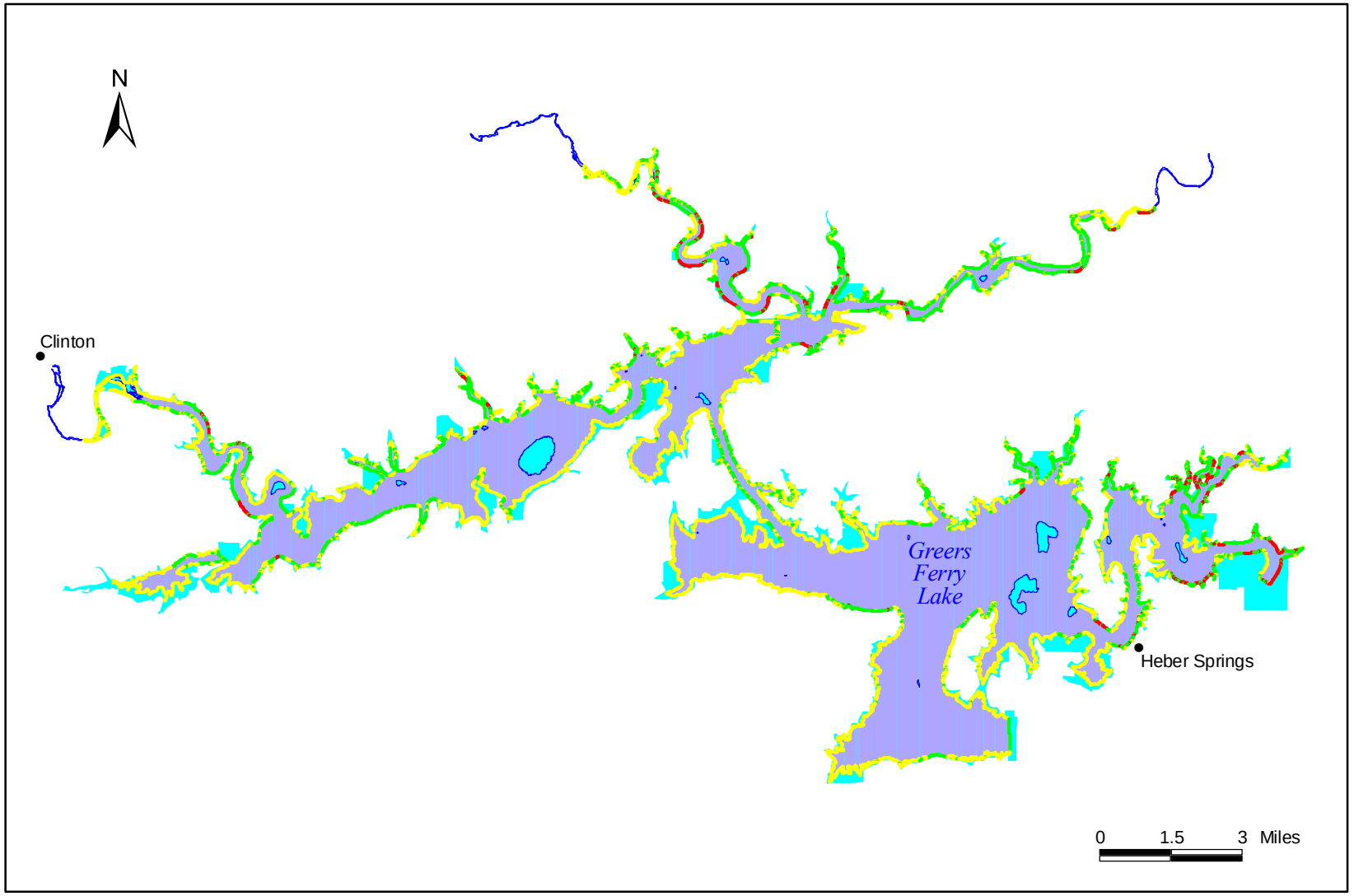
as 19 gallons per minute to wells (USGS, 2001a). No major aquifers occur beneath Greers Ferry Lake (USGS, 1998).

The Pennsylvania Atoka Formation underlies Greers Ferry Lake. Figure 3-4 shows a geological cross section of north-central Arkansas. The rock strata in this formation are principally sandstone, shale, sandy shale, and shaley sandstone. Beneath the Atoka Formation lies the Bloyd shale and the Prairie Grove member of the Hale Formation (AGC, 2001b). The Bloyd shale and the Hale Formation are part of the Western Interior Plains Confining System. This regional confining system includes relatively permeable sandstone and limestone beds separated by thick layers of impermeable shale that results in an overall low permeability (Adamski et al., 1995, cited in Parsons Engineering Science, Inc., 2000).

The groundwater flow system within the Western Interior Plains Confining System can be separated into two zones: an upper zone, within soil and highly weathered bedrock, and a lower zone, within moderately weathered to unweathered bedrock. Water enters the confining system as precipitation that falls on topographically high interstream areas and then moves through the weathered zone toward stream valleys, where much of the water is discharged. Regional groundwater movement toward the Arkansas River is southward. Groundwater movement within the unweathered zone is, for the most part, dependent on fracture density and fracture interconnection of the bedrock (USGS, 2001a).

Water levels within the Western Interior Plains Confining System can fluctuate as much as 10 feet per year in response to seasonal variations in rainfall and evapotranspiration. The water level fluctuations are directly attributed to the nature of the fractures in the rocks that compose the water-yielding zones (USGS, 2001a).

Wells withdraw water from the confining system mostly for domestic use because well yield and water quality are generally inadequate for public supply. Wells completed in the weathered zone of the confining system generally yield only small volumes of water; the yield of wells ranges from 2.5 to 19 gallons per minute. The Atoka Formation also functions as a local water-yielding zone; the median yield of wells completed in the Atoka Formation is reported to be 9 gallons per minute. The quality of groundwater in the Western Interior Plains Confining System is highly variable but meets most secondary drinking water standards and is considered suitable for domestic and livestock uses. The main constituents in the water are sodium and bicarbonate ions (USGS, 2001a).



LEGEND

- 0% - 19% Slope
- 20% - 49% Slope
- 50+% Slope
- Water
- Corps Property

Slope Distribution Along Greers Ferry Lake Shoreline

Source: USACE, Little Rock District, 2001.

Figure 3-3

System	Formation		Thickness (ft)	CharacterofRocks
Pennsylvanian	Hartshorne		75-100	Massive, irregularly bedded sandstone and shale
	Atoka		4,500+	Sandstones and sandy micaceous shales. Sandstones usually thin to medium-bedded and compact.
	Bloyd	(KesslerMember)	(0-5)	Compact fossiliferous limestone, locally conglomeratic
			60-200	Clayshale
		(Brentwood Member)	(0-80)	Fossiliferous limestone interbedded with shales
	Hale		50-150	Calcareous sandstones, sandy shales, and clay shales with s andy plates
	Unconformity			
Mississippian	Pitkin		20-100	Fossiliferous limestone
	Fayetteville	(Wedington Member)	(0-55)	Massive sandstone, in part c alcareous
			20-100	Carbonaceous, fissile shale with clay ironstone concretions
	Batesville		0-75	Calcareous sandstone, weathering to porous sandstone
		(Hindsville Member)	(0-50)	Fossiliferous limestone w/thin sandstone beds
	Boone		350-400	Massive, crystalline, fossiliferous limestone
		(St. Joe Member)	(10-100)	Thin-bedded crinoidal limestone
Devonian?			0-8	Thinly fissile clay shale
Ordovician				Interbedded shale, limestone, and sandstone

Geologic Cross Section

Source: Crutchfield, 2001.

Figure3-4

Numerous groundwater wells are located in the Greers Ferry Lake watershed. There are 73 documented wells within a 1-mile radius of the lake (Figure 3-5). Most potable water in the Greers Ferry Lake area is supplied by surface water resources, but supplemental water is provided by groundwater. The groundwater wells in the watershed withdraw water from the Atoka Formation and supply areas generally located in rural areas not supplied with public water. Water withdrawn from the wells in the Greers Ferry Lake watershed is primarily used for domestic water supply. Other water use includes livestock watering, institutional water supply (e.g., large schools, hospitals), and public water supply (pumped and distributed to several homes) (USGS, 2001b).

3.2.3 Water Quality

3.2.3.1 Pollutant Loads to 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.
- Septic systems within the immediate Upper and Lower Lake watersheds.
- Boating activities on the lake (fueling, illegal discharge of human waste).

Watershed Loads. The three major tributaries that flow into the Upper Lake drain more than 77 percent of the total watershed above the dam. The remaining watersheds to the lake provide direct loading to the northern portion (above the Narrows) and the southern portion (below the Narrows) of the lake. To determine annual average loadings to Greers Ferry Lake under existing land use conditions, the watershed was broken down into four distinct zones: Zone 1, the Upper Watershed, which drains to the three primary tributaries and eventually to the northern portion of the lake; Zone 2, the Upper Greers Ferry Lake Watershed, which drains directly to the northern portion of the lake; Zone 3, the Lower Greers Ferry Lake Watershed, which drains directly to the

southern portion of the lake; and Zone 4, the Lower Watershed, below the dam. Figure 3-1 presents the zone delineations.

Table 3-1 presents the land use distribution within the Greers Ferry Lake watershed broken down by land use and acreage distribution for the three zones described above that drain to the lake. The Lower Watershed does not provide a source of pollutant loads to the lake. An examination of the acreage distribution shows that the overall watershed of Greers Ferry is relatively undisturbed. More than 82 percent of the watershed is deciduous, evergreen, or mixed forest, or wetlands. The remaining 18 percent is primarily agricultural or open water; less than 1 percent of the land is used for residential or commercial purposes. Of the residential and commercial use area, more than 80 percent lies within the relatively small watersheds of the Upper and Lower Lake. These watersheds make up only 22 percent of the total watershed.

Table 3-1
Greers Ferry Lake Watershed Land Use Distribution by Zone

Land Use	Zone 1 Upper Watershed (mi^2)	Zone 2 Upper Greers Ferry Lake Watershed (mi^2)	Zone 3 Lower Greers Ferry Lake Watershed (mi^2)	Total Land Use Area (mi^2)	Percent of Total
Open Water	4.75	21.02	29.42	55.18	4.86
Low-Intensity Residential	0.34	0.93	1.06	2.34	0.21
High-Intensity Residential	0.06	0.07	0.14	0.28	0.02
High-Intensity Commercial/Industrial/Transportation	0.22	0.19	0.17	0.59	0.05
Bare Rock/Sand/Clay	0.01	0.00	0.01	0.02	0.00
Quarries/Strip Mines/Gravel Pits	0.01	0.00	0.00	0.01	0.00
Transitional	0.75	0.09	0.12	0.95	0.08
Deciduous Forest	499.00	48.88	38.32	586.19	51.64
Evergreen Forest	86.05	19.61	5.02	110.68	9.75
Mixed Forest	165.72	42.23	27.67	235.62	20.76
Deciduous Shrubland	1.49	0.06	0.00	1.55	0.14
Grassland/Herbaceous	0.13	0.00	0.00	0.13	0.01
Pasture/Hay	110.99	13.38	9.73	134.09	11.81
Row Crops	2.80	0.28	0.29	3.37	0.30
Small Grains	0.03	0.00	0.00	0.03	0.00
Other Grasses	0.15	0.47	0.01	0.63	0.06
Woody Wetlands	2.26	0.10	0.00	2.36	0.21
Emergent Herbaceous Wetlands	0.29	0.79	0.00	1.08	0.09
Totals	875.06	148.12	111.95	1135.12	100.00

Source: USGS, 2001c.

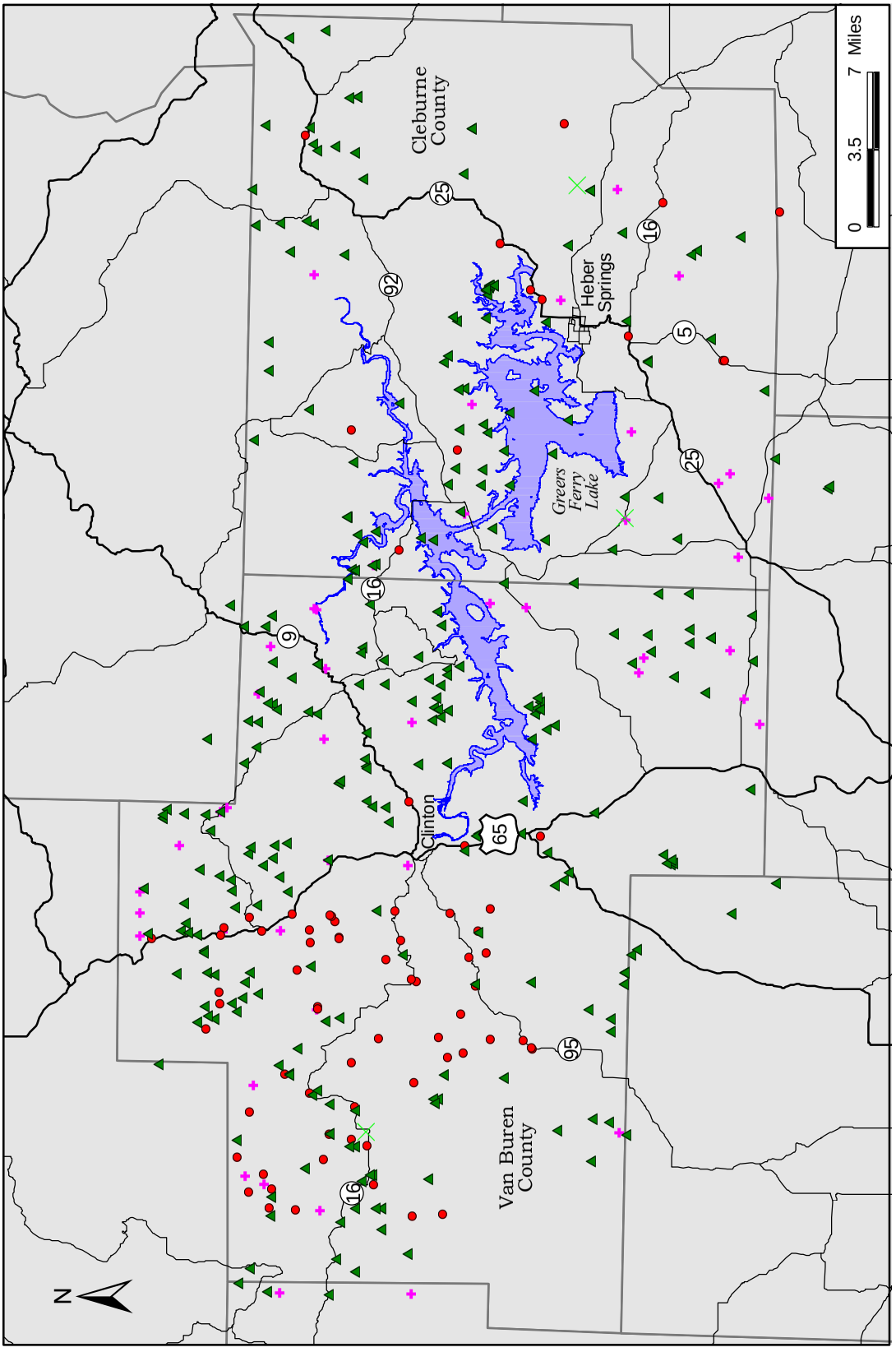

Groundwater Wells
Cleburne County
Heber Springs
Greers Ferry Lake
Clinton
Van Buren County
0 3.5 7 Miles
N
LEGEND
Groundwater Well Location (Source: USGS, 2001b)
Groundwater Well Location (Source: ADH, 2001)
Groundwater Well Location (Source: ASWCC, 2001)
Potential Groundwater Well Location (Source: ADH, 2001)

Figure 3-5

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A quantitative determination of the relative impact of various shoreline management actions on water quality in Greers Ferry Lake requires the development of a baseline loading condition for the lake that can be evaluated in a manner relative to various development options. To develop this baseline loading condition, the three zones described above that provide loads to the lake above the dam were input into the Hydrologic Simulation Program–Fortran (HSPF) and Nonpoint Source Loading Model (NPSM) (USEPA, 1998a). The land uses presented in Table 3-1 were then consolidated into four primary categories: built-up, cropland, wetlands, and forest.

Table 3-2 presents the consolidation used in the modeling, along with the percent of impervious land associated with each. Impervious land area was associated only with developed areas; the degree of imperviousness was based on the density of development.

Table 3-2
Land Use and Percent Imperviousness

Original Land Use	Grouped Land Use for HSPF	Percent Impervious
Open Water	Not Used	Not Used
Low Intensity Residential	Built-Up	0.19
High Intensity Residential	Built-Up	0.65
High Intensity Commercial/Industrial/Transportation	Built-Up	0.8
Bare Rock/Sand/Clay	Forest	0
Quarries/Strip Mines/Gravel Pits	Forest	0
Transitional	Built-Up	0.1
Deciduous Forest	Forest	0
Evergreen Forest	Forest	0
Mixed Forest	Forest	0
Deciduous Shrubland	Cropland	0
Grassland/Herbaceous	Cropland	0
Pasture/Hay	Pasture	0
Row Crops	Cropland	0
Small Grains	Cropland	0
Other Grasses	Forest	0
Woody Wetlands	Wetland	0
Emergent Herbaceous Wetlands	Wetland	0

Using the land use distributions and percent imperviousness from Tables 3-1 and 3-2, along with an annual average rainfall calculated using the long-term weather station nearest to the Little Red River watershed (Figure 3-1), the average annual loadings for each of the three zones were determined. The model parameters used for this simulation were taken from default datasets determined for watersheds of similar nature, grade, and soil type. Although not calibrated, the results are based on reasonable literature values and represent a good baseline for comparative purposes.

Table 3-3 presents the annual average loads of biological oxygen-demanding (BOD) material, total nitrogen (TN), total phosphorus (TP), fecal coliform bacteria (FC), and total suspended solids (TSS) by zone. These are the primary pollutant load constituents associated with the land uses in the Greers Ferry watershed. Table 3-3 presents the land uses considered in the evaluation grouped into the primary categories used: built-up, forest, cropland, pasture, and wetland. These loads were calculated using the HSPF model and represent typical annual average loading conditions. A detailed explanation of the methodology used in the calculation of these loads is presented in Appendix F.

Table 3-3
Annual Average Loads by Zone

Land Use	BOD (lb/yr)	Total Nitrogen (lb/yr)	Total Phosphorus (lb/yr)	FC (#/100mL/yr)	TSS (lb/yr)
Zone 1 Upper Watershed					
Built-Up, Impervious	425	86	8	282	138
Built-Up, Pervious	539	737	20	1,235	1,298
Cropland	867	522	120	20,500	5,134
Forest	56,154	9,203	529	703,596	268,910
Pasture	25,733	13,172	625	13,483,342	94,524
Wetland	187	31	2	2,373	898
Totals	83,905	23,752	1,303	14,211,328	370,901
Zone 2 Upper Greers Ferry Lake Watershed					
Built-Up, Impervious	457	92	8	303	148
Built-Up, Pervious	475	650	17	1,089	1,144
Cropland	68	41	9	1,603	401
Forest	8,314	1,363	78	104,178	39,816
Pasture	3,101	1,588	75	1,625,107	11,393
Wetland	66	11	1	835	316
Totals	12,482	3,744	189	1,733,115	53,218
Zone 3 Lower Greers Ferry Lake Watershed					
Built-Up, Impervious	522	105	10	347	170
Built-Up, Pervious	554	757	20	1,268	1,333
Cropland	57	34	8	1,351	338
Forest	5,310	870	50	66,538	25,431
Pasture	2,255	1,154	55	1,181,669	8,284
Wetland	1	0	0	7	3
Totals	8,700	2,922	142	1,251,181	35,558

The lake watersheds are primarily the areas in the immediate vicinity of the lake shoreline and the areas that drain to the small creeks surrounding the lake. The results show that on a total loading basis, the Upper Watershed contributes nearly 80 percent of the total load to the lake. The critical pollutants to the lake relative to water quality are TP, FC, and TSS. Because most lake systems are phosphorus-limited relative to eutrophication issues, nitrogen plays a less critical role in water

quality. TP loads to the lake are on the order of 1500 lb/yr, while total suspended solids loads are approximately 450,000 lb/yr. This analysis shows that the bulk of the overall load to the lake comes in through the three primary tributaries, the South Fork of the Little Red River, the Middle Fork of the Little Red River, and the Devils Fork. For all of the constituents the Upper Watershed load is an order of magnitude greater than the load from the areas immediately adjacent to the lake.

Point Source Discharges. Figure 3-1 presents the locations of all permitted point source discharges in the Greers Ferry Lake watershed. Table 3-4 presents the identification numbers, names, locations, receiving waters, and design discharges for each point source. For those National Pollutant Discharge Elimination System (NPDES) point source discharges above the dam, the design discharge volumes are relatively low and most represent storm water loads or small treatment facility discharges. All flows for discharges above the dam are less than or equal to 0.5 million gallons per day (mgd). These loads were taken into account in the loading determination presented previously.

Loads from Boating Activities. Boating activity and operation affects water quality in Greers Ferry Lake in the following ways:

- Resuspension of material through boat operations, wakes, and illegal mooring of boats along the shoreline.
- Introduction of hydrocarbons to the water through refueling and boat operation.
- Introduction of metals and other toxic materials associated with boat maintenance.

For all of these potential pollutant sources, there is not a good mechanism to directly calculate the loading from boats and boating activities. Numerous historical studies have been conducted, and the results of those studies have been summarized in the USEPA *Coastal Marinas Assessment Handbook* (USEPA, 1985) and other reports (e.g., Nachez, 1991). Although the studies are more directly related to saltwater environments, other than the potential for FC discharges many of the potential pollutants and sources are the same. The studies show that generally significant pollutant accumulations occur in areas of high densities of boats with low flushing rates (USEPA, 1985). Because the Clean Water Act does not allow for marine sanitation devices (MSDs) with the potential for overboard discharge in freshwater lakes, the potential for FC loads from boating activities in Greers Ferry Lake is not significant and is not considered an existing load.

Table 3-4
Point Source Discharge Locations

Identification Number	Name	City Name	County	Receiving Water	Design Flow (mgd)
Stations Located Above Greers Ferry Lake					
AR0020516[1]	USACE Dam Site Park-Greers Ferry	Heber Springs	Cleburne	Little Red River	0.025
AR0024066	Eden Isle Corp	Heber Springs	Cleburne	Greers Ferry Reservoir, Little Red River	0.180
AR0034428	Fairfield Bay-Hidden Valley WW	Fairfield Bay	Van Buren	Tributary, Lynn Creek, Greers Ferry Lake	0.100
AR0034657	City of Leslie	Leslie	Searcy	Cove Creek	0.060
AR0037303	Fairfield Bay-Hamilton Hills	Fairfield Bay	Van Buren	Tributary, Lynn Creek, Greers Ferry Lake	0.100
AR0038423[1]	USACE Narrows Park-Greers Ferry	Cleburne County	Cleburne	Greers Ferry Lake, Little Red River	0.004
AR0042919	Shirley Car Wash and Laundry	Shirley	Van Buren	Ditch, Little Red River	0.003
AR0043460	Fairfield Bay-Hooten Hollow	Fairfield Bay	Van Buren	Hooten Hollow, Greers Ferry Lake	0.013
AR0043940	West Side School District No. 4	Town of Greers Ferry	Cleburne	Tributary, Greers Ferry Reservoir	0.014
AR0044580	Fairfield Bay-Lynn Creek WWTP	Fairfield Bay	Van Buren	Lynn Creek, Greers Ferry Lake	0.500
AR0044920	Diamond Bluff Estates	Higden	Cleburne	Greers Ferry Lake	0.017
Stations Located Below Greers Ferry Lake					
AR0021601	City of Searcy	Searcy	White	Little Red River	5.000
AR0022322	City of Kensett	Kensett	White	Black Creek, Little Red River	0.250
AR0022381	City of Heber Springs	Heber Springs	Cleburne	Little Red River	1.750
AR0029181	USFWS-Greers Ferry National Fish Hatchery	Heber Springs	Cleburne	Little Red River	15.120
AR0034509	USFWS-Greers Ferry National Fish Hatchery	Heber Springs	Cleburne	Little Red River	0.008
AR0035742	City of Judsonia	Judsonia	White	Little Red River	0.200
AR0035807	City of Bald Knob	Bald Knob	White	Big Mingo Creek, Little Red River	0.480
AR0039233	City of Pangburn	Pangburn	White	Little Red River	0.200
AR0042714	Arkansas General Industries	Bald Knob	White	Ditch, Gum Creek, Little Red River, White River	0.028

[1]Discharger currently inactive.

1

2

Resuspension of material through boat wakes and shoreline activities is generally a localized condition. Section 3.2.3.2 describes in detail the present turbidity conditions in the lake.

To quantify the existing conditions in the lake relative to potential fuel contamination, samples were collected at eight locations throughout Greers Ferry Lake on August 4 and 8, 2001. This time period reflects summer usage and should represent periods of high boating activity on the lake. Tables F-5 through F-12 in Appendix F show the parameters analyzed, the sampling locations, and the results of the sample analyses. The data presented are for oil and grease as well as the typical polycyclic aromatic hydrocarbons (PAHs) and benzene, toluene, ethylbenzene, and total xylene (BTEX) associated with boat fueling operations. Samples were collected in areas of the lake with typically high boating activity densities in relation to other areas of the lake (Cove Creek, Eden Isle), as well as in areas representative of background conditions. Examination of the sample data shows that for all of the samples collected no detectable levels of fuel contamination were found for any of the parameters. This shows that under present conditions at the lake, boating activities are not creating adverse water quality conditions relative to fuel contamination.

3.2.3.2 In-Lake Water Quality

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. According to historical monitoring of the lake, none of the waters of Greers Ferry Lake have been listed as impaired under the Clean Water Act Section 303(d) listing program for any parameters. Development in the watershed is limited in relation to its overall acreage because more than 82 percent of its area (above the dam) is undisturbed forest. Loads to the lake come primarily from three tributaries entering the northern portion of the lake above the Narrows. These tributaries drain more than 77 percent of the watershed above the dam.

Existing water quality in the lake was evaluated based on eight historical monitoring stations in the lake and its adjacent tributaries. Figure 3-1 shows the locations of the stations. Table 3-5 lists the station numbers with their descriptions. Of those eight stations, four are on major tributaries that enter into the upper portion of the lake (above the Narrows):

- 07075602 – Near Choctaw, Arkansas
- 07075490 – Near Clinton, Arkansas
- 07075025 – At Brush Creek, Arkansas
- 07075215 – Above Hill Creek, Arkansas

Station 07075638 is located in the Narrows that connect the upper and lower sections of the lake. Station 07075660 is located in the lake, below the Narrows near Eden Isle. Stations 07075900 and 07076000 are located above and below the Greers Ferry Lake Dam, respectively.

Table 3-5
Water Quality Stations in the Little Red Watershed

Station Identification	STORET Number
Little Red River near Heber Springs	07076000
Lake station at dam near Heber Springs	07075900
Near Eden Isle	07075660
At Higden	07075638
Above Hill Creek	07075215
At Brush Creek	07075025
Near Choctaw	07075602
Near Clinton	07075490

Data from these stations were analyzed for the parameter list presented in Table 3-6. The data were collected over a 10-year period, from 1990 to the present, and provide a good representation of conditions in the lake over various seasons and meteorological conditions. However, by analyzing a large data set that spans a 10-year period, "lumping" of water quality data is required and only general water quality conclusions can be drawn from this approach.

The parameter list in Table 3-6 reflects the water quality parameters potentially affected by activities under the revised SMP. Table 3-6 also lists Arkansas water quality standards that apply for each parameter where applicable. The present water quality conditions for these parameters are presented and discussed below.

Tables F-5 through F-12 (Appendix F) present summaries of the measured water quality from sample analyses for the eight stations in the lake, while Tables F-13 through F-20 (Appendix F) provide summaries of in situ vertical profiling of dissolved oxygen (DO), water temperature, and pH. The water chemistry data provide existing conditions for water clarity and suspended material, pathogens, nutrients and related algal growth (chlorophyll *a*), oxygen-demanding material, and metals. The tables present the mean, median, minimum, maximum, and number of observations.

Water Clarity. Turbidity, color, and Secchi depth data provide information on the level of water clarity in the lake. Generally this is a function of the amount of dissolved and particulate matter in

the water column. Water clarity is decreased by the introduction of suspended material through erosion of disturbed areas within the watershed and adjacent to the lake.

Table 3-6
Water Quality Standards for the Greers Ferry Lake Watershed

Parameter	Units	Arkansas Water Quality Standard
Water Temperature	ºC	32 ºC
Dissolved Oxygen	mg/L	5 mg/L
pH	SU	>6 and <9
Turbidity	Hach FTU	
Secchi Depth	Meters	
Color PT-CO	PT-CO	
Total Nitrogen	mg/L	
$NH_3 + NH_4$-N, Total	mg/L	
$NO_2 + NO_3$-N, Total	mg/L	
Organic Nitrogen	mg/L	
Total Phosphorus	mg/L	0.05 mg/L
Total Ortho-Phosphorus	mg/L	
BOD5	mg/L	
Dissolved Copper[1]	µg/L	8.86 µ/L
Dissolved Iron	µg/L	
Dissolved Lead[1]	µg/L	30.14 µg/L
Dissolved Zinc[1]	µg/L	63.6 µ/L
Dissolved Mercury	µg/L	2.04 µ/L
Fecal Coliform Bacteria	#/100mL	See note
Chlorophyll *a*	µg/L	

Note: The Arkansas fecal coliform standard is "Between April and September 30, the fecal coliform content shall not exceed a geometric mean of 200/100 mL nor shall more than 10 percent of the total samples during any 30-day period exceed 400/100 mL. During the remainder of the calendar year, these criteria may be exceeded, but at no time shall the fecal coliform content exceed the level necessary to support secondary contact recreation."
[1]Calculated at a hardness of 50 mg/L ($CaCO_3$).

An examination of the turbidity and color data shows a distinct pattern in the lake: the highest maximum, mean, and median readings occur in the stations in the Upper Lake tributaries and the station in the Narrows. Figures F-1 and F-2 in Appendix F are bar graphs that show the distribution of the maximum, mean, and median turbidity and clarity moving from the Upper Lake stations, through the Narrows, and down to the dam. The data clearly identify the predominance of the major tributary inflows as the source of decreased water clarity in the lake. The upper and lower portions

of the lake show distinct differences not only in the event-based reductions in water clarity but also in the long-term clarity, as shown in the mean and median values.

In general, other than event-based conditions, water clarity in the lake is good. Mean and median ranges of turbidity in the Upper Lake are 8 to 15 Farmazene turbidity units (FTU) and 4 to 6 FTU, respectively; mean and median levels in the Lower Lake range from 2.2 to 2.8 FTU and from 1.1 to 1.4 FTU, respectively. During storm events, the turbidity levels in the Upper Lake have reached levels up to 130 FTU, whereas turbidity levels in the Lower Lake have not exceeded 30 FTU during any period.

Nutrients and Algal Growth. Freshwater lakes in general are phosphorus-limited. This means that usually there is sufficient nitrogen for growth and that the amount of growth is driven by the concentrations of phosphorus in the water column. Therefore, the degree of nutrient enrichment or eutrophication of the water column is not a function of the loading of nitrogen. Figures F-3 and F-4 in Appendix F present bar graphs for total phosphorus and chlorophyll *a* similar to those for water clarity. In general, the graphs show trends similar to those shown for water clarity, although the trends are not as clear.

Pathogens. Sources of FC loading to Greers Ferry Lake include runoff from agricultural areas, failing septic systems in lots adjacent to the lake,[2] wildlife (e.g., ducks, geese), and other sources associated with urban and residential land uses. In general, MSD loadings to the lake are nonexistent because of restrictions on MSD use and dumping, as well as the low number of live-aboard users on the lake. During the recreational carrying capacity study, anecdotal accounts of sewage discharge were reported. These discharges have not been substantiated and are not considered a source of FC at Greers Ferry Lake at this time.

Arkansas has set a FC standard in the lake of a geometric mean of 200 most probable number (MPN) per 100 milliliters (mL) between April 1 and September 30.[3] The standard also states that no more than 10 percent of the total samples during any 30-day period can exceed 400 MPN/100 mL. This standard is typical for recreational use listings. Figure F-5 in Appendix F presents a transect of fecal coliform bacteria concentrations through the lake. The fecal results, as with the other parameters, identify the primary sources as the inflow from the tributaries in the Upper Lake. The differences between the various stations are seen only in the maximum and mean values; in general, the median concentrations are similar and all are less than 5 MPN/100 mL.

[2] The typical 20 percent failure rate for septic systems is assumed despite the lack of reported septic system violations.

The maximum measured fecal coliform concentration was 3,100 MPN/100 mL in the Upper Lake tributaries and is associated with a storm event. The maximum measured FC concentration in the lower lake is 500 MPN/100 mL.

Dissolved Oxygen, Temperature, and pH. Tables F-13 through F-20 (Appendix F) present the analyses of water temperature, pH, and dissolved oxygen data for the lower (> 30 feet) and upper (< 15 feet) waters of the lake. Arkansas has set standards for each of these parameters; they are 32 ºC, pH 6.0 to 9.0, and 5.0 mg/L, respectively. In general, the compliance point for these parameters is near the surface; therefore, the surface data should be evaluated against the standards. Examination of the data analyses shows a single measurement of noncompliance with these standards in the surface waters near Clinton on the western side of the lake. All data for temperature and pH are within the State standards.

Examination of the data for the oxygen-demanding material shows overall low levels throughout the lake and the inflowing tributaries. Overall results show levels generally below 2.0 mg/L.

Metals. Median and mean zinc concentrations are generally constant throughout the lake, with values between 20 and 30 µg/L and 30 to 40 µg/L, respectively.

Total copper and total lead have median and mean concentrations between 3.0 and 5.0 µg/L. The data show one hot spot for copper and lead concentrations at the station in the Narrows. Mean and median values range between 10 and 16 µg/L. Because the data presented in the tables is for total metals and the Arkansas water quality standards are for dissolved metals, the data are inappropriate for evaluation of compliance with water quality standards. In contrast to the other parameters evaluated, the metals data do not show a decreasing trend moving from the Upper Lake to the Lower Lake, but rather areas of higher concentration.

Water Quality Trends. Two separate analyses have been conducted to determine any trends in water quality in the lake up to the present. A study conducted for the Corps by FTN Associates (FTN, 1999) found that "No statistically significant trends in nutrients, chlorophyll *a*, or metals were observed" based on data collected between 1990 and 1996.

A second trend evaluation was performed on the data presented here for three of the stations. The first station was in one of the tributaries to the Upper Lake (7075025), the second was in the Narrows (7075638), and the third was upstream of the dam (7075900). Trend analyses were

[3] During the remainder of the calendar year the fecal coliform content must not exceed a geometric mean of 1,000 MPN/ 100 mL nor equal or exceed 2,000 MPN/100 mL in more than 10 percent of the samples taken in any 30-day period.

performed on these stations with data going back to 1975. Sufficient data were available from this data set to evaluate turbidity, total phosphorus, and fecal coliform bacteria; the metals data were insufficient. At all stations evaluations did not show a statistically significant trend in any of the three parameters. The data indicate that the lake water quality conditions have not changed significantly for these critical parameters over the past 20 years.

Water Quality Summary

Based on the historical data presented here, Greers Ferry Lake shows some general trends in water quality moving from the tributaries through the Upper Lake to the dam. The data show higher levels of nutrients, total suspended solids, fecal coliform bacteria, and other parameters where the three primary tributaries enter the Upper Lake. Water quality conditions improve moving through the Narrows to the dam. The data, along with load analyses presented here show that more than 80 percent of the pollutant loading to the system comes through the three primary tributaries and is a result of land use and management practices in the Greers Ferry watershed rather than sources immediately adjacent to the lake. DO conditions in the surface waters are all above 5.0 mg/L, with measurements in the bottom waters showing levels as low as 2.0 mg/L. This is typical of deep, stratified lakes. Measurements of potential fuel contamination showed no significant levels of such pollutants in the system.

3.3 LAND USE, LAND COVER, AND LAND USE CONTROLS

Land use refers to human use of the land for economic production (residential, commercial, industrial, recreational, or other purposes) and for natural resource protection. Although a particular parcel of land might support many uses simultaneously, some uses are mutually exclusive. Similarly, although the quantity of land is fixed, there are infinite combinations of land uses. Land uses change, and property that has been degraded from a former condition can be restored, but often at great cost. Land use describes what is practiced, permitted, or planned. Land cover, an increasingly important attribute of land use, describes what is physically on the ground.

The following land use sections address land use immediately adjacent to the lake's shoreline and in the broader drainage area, or watershed, above the dam.

3.3.1 Land Use/Land Cover

3.3.1.1 Greers Ferry Lake Shoreline

At the top of the conservation pool, 461 feet above MSL, the shoreline of the lake has a total length of 276 miles. The Greers Ferry Project contains a total of 45,548 acres—31,500 acres of surface water and 14,048 of land at the conservation pool. There are 40,914 acres owned in fee and 4,634 acres managed by flowage easement. The acreage managed by flowage easement is located in the flood control pool.

At the top of the flood control pool, 487 feet above MSL, the shoreline length increases to 343 miles. Under these conditions, approximately 40,500 acres of the Greers Ferry Project acreage are within the flood control pool. This results in only 5,048 acres of land of the total 45,548 Greers Ferry Project acres. A portion of the flood control acreage is dually allocated as Project Operations/Recreation-Intensive Use. There are 2,864 acres allocated exclusively for Recreation-Intensive Use, and 66 acres are allocated exclusively for management of fish and wildlife above the flood control pool elevation.

Lake Access. The waters of Greers Ferry Lake are easily accessible to recreational boaters and adjoining property owners alike. In addition to the 59 boat launching lanes located in the parks, 78 severed roads around the lake are used by residents and sports enthusiasts for boat launching. A total of 26 rights-of-way have been granted to local county governments for the construction of public launching ramp complexes. Many of these complexes, consisting of an access road, a parking area, and a launching ramp, are located adjacent to subdivision developments. Rights-of-way have been granted to another 20 adjoining landowners for the construction of tramways to provide access to the waters of the lake. A total of 181 path-only permits, 44 combination mow/path permits, and 219 combination dock/path permits for pedestrian access paths have been issued.

Private Boat Docks. Private boat docks have been permitted on Greers Ferry Lake since impoundment began in January 1961. The number of private floating facilities on the lake has continued to increase since that time, growing from 125 in 1968 to 195 in 1990 to 295 in 2001. Figure 2-1 shows the locations of the existing private docks on Greers Ferry Lake.

The entire shoreline of Greers Ferry Lake, totaling 276 miles at the conservation pool elevation of 461 feet, is allocated to one of the following shoreline classifications: LDA's, Public Recreation Areas, Protected Shoreline Areas, and Prohibited Access Areas. Shoreline allocations extend from the water's edge to the project boundary for land-based uses and from the shoreline

waterward for floating facility considerations. The classifications are delineated in Figure 3-6 and are described in the paragraphs that follow.

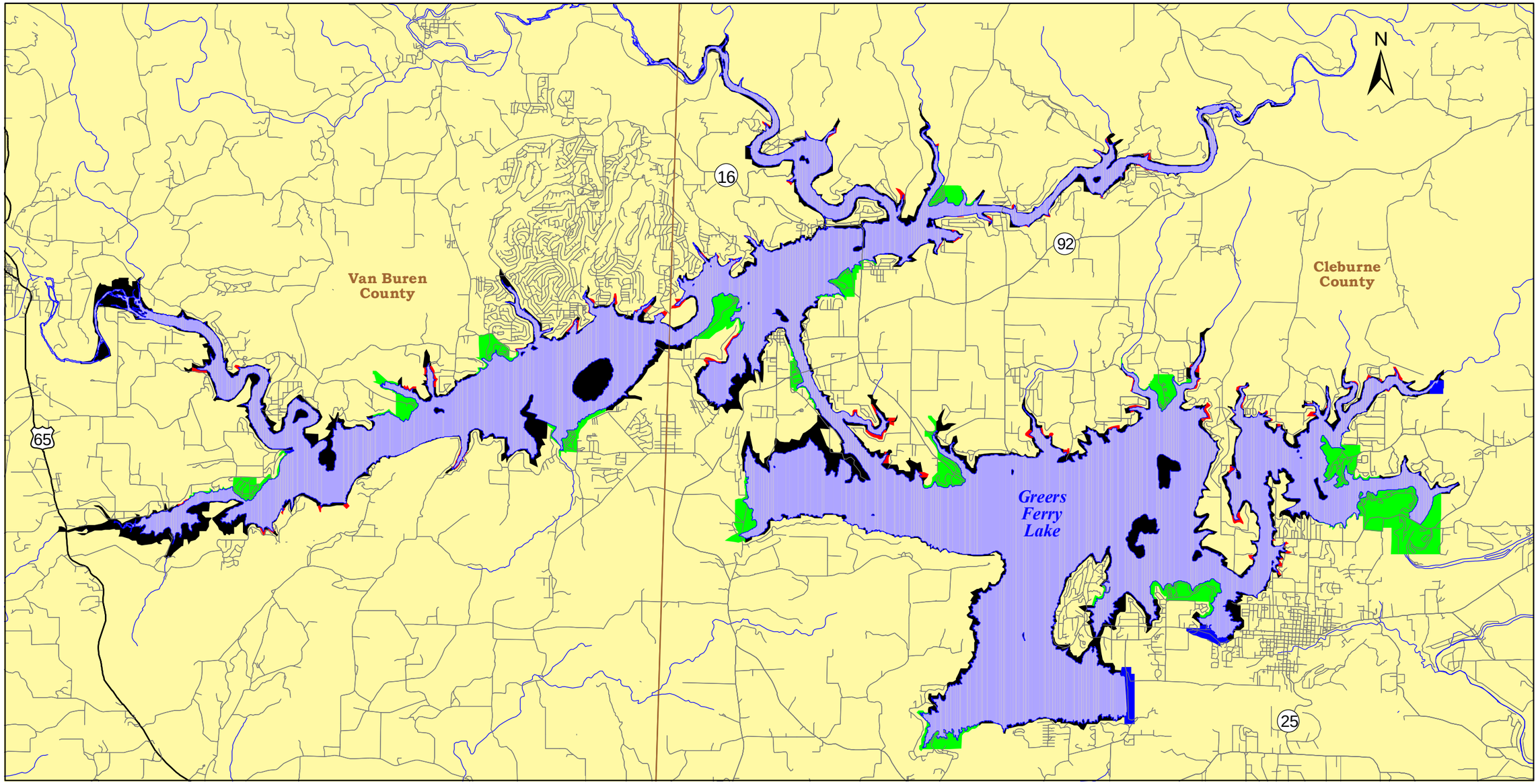
Limited Development Areas. Approximately 19 miles, or about 7 percent of the shoreline at the top of the conservation pool, is designated for limited development. Private facilities or activities, including vegetation modification (for fire protection only) and foot-path construction, are allowed in these areas. As of August 2001, 295 private floating dock facilities were spread among 103 limited development zones.

Private floating facilities are permitted in areas designated for limited development. The density of development depends on and is consistent with the ecological and aesthetic characteristics of the particular area. Under the existing SMP, the density of development may not exceed 50 percent of the shoreline allocated for limited development when the lake level is at the top of the conservation pool. Density is determined by measuring the linear feet of shoreline in the LDA and comparing that measurement to the width of the facilities.

Generally, the number of docks that will be permitted in an area is limited by spacing a minimum of 100 feet apart under ideal shoreline conditions. The Operations Manager is responsible for assessing conditions and considering designating the zone for community docks only when the number of docks in a given zone reaches 50 percent of the estimated capacity of that zone (at conservation pool elevation) or when development and/or growth patterns indicate high demand potential for mooring facilities. Compatibility with existing docks and adequacy of access roads and parking facilities are considered before designating a zone for community docks only.

All U.S. citizens, not just lakeshore or local area residents, have an equal opportunity to moor a dock in an LDA, provided the area has not reached the maximum density of development. The applicant must have legal access (within 200 feet) across adjoining property. Dock owners who are not permanent residents of the area must designate a local party who will be responsible for surveillance of their dock on a 24-hour basis.

Public Recreation Areas. Park and buffer areas make up 45 miles, or 16 percent, of the lake's shoreline. In addition to the visitors center, Greers Ferry Lake currently has 16 parks/recreation areas (Figure 3-7). Eight of these (from east to west, the Dam Site, John F. Kennedy, Old Highway 25, Heber Springs, Cherokee, Cove Creek, Shiloh, and Salt Creek) are on the lower, southeast portion of the lake, and seven (from east to west, Hill Creek, Devils Fork, Mill Creek, Sugar Loaf, Fairfield Bay, South Fork, and Choctaw) are on the upper part of the lake. One



LEGEND

Shoreline Allocation

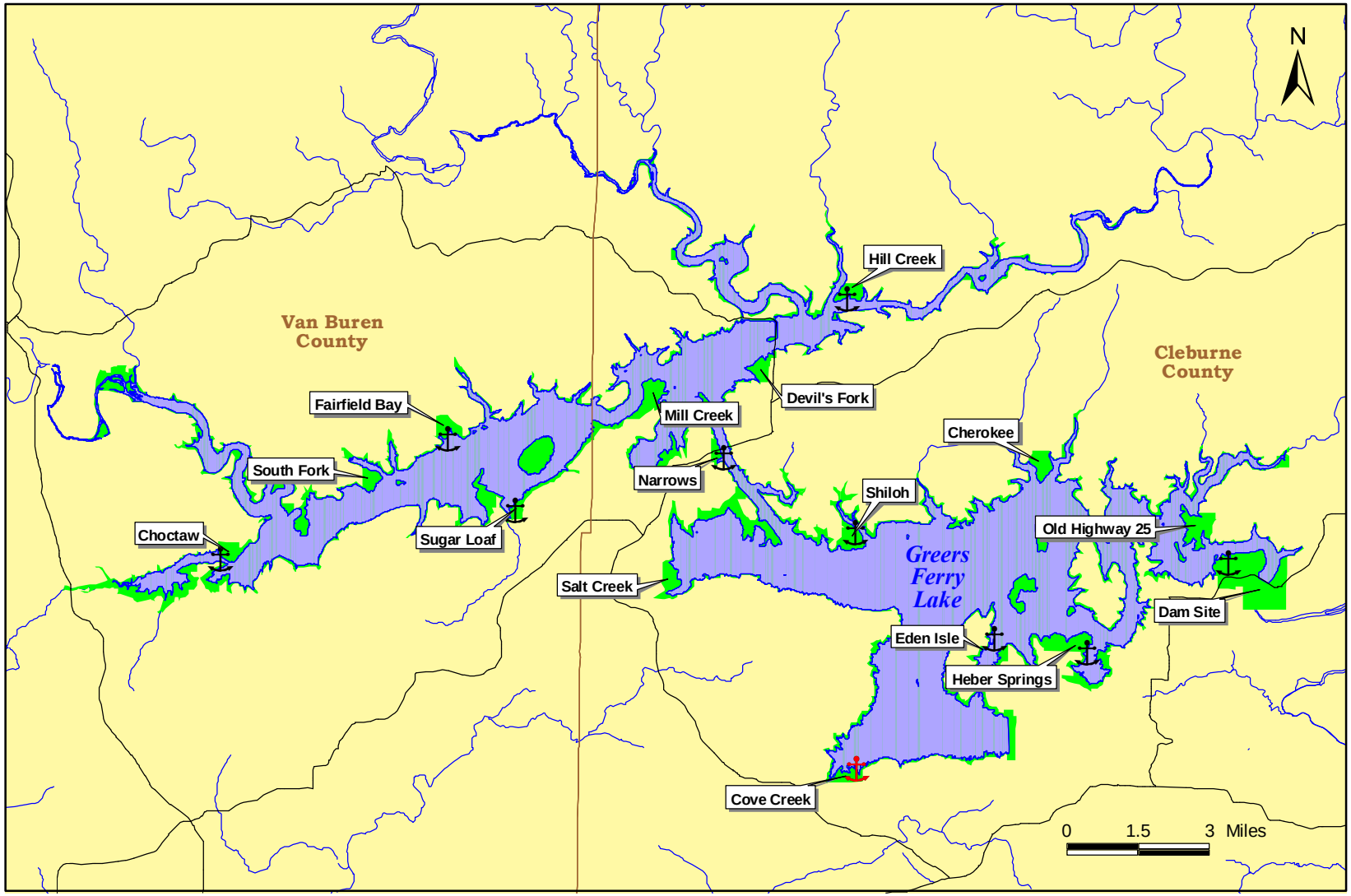
- Limited Development Area
- Park Buffer
- Prohibited
- Protected

- Road
- County Boundary
- Water

Source: USACE, Little Rock District, 2001.

Greers Ferry Lake Shoreline Allocation

Figure 3-6



LEGEND

- Marina (⚓ - Proposed Cove Creek Marina)
- Park/Recreation Area
- Road
- Water

Source: USACE, Little Rock District, 2001.

Recreational Facilities

Figure 3-7

recreation area, the Narrows, is on the west side of the Narrows channel connecting the two main bodies of water. In addition, Sugar Loaf Mountain Island has a much-visited National Recreation Trail.

In addition to the public recreation areas and the shoreline immediately around them, much of the eastern shoreline of the Eden Isle Peninsula north of the Eden Isle marina is designated as a park buffer zone.

Land uses in the Public Recreation Areas include marinas (Choctaw, Dam Site, Heber Springs, Hill Creek, Narrows, Shiloh, Sugar Loaf, and Fairfield Bay), public campgrounds and picnic areas at all the public recreation areas (except Salt Creek), public launching ramps (except Salt Creek), restrooms (except Salt Creek and South Fork), and swimming areas (except Cherokee, Narrows, Salt Creek, South Fork, and John F. Kennedy).

Private shoreline use facilities or activities are not permitted in designated or developed recreation areas or their adjoining buffer areas.

Protected Shoreline Areas. The Protected Shoreline Areas constitute the rest of the lake's shoreline, totaling 210 miles, or about 76 percent of the shoreline. Vegetative modification for fire protection only and for foot path construction is permitted in these areas. Before issuing the shoreline use permit, the Operations Manager must determine that the requested land use will not have an adverse impact on the environment or physical characteristics of the zoned area. Shoreline permits are not issued for floating facilities in protected shoreline areas.

Prohibited Access Areas. These areas typically include hazardous zones near dams, spillways, hydroelectric power stations, or water intake structures. Public access is not allowed for health, safety, or security reasons. No shoreline use permits are issued in Prohibited Access Areas. The Prohibited Access Areas total 2 miles, or approximately 1 percent of the shoreline at the conservation pool water level.

In terms of land cover, almost the entire shoreline is forested with a mixture of shorter pines, oaks, hickories, and secondary hardwoods. Understory vegetation has been suppressed in areas of public use all around the lake.

3.3.1.2 Adjacent Private Land

The area around Greers Ferry Lake is a popular vacation and retirement area. In fact, more than 200 subdivisions adjoin government-owned property. About 30 percent of the lots in these

subdivisions have been developed. Land use is predominantly private residence or vacation home dwelling units. Only a small number of motel, resort, and campground leases exist on adjacent private land.

In terms of land cover, some of the residential areas on private lands adjacent to the government land around the lake have modified vegetation or mowed areas for fire suppression. Because of surveying errors in some areas, private land reaches the lake itself; some property owners have removed many trees and shrubs, producing an urban grass cover. These areas, however, are very limited in extent.

3.3.1.3 Watershed Land Use

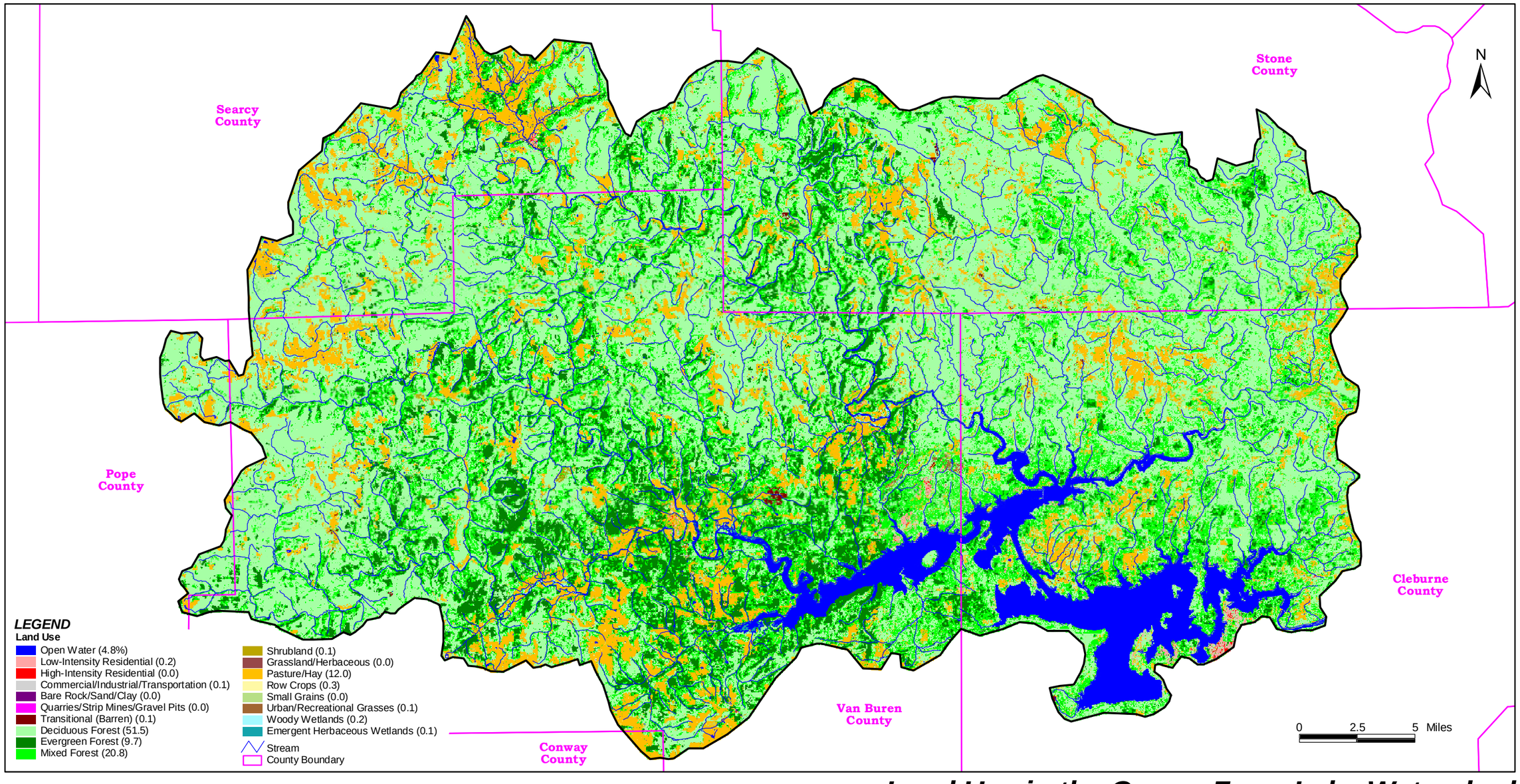
The broader drainage area, or watershed, above the dam covers 1,146 square miles and drains the southeastern part of the Ozark Mountains in north-central Arkansas. Based on the latest available multi-resolution land cover satellite imagery, the principal land use/land cover is forest, accounting for 82 percent of the total area. Deciduous forest accounts for almost 52 percent, mixed forest for 21 percent, and coniferous or evergreen forest for a little less than 10 percent. The next important land use/land cover in the watershed is pasture/hay, representing 12 percent of the total watershed. All other land use/land cover categories account for far less than the lake itself and its tributaries (which occupy almost 5 percent of the total land area). Land in row crops (0.3 percent) is followed by woody wetlands and low-density residential (0.2 percent each); commercial/industrial/transportation, transitional (barren), shrubland, urban/recreational grasses, and emergent herbaceous wetlands all account for 0.1 percent of the total watershed area (Figure 3-8).

3.3.2 Land Use Controls

3.3.2.1 Greers Ferry Lake Project Land

Private use of government-owned land at the Greers Ferry Lake Project is governed and controlled by the 1994 SMP (Appendix B). No other Federal agencies have jurisdiction over administration of the shoreline covered by this plan. No American Indian lands are present within the boundaries of the Greers Ferry Lake Project (USACE, Little Rock District, 1994).

The 1994 SMP contains details on shoreline allocation; shoreline use permit guidelines; design of private floating facilities, including tramways; facilities existing under special conditions (grandfathered facilities); construction and maintenance requirements for private boat docks; and private use of the shoreline (only limited activities such as paths and vegetation modification for fire protection are allowed). (See Appendix B.)



Land Use in the Greers Ferry Lake Watershed

Source: USGS, 2001c.

Figure 3-8

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Vegetation modification, or mowing, of the shoreline is permitted for fire protection only. The limits of the mowing depend on the proximity of privately owned dwellings and out buildings to the government boundary. A maximum mowed radius of 50 feet from habitable structures is allowed. The limits of mowing in each case are determined by the Operations Manager and defined in writing in the shoreline use permit. The use of chemicals for vegetation modification is not allowed on Greers Ferry Lake.

In addition to the restrictions on land use on the shoreline, there are restrictions on boats with sleeping quarters and/or MSDs on the lake itself. Because Greers Ferry Lake has been classified as a "no discharge" lake, only U.S. Coast Guard-certified MSDs are allowed. The discharge of any type of effluent in the waters or on lands of the lake is prohibited (USACE, Little Rock District, 1993). The use or possession of any type of MSD other than a U.S. Coast Guard-approved "no discharge" type is prohibited on boats operating on the lake. All MSDs must be capable of being pumped out only at marine dump stations, which are located at Dam Site, Eden Isle, Fairfield Bay, Heber Springs, the Narrows, Shiloh, and Choctaw marinas on the lake.

The 1994 SMP does not affect floating facilities used in conjunction with commercial concessions. These commercial operations are effectively controlled under existing Corps of Engineers real estate regulations. The services and storage facilities provided by these commercial operations will reduce the need for individually owned docks along the shoreline.

Floating facilities used in connection with limited motel, resort, and campground leases are subject to the shoreline allocations presented in the SMP. Because of the economic impact on existing motels and resorts that already have docks for their guests, these leases may be renewed to the present owner or transferred to the next owner, and the floating facilities serving these operations may remain moored at their present locations even though they might not be in an area currently designated for limited development. Expansion or major repairs of existing docks serving these motels and resort leases in areas not approved for limited development are considered on a case-by-case basis. The Lakeshore Resort at Edgemont, on the lake's northern shore east of Fairfield Bay, is an example.

3.3.2.2 Adjacent Private Land

The area around Greers Ferry Lake is a popular vacation and retirement area. In fact, more than 200 subdivisions adjoin government-owned land. Approximately 30 percent of the lots in these subdivisions have been developed. Land use controls on these private lands vary from very lax to the relevant incorporated area zoning ordinances to very restrictive covenants, codes, and

restrictions. Examples of the last include the various covenants and restrictions on land in the Emerald Isle subdivision, on the lake's northern shoreline. Among them are limits on the minimum size of dwellings, their height, and distances to lot lines. They also include required Architectural Control Committee approvals for dwelling unit and out-building plans, driveway paving material requirements, lot subdivision prohibitions, propane tank placement requirements, landscaping requirements, and garbage burning prohibitions (Emerald Isle, 2001).

3.3.2.3 Watershed Land

The broader drainage area, or watershed, above the dam covers 1,146 square miles and lies largely within four counties (Cleburne, Van Buren, Stone, and Searcy Counties), with small areas in Pope and Conway Counties to the west and southwest, respectively. Land use is governed by these counties' comprehensive plans and zoning ordinances, except for those lands within the incorporated areas of Heber Springs, Greers Ferry, Fairfield Bay, and Clinton. Land use in these four incorporated areas is governed by their respective city zoning ordinances.

3.3.3 Past, Current, and Future Development in the Region of Influence

This section describes activities and actions that have occurred, are occurring, or are reasonably expected to occur in the Greers Ferry Lake region that combined with the proposed action or alternatives could produce cumulative impacts on the human and natural environment. Cumulative impacts result when the effects of an action are added to or interact with other effects in a particular place and within a particular time frame.

To determine past, current, and future development in the Greers Ferry Lake region, a number of State and local agencies were contacted (Table 3-7). During the data gathering phase every public jurisdiction in the Greers Ferry Lake watershed was contacted by letter, by phone, or in person. Mr. Carl Garner, former resident manager of Greers Ferry Lake for more than 30 years, also was interviewed by the USACE, Little Rock District. A transcript of the interview is in Appendix G.

Past Actions. As described in previous sections, Greers Ferry Lake was created through the impoundment of the Little Red River from March 1959 to July 1964. This lake was one of many reservoirs created under various programs with a history that began back in the 1880s. Various acts passed by Congress, such as the Rivers and Harbors Acts of 1890 and 1899 and the various Flood Control Acts, propelled our nation and the Corps of Engineers into an extensive program of civil works, including the construction of reservoirs, channel modification, and the like. The passage of the 1936 Flood Control Act was one of the most important events in the history of the

1

Table 3-7
Agencies Contacted

Aeroquip Corporation–Industrial Wastewater Inventory	Eastern Newton County Water
Agency for Toxic Substances and Disease Registry Region VI	Eden Isle Marina
Arkansas Commission on Water Well Construction	Eden Isle Wastewater Treatment Plant
Arkansas Community Water System	Fairfield Bay Area Chamber of Commerce
Arkansas Department of Economic Development	Fairfield Bay Marina and Campground
Arkansas Department of Environmental Quality	Fairfield Bay Resort - FCI, Inc.
Arkansas Department of Park and Tourism	Fairfield Bay-Dave Creek Wastewater Treatment Plant
Arkansas Department of Pollution Control and Ecology	Felsenthal National Wildlife Refuge
Arkansas Ecological Services Field Office	Federal Emergency Management Agency Region VI
Arkansas Forestry Commission	Forrest City Area Chamber of Commerce
Arkansas Game and Fish Commission	G.E.C., Inc. and Gulf South Research Corporation
Arkansas Geological Commission	Greers Ferry Chamber of Commerce
Arkansas Government	Greers Ferry Lake/ Little Red River Association
Arkansas Highway and Transportation Department	Greers Ferry National Fish Hatchery
Arkansas Historic Preservation Program	Harrleson Retreat
Arkansas Municipal League	Heber Springs Area Chamber of Commerce
Arkansas Natural Heritage Commission	Heber Springs Marina
Arkansas Rural Development	Heber Springs Water Works
Arkansas Soil and Water Conservation Commission	Heber Springs Wastewater Treatment Plant
Arkansas State Clearing House	Hidden Valley Wastewater Treatment Plant
Arkansas State FSA Office	Holla Bend National Wildlife Refuge
Arkansas State Land Information Coordinator's Office	Jonesboro Chamber of Commerce
Arkansas State Library	Keep Arkansas Beautiful Commission
Arkansas Water Conservation Commission	Lacey's Narrows Marina
Arkansas Waterways Commission	Lake Vacation Home
Arkansas Wildlife Federation	Lakeshore Resort
Association of Arkansas Counties Mission	Leslie Wastewater Treatment Plants
Bald Knob National Wildlife Refuge	Logan Cave National Wildlife Refuge
Batesville Area Chamber of Commerce	Mammoth Spring National Fish Hatchery
Bellefonte Water Department	Mockingbird Hill Water Association
Big Lake National Wildlife Refuge	National Park Service
Blytheville Chamber of Commerce	Natural and Scenic Rivers Commission
Brunner Hill Water Association	The Nature Conservancy
Cache River National Wildlife Refuge	Norfork National Fish Hatchery
City of Fairfield Bay	North Arkansas College
City of Greers Ferry	Northern Arkansas Telephone Company
City of Shirley	Oak Tree Inn
City Water Works	Office of Government and Community Relations
Clean Water for Rural America	Office of the Attorney General
Cleburne County Courthouse	Overflow National Wildlife Refuge
Cleburne County Vital Records Office	Paragould Chamber of Commerce
Clinton Wastewater Treatment Plant	Parks, Recreation, and Travel Commission
Commissioner of State Lands	Petit Jean Electrical Cooperative
Compton Water Association	Piggott Area Chamber of Commerce
Conway Area Chamber of Commerce	Pond Creek National Wildlife Refuge
Council on Environmental Quality	Redbird Inn
Cox Communications	Richwoods Water Association
Devils Fork Resort	Rural Arkansas Community Development Records

Table 3-7
Agencies Contacted (continued)

DOT Coordinator for Water Resources	Sandiff Retreat
Searcy Chamber of Commerce	Tennessee Valley Authority
Searcy County Court House	The Red Apple Inn Resort and Conference Center
Searcy Water and Sewer	Thermogas Company
Shadow Ridge Villas	Tumbling Shoals Water System
Shiloh Marina	University of Arkansas Libraries
Shirley Community Development Corporation	Van Buren County Vital Records Office
Southwest Boone County Water	Van Buren County Water Association
Southwestern Power Administration	Vardelle Parham Geology Center
Southwestern Power Resources Association	Wapanocca National Wildlife Refuge
SPG Water Association	Warth House on the Lake
Stone County Courthouse	West Stone County Water Department
Sugar Loaf Marina	White River National Wildlife Refuge
Tannenbaum Resort	Wildlife and Habitat Management Office

Corps of Engineers. For the first time, Congress declared that flood control was a proper activity of the Federal government. The act put the Corps firmly into the reservoir construction business. Greers Ferry Lake was constructed under the Eisenhower Administration, which challenged some of these ambitious projects as costly Federal burdens. As a result, the amount of land purchased for lake projects such as Greers Ferry Lake was minimal, resulting in arguably inadequately sized buffer land to properly avoid potential environmental impacts from development occurring off Corps property. It should be noted that this Corps work of creating reservoirs predated NEPA and that environmental impacts were usually not considered over the requirements to provide for hydropower, flood control, navigation, and other authorized purposes.

Creating Greers Ferry Lake altered aquatic and terrestrial habitat when the region was converted from a river environment to a lake environment. This change significantly transformed both the environment and the economics of the region. Before construction of the Greers Ferry Dam, the Little Red River provided an unobstructed, free-flowing river system offering a diverse network of lotic (free-flowing, river-like) habitats in which the endemic fish species of the Little Red River evolved. Construction of the dam inundated much of the main stem river and its tributary junctions, eliminating those aquatic habitats altogether and converting them to a lentic (still-water, reservoir-like) function. Also as a result of this change, people were drawn to this area principally for recreation. Communities around the lake grew, and new communities such as Fairfield Bay were developed. It could be argued that the Corps action was a direct stimulus for this growth. However, the environment and the region adapted to the change. Growth over the past 10 years has been limited.

Current Actions. In May 2001, during the data-gathering phase of the EIS, overflights of the watershed were conducted in a 2-mile grid at 800 feet to determine changes in land use. Observations of the landscape were made and compared to a 1994 aerial land use map (the latest available). The overflights indicated no discernible development changes from the 1994 land use map. (See Figures 1-2 and 3-8.) The only major event that occurred in the 10-year period was the construction of a bypass around Heber Springs. Several realtors and builders were interviewed. They agreed to offer information only if their identity would remain private. This discussion revealed the following observations:

- The only community in the drainage basin that has a planning function is the Town of Heber Springs. No other jurisdiction maintains a planning and zoning function or issues building permits. In Heber Springs slightly more than 1,000 permits were issued over 9 years. More than half of these permits were for additions to existing facilities. This information is provided in Table 3-8.

Table 3-8
Building Permit Comparison, City of Heber Springs

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001[1]
Erect Single-Family Residence	37	36	45	27	31	29	47	34	37	18
Erect Multi-Family Residence (Duplex, Apartment Complex)	2	1	2	5	4	4	2	2	2	3
Additions and Remodeling	32	22	23	28	15	29	34	25	7	11
Erect Detached Garages and Storage Buildings	25	14	10	13	16	11	21	23	20	7
Additions and Remodeling of Commercial Buildings	14	14	7	10	9	11	11	16	12	8
New Commercial Buildings	9	10	4	14	19	11	7	15	11	12
Total	119	97	91	97	94	95	122	115	89	59

[1] Through June 30, 2001.
Source: City of Heber Springs, September 2001.

- The realtor/builder interviews raised concerns that there is no planning/zoning or code enforcement in the counties around the lake. Several persons noted that this could have negative impact on the lake in the future.

- Review of the Census records indicates that the population increase has been modest in all four counties. The greatest increase has been in Heber Springs, whose drainage basin for the most part does not drain into the lake.

Attempts were made to define the intensity of timber operations within the watershed outside Corps property. This information would be useful in characterizing cumulative impacts, especially for sediment and nutrient loadings in the watershed resulting from timbering operations. The information is not available because there is no monitoring or permitting program in place to track this activity. The closest State-run logging area (17,000 acres) is near Camden. The Game & Fish Commission owns approximately 300,000 acres, from which they occasionally harvest timber. Any landowner may harvest timber at any time; no permit is required, and there are no required procedures. Although Arkansas does have Best Management Guidelines, provided on the World Wide Web (www.forestry.state.ar.us/manage/bmp.html), compliance with these guidelines is voluntary, not required (Grant, personal communication, October 2001).

The only major change to the road network in the region consists of the bypass around Heber Springs, which was completed about 8 years ago. In addition, a new low-weight-limit bridge was built on Highway 263. As far as new road work is concerned, resurfacing is planned, as well as adding passing lanes on Highway 5 south of Highway 25 to the south and from Highway 25 to Highway 65 (Waits, personal communication, October 2001).

The only available traffic studies are for Heber Springs. The most recent studies available are dated 1990–1991. No high volumes are reported around the lake; however, no studies have been done except one for the bypass at Heber Springs (Sims, personal communication, October 2001).

In defining the overall watershed loads to the lake, it was determined that the three major tributaries, the South Fork of the Little Red River, the Middle Fork of the Little Red River, and the Devils Fork of the Little Red River, drain the overall watershed. Of the total watershed to the lake, 80 percent of the pollutant load is drained through these tributaries and the other 20 percent drains from the local area around the Upper and Lower Lakes. Therefore, the bulk of the pollutant load to the lake comes in through these tributaries. The water quality data bear this out: the stations on the tributaries show much higher overall concentrations of pollutants than the lake, and there is a distinct downgradient moving from the Upper Lake through the Narrows to the Lower Lake. This fact tends to buffer the overall impact of the local activities.

As described in Section 3.2.3.2, based on the historical data presented herein, the lake does show some exceedances of water quality standards for nutrients, fecal coliform, metals, pH, and DO.

The nutrient and fecal coliform exceedances show a significant decreasing trend moving from the tributaries to the Upper Lake and down to the dam. Exceedances for fecal coliform bacteria and nutrients range from 0 to 24 percent and 0 to 15 percent, respectively. Although the metals data do show exceedances, the evaluation is highly conservative because it assumes all of the total metals are in dissolved form and this is usually not the case. Exceedances of pH range from 0 to 5 percent. DO exceedances are restricted to the bottom waters and are the result of typical lake stratification conditions; no exceedances of DO were found in surface waters. Measurements of potential fuel contamination showed no significant levels of pollutants in the system

Future Actions. The most important potential future action that could contribute to cumulative impacts is the proposed construction of a 400-slip marina at the Cove Creek Park site in the Lower Lake. The construction would involve an area of 13 acres and add boat slips to an area of the lake currently containing no marinas and only a few grandfathered docks. This action is analyzed throughout the EIS for potential cumulative impacts; however, a separate EA is expected to be prepared.

A 50-year easement permit, effective October 1, 2001, for a water intake structure at Cove Creek has been issued to Community Water Systems (Anslow, personal communication, 2002). A separate EA and FNSI were prepared for the project, and the project was found to have no significant impacts on the lake or its environs. Construction of the structure has not yet begun.

No other future actions or activities have been identified.

3.4 INFRASTRUCTURE

3.4.1 Shoreline Structures

Greers Ferry Project Office personnel have granted 230 permits for pedestrian access paths from private land to the lake shoreline. Corps regulations specify that access paths to the shoreline must be no wider than 6 feet and must meander to minimize erosion and avoid tree removal (USACE, Little Rock District, 1993). Excavation and filling are not allowed in association with the creation of an access path, and no bridges, steps, or other structures may be constructed in conjunction with the paths. Permits for the paths are valid for 5 years and must be renewed upon expiration.

3.4.2 Traffic and Transportation

The area surrounding Greers Ferry Lake is rural. Two-lane roads serve the parks on the lake and the towns that surround it. U.S. Route (US) 65 connects Little Rock to Clinton, passing through

Choctaw west of the lake. State Route (SR) 263 and SR 225 connect the northeastern branch of the lake with points north. SR 5 and SR 25 are the major roads serving the area east of the lake, connecting to US 65 and US 67 to the south. SR 25 serves the Greers Ferry Lake Project Office and Dam Site Park. Both US 65 and US 67 serve Little Rock. SR 110 and SR 107 serve Heber Springs and Eden Isle, SR 330 serves Choctaw and Fairfield Bay, and SR 16 and SR 92 serve Greers Ferry. Bridges over the lake are located on SR 263 over the Devils Fork of the Little Red River, SR 225 near Hill Creek Park, SR 16 near Devils Fork Park, and SR 16/SR 92 at Narrows Park.

During the off season, which is generally from September through March, traffic on U.S. highways, State highways, and local roads in the vicinity of the lake is typical of rural areas. Traffic during this period is light, and roads are not used at or near their design capacities. Though a traffic volume study has not been done in the area since 1991, the Arkansas Office of Statewide Planning reports that there are no heavy traffic volumes in the area (Sims, personal communication, October 2001). Traffic on area roads can be heavy during the boating season, April through August, however, especially at more popular parks such as Dam Site and Heber Springs. Road improvements planned for the area include the addition of passing lanes on SR 25 to SR 65 (Waits, personal communication, October 2001).

Traffic congestion during the boating season can dramatically increase travel time on local roads around the lake. Traffic congestion in and near parks where day users and campers use the same area can be heavy. Parks with this arrangement are Dam Site, Cove Creek, Heber Springs, Narrows, Devils Fork, and Choctaw.

3.4.3 Water Supply

Water withdrawal from Greers Ferry Lake for multiple purposes is provided to five entities, as summarized in Table 3-9.

Table 3-9
Water Withdrawals at Greers Ferry Lake

Water User	Storage Allocated (acre-feet)	
Community Water System	8,286.80	
Clinton Water District	904.98	
City of Heber Springs	4,530.00	
Red Apple Inn and Country Club	65.89	
Thunderbird Country Club	54.89	
Total	13,842.56	
Total Lake Allocations	Lake total (conservation pool):	2,800,000.00
	Flood control:	934,000.00
	Water supply and power generation:	1,852,157.44

Source: USACE, 1998, cited in Parsons Engineering Science, Inc., 2000.

3.4.4 Wastewater Treatment

Public sewer systems serve the communities of Eden Isle, Heber Springs, part of Greers Ferry, and Clinton. Other communities are served by septic systems (Norton, personal communication, June 2001; Ramlet, personal communication, June 2001).

The town of Clinton constructed two new wastewater treatment plants, referred to as the East and West Plants, in 2000 (Van Buren County, Water Department Manager, personal communication, June 13, 2001). The East Plant has a capacity of 1.2 mgd, and the West Plant has a capacity of 1.5 mgd. Wastewater produced in warm months (May–November) has been land applied since 1992. Wastewater produced in cold months (December–April) is discharged into the South Fork of the Little Red River. Both plants provide tertiary treatment and are operating below capacity.

3.4.5 Septic Tanks

Before 1977 people were permitted to install septic tanks to the flood pool elevation (487 feet). After 1977 a 100-foot setback from the flood pool elevation was established for septic tanks. Two inspections are required for all proposed septic tanks: an initial soil percolation test and a postinstallation inspection to ensure proper installation. Further inspections or requirements to ensure that septic systems are maintained and function properly are not currently components of either Cleburne County's or Van Buren County's health department programs.

Neither county has reported water quality problems in its public water supplies that are associated with septic tanks. Areas near Greers Ferry Lake are on public water supply systems, and Heber Springs, Clinton, and Greers Ferry use water from Greers Ferry Lake for their public water supplies.

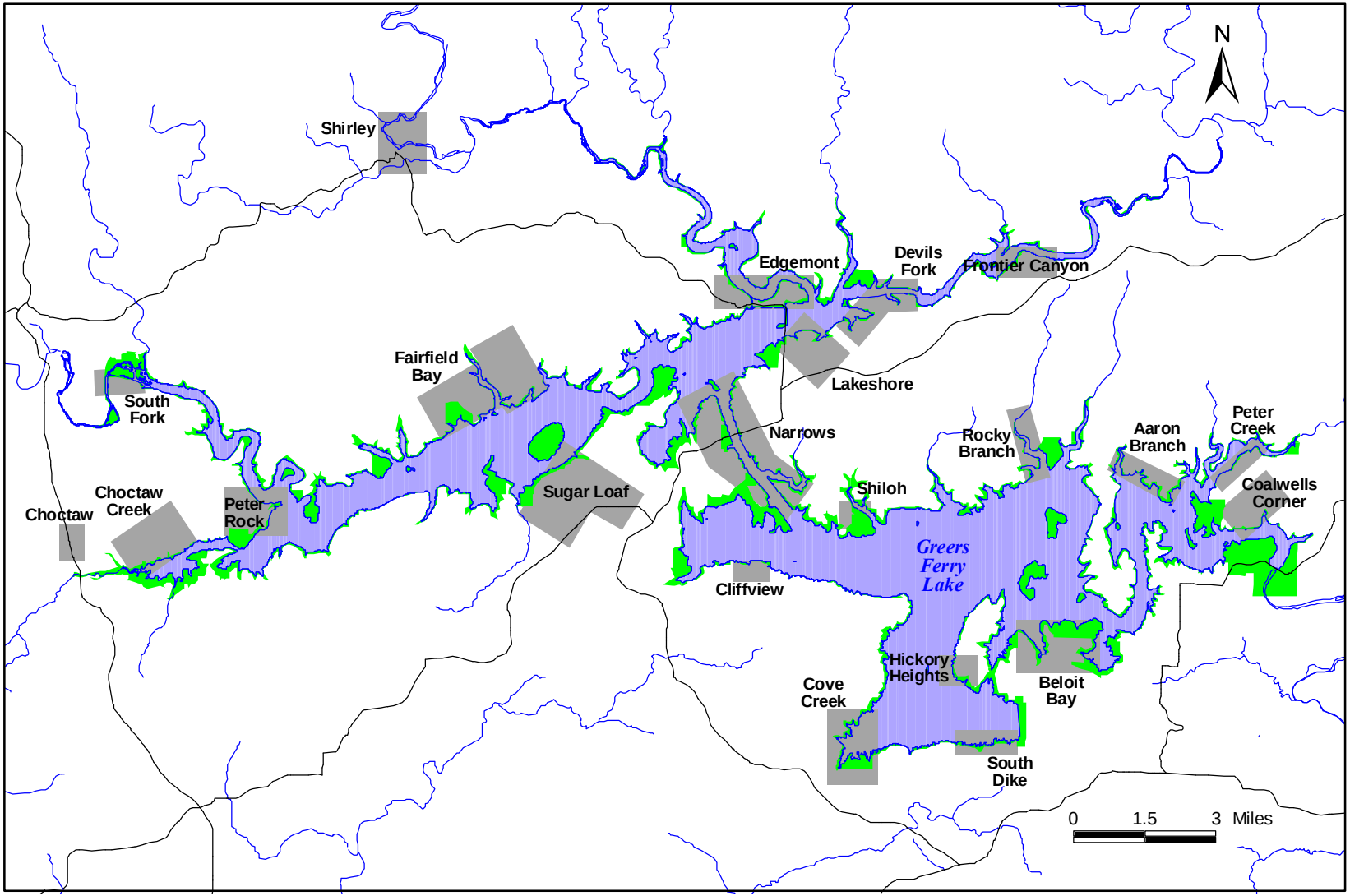
Septic tanks are widely used in the communities surrounding Greers Ferry Lake. Communities other than those mentioned previously as having public sewer systems use septic tanks (Norton, personal communication, June 2001; Ramlet, personal communication, June 2001). The largest concentrations of septic tanks are in Fairfield Bay, Greers Ferry, Higden, and residential subdivisions (USACE, Little Rock District, 1981).

In a 1981 environmental protection study, pockets of soils surrounding Greers Ferry Lake were rated as severely limited for the operation of septic tank absorption fields (USACE, Little Rock District, 1981). A high to moderate potential for septic tank failure of absorption systems was found in 23 areas (Figure 3-9). Areas found to have the most serious soil limitations were the Narrows, Lakeshore, Aaron Branch, Peter Rock, and Frontier Canyon.

Figure 3-9 shows numerous areas along the shoreline of the lake that have been identified as septic tank problem areas. The shaded areas on Figure 3-9 are very generalized; that is, they represent generalized boundaries within which lie all soils identified as posing problems for septic tank functioning. A more accurate way to determine the actual quantity of soils near the lake that pose problems for septic systems is to identify the acres of hydric soils or soils with hydric inclusions within the areas identified as posing problems for septic systems. There are 4,814 acres of hydric soils or soils with hydric inclusions (soils that are not hydric but demonstrate some hydric characteristics) within 1 mile of the lake. Fifty acres of these soils are a true hydric soil, Guthrie Silt Loam; the remaining 4,764 acres are soils with hydric inclusions. Of the 4,814 acres of these soils, only 220 acres lie within the shaded areas on Figure 3-9. None of the 220 acres are Guthrie Silt Loam soil; rather, they are all soils with hydric inclusions. There is a total of 111,221 acres of soil within 1 mile of the lake, so the 220 acres of soils with hydric inclusions in the shaded areas on Figure 3-9 represent only 0.2 percent of soils surrounding the lake. The area surrounding the lake that is problematic with respect to septic system functioning is, therefore, quite small.

3.4.6 Safety

The Arkansas Game and Fish Commission is the investigating agency for accidents on the lake, and its personnel enforce State fishing, hunting, and boating laws. Four or five agents regularly patrol the lake. All accident reports are sent to the Greers Ferry Lake Project Office (GFLPO), which forwards them to the Corps District Security Officer (Hargis, personal communication, October 2001). Table 3-10 lists recent accident statistics for Greers Ferry Lake. The most common cause of accidents is collision involving a personal watercraft (PWC) (e.g., jet skis). In Arkansas, all persons 15 years of age and older as of January 1, 2001, are now required to carry proof of completing a boater safety education course about operating motorboats, including PWCs.



LEGEND

- Potential Septic Tank Problem Area
- Corps Property
- Stream

Source: USACE, Little Rock District, 1981.

Potential Septic Tank Problem Areas

Figure 3-9

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Table 3-10
Recent Accident Statistics for Greers Ferry Lake

Year	Number of Accidents Reported	Additional Information
2000	14	Most were due to collisions between boats and PWCs.
1998	17	Eight were collisions, seven of which involved PWCs; five involved intoxication.
1997	19	Ten involved collisions with PWCs.
1996	17	Five were collisions with PWCs, three of which involved two PWCs.

Source: Arkansas Game and Fish Commission, Boating Division, 2001.

Fire prevention and suppression is the responsibility of fire-fighting organizations in the area, whether on Federal land, county land, State land, or private property. GFLPO belongs to all local volunteer fire departments and responds along with local volunteer fire departments and the Arkansas Forestry Commission to wildfires and structure fires in the area. Many GFLPO personnel are trained and certified in wildfire prevention and suppression (Hargis, personal communication, October 2001). Local fire departments are located in Heber Springs, Greers Ferry, Higden, Drasco, Clinton, and other area towns.

The National Fire Protection Association (NFPA) has established recommendations for fire prevention in areas where woodlands and residential structures are in close proximity. NFPA Standard 299, *Standard for Protection of Life and Property From Wildfire*, recommends a minimum 30-foot cleared "defensible area" around structures to prevent wildfire from igniting a house fire and vice versa. Depending on conditions, the recommended buffer might be larger than 30 feet. For instance, a minimum 100-foot vegetative buffer strip is recommended for structures near pine forests. NFPA 299 also contains recommendations for building materials, sources of water for fire suppression, and safety planning. Homeowners are responsible for implementing the NFPA's recommendations.

The GFLPO Safety Plan specifies safety response and training rules for GFLPO personnel. Relevant points from the safety plan are noted below.

- All employees receive safety and occupational health training appropriate to their duties in accordance with Army Regulation (AR) 385-10 and ER 385-1-1.

- At least two employees on each work shift are certified to administer first aid and CPR.

- All employees who are occupationally exposed to hazardous or toxic chemicals/ materials/substances receive at least an initial 4 hours of hazard communications training and annual refreshers. The Operations Manager is promptly notified of all accidents that occur on Federal lands managed by the GFLPO. All accidents are thoroughly investigated and reported on ENG form 3394, in addition to any other report that may be required.

- Fire hazards are corrected as they are found. All project employees are instructed in the correct use of project fire-fighting equipment. Fire drills are conducted at least once every 3 months. Fire reports are submitted in accordance with AR 420-90 and the Southwest Division, Little Rock (SWL) Safety Plan.

- Employees working over or near water, where the danger of drowning exists, wear a U.S. Coast Guard-approved life jacket. Upon change of job assignment or at least annually, each person who works over or adjacent to water is trained in the correct use of life jackets and buoyant work vests, man-overboard procedures, and ring buoy use. Employees performing water safety patrols must successfully pass the Corps of Engineers Boat Operator Safety Course before they assume patrol duties.

- The GFLPO maintains and conducts an active water safety program. Public media outlets such as newspapers, radio, television, and cable services are used to remind the public of the danger inherent in aquatic activities. GFLPO personnel solicit and sponsor boating and swimming safety activities. Rangers give water safety presentations to school and civic groups.

- At least once annually, all employees receive training concerning hazard communications. The training includes the following:

  - The Federal Hazard Communication Standard (29 CFR 1910, 1200)
  - Chemical Forms and Exposure Hazards
  - Types of Physical and Health Hazards
  - Controlling Chemical Hazards
  - Introduction to Material Safety Data Sheets (MSDS) and MSDS Physical Hazard Information

- MSDS Health Hazard Information

- Proper Labeling and the Toxic and Hazardous Material Inventory

3.5 SOCIOECONOMICS

3.5.1 Economic Development

This section describes the contribution of Greers Ferry Lake to the economy and the sociological environment in the region. The socioeconomic indicators used for this study include regional economic activity, population, housing, and schools. Also discussed are recreational and community facilities and public and social services. These indicators characterize the region of influence (ROI).

An ROI is a geographic area selected as a basis on which social and economic impacts of project alternatives are analyzed. The criteria used to determine the ROI are the residency distribution of recreational users of Greers Ferry Lake and the location of businesses providing goods and services to residents around the lake and recreational users of the lake. Based on these criteria, the ROI for the social and economic environment is defined as Cleburne County and Van Buren County. The ROI covers an area of 1,265 square miles (USDOC, Census, 2001).

The baseline year for socioeconomic data is 2000, the date of the Little Rock District's decision to proceed with the EIS. Where 2000 data are not available, the most recent data available are presented.

Regional Economic Activity. In 1999 employment in the ROI was almost exclusively nonagricultural. Table 3-11 shows ROI employment by industry. The primary sources of employment were services, retail trade, and manufacturing, which together accounted for 57 percent of regional employment. The largest source of jobs in the ROI in 1999 was the services sector, which accounted for 23.5 percent of total employment. The services industry includes establishments primarily engaged in providing a variety of services, such as hotels and other lodging places; establishments providing personal, business, repair, and amusement services; health, legal, engineering, and other professional services; educational institutions; membership organizations; and other miscellaneous services (OSHA, 2001). The retail trade sector was the second-largest employer, providing 18.2 percent of the total number of jobs, followed by manufacturing, which accounted for 15.5 percent.

Table 3-11
Greers Ferry Lake ROI Employment by Industry

Employment Sector	1990 ROI Employment (Percent of Total Employment)		1999 ROI Employment (Percent of Total Employment)	
Agricultural Services and Other	219	(1.6)	N/A[1]	
Mining	19	(0.1)	N/A	
Construction	931	(7.0)	1,362	(7.9)
Manufacturing	2,462	(18.4)	2,675	(15.5)
Transportation and Public Utilities	591	(4.4)	1,036	(6.0)
Wholesale Trade	261	(2.0)	249	(1.4)
Retail Trade	2,093	(15.7)	3,130	(18.2)
Finance, Insurance, and Real Estate	991	(7.4)	1,130	(6.6)
Services	2,907	(21.7)	4,056	(23.5)
Government and Government Enterprises	1,458	(10.9)	1,810	(10.5)
Total Nonfarm Employment	11,932	(89.3)	15,839	(91.9)
Farm Employment	1,435	(10.7)	1,392	(8.1)
Total Employment	13,367	(100)	17,231	(100)

[1]This information is not available (N/A) because of potential disclosure of confidential information or because there are fewer than 10 jobs, but the estimates for this item are included in the totals.
Source: USDOC, BEA, 2001.

Tourism is a major contributor to the ROI's economy. Greers Ferry Lake is a popular recreation, vacation, and retirement destination that generates income for local businesses in the form of sales of goods and services. The retail, services, and construction industry sectors are major beneficiaries of activities associated with Greers Ferry Lake. Table 3-12 shows the impact that tourism has had on the economy of the ROI over the past 6 years. Total travel expenditures in the ROI and local tax receipts resulting from tourism have both increased by 30 percent since 1995 (Table 3-12). According to the Arkansas Department of Parks and Tourism (2001), Greers Ferry Lake had more than 700,000 users and visitors in 2000, generating more than $130 million in local expenditures. Almost 10 percent of ROI total nonfarm employment in 1999 was generated by tourism.

Unemployment rates decreased in the ROI during the period between 1990 and 2000 (Table 3-13). In 2000 the unemployment rate was 4.7 percent in Cleburne County and 5.8 percent in Van Buren County. Despite the positive economic growth that occurred during the past decade, the unemployment rates in the ROI were still slightly higher than the State unemployment rate of 4.4 percent and the U.S. rate of 4.0 percent (Table 3-13).

Table 3-12
Impact of Travel and Tourism on the Greers Ferry Lake ROI

Year	Total Travel Expenditures (Dollars)	Travel-Generated Payroll (Dollars)	Travel-Generated Employment (Total)	State Tax Receipts (Dollars)	Local Tax Receipts (Dollars)	Visitors (Person-Trips)
1995	100,729,700	16,003,531	1,402	5,231,219	2,602,838	605,803
1996	104,220,800	16,559,752	1,402	5,443,965	2,688,491	606,376
1997	106,389,846	16,899,671	1,404	5,555,570	2,743,054	608,579
1998	114,931,800	18,210,934	1,449	6,002,020	2,967,326	655,491
1999	125,922,836	19,983,607	1,499	6,564,636	3,251,063	700,187
2000	131,508,840	20,857,629	1,508	6,877,055	3,396,400	708,234
Percent Change (1995 to 2000)	30.6	30.3	7.6	31.5	30.5	14.5

Source: Arkansas Department of Parks and Tourism, 2001.

Table 3-13
Unemployment in the Greers Ferry Lake ROI

	1990 Unemployment Rate (Percent)	2000 Unemployment Rate (Percent)
Cleburne County	7.2	4.7
Van Buren County	9.0	5.8
Arkansas	7.0	4.4
United States	5.6	4.0

Source: AESD, 2001.

3.5.2 Demographics

Table 3-14 portrays population trends in the two-county ROI from 1980 to 2000, with comparative data for Arkansas. According to the U.S. Census, the ROI experienced a 20.4 percent increase in population from 1990 to 2000, 6.7 percent higher than the State's rate of growth during the same time period. Migration accounts for most of the population increase, with net migration (in-migration minus out-migration) exceeding 6,000 people since 1990 (USDOC, Census, 2000a). Cleburne County has received approximately two-thirds of the in-migration of the two-county area. Recreational activities associated with Greers Ferry Lake and an influx of retirees are major factors in this population growth and makeup. According to the 2000 U.S. Census, the percentage of the population over 65 years of age in the ROI was approximately 22 percent compared to 14 percent for Arkansas (USDOC, Census, 2000b).

Table 3-14
Population Changes for the ROI and Arkansas

	Population 1980[a]	Population 1990[1]	Population 2000[2]	Percent Change 1990-2000	Net In-Migration[3]
Cleburne County	16,909	19,411	24,026	23.9%	4,559
Van Buren County	13,357	14,008	16,192	15.6%	2,180
Total ROI	30,266	33,419	40,238	20.4%	6,739
Arkansas	2,286,435	2,350,725	2,673,400	13.7%	118,744

[1] Source: USDOC, Census, 1995.
[2] Source: USDOC, Census, 2000c.
[3] Source: USDOC, Census, 2000a.

General population characteristics of the ROI, including median age, average household size, and median household income for 2000, are presented in Table 3-15. As discussed earlier, the median age for the ROI is higher and the median household size lower than those for Arkansas. Median household income is slightly higher for the State than for the ROI.

Table 3-15
Selected Population Characteristics for the ROI

	Median Age 2000	Average Household Size 2000	Median Household Income 2000
Cleburne County	43.7	2.33	$27,223
Van Buren County	44.2	2.33	$23,828
Arkansas	36.0	2.49	$27,875

Source: USDOC, Census, 2001.

3.5.3 Housing

Table 3-16 portrays selected housing characteristics for the ROI. (Census 2000 data were not yet available for all housing characteristics.) Based on the rate of population growth since 1990, it is estimated that the number of housing units in the ROI currently exceeds 22,000 (USDOC, Census, 2001). The median value of owner-occupied housing for the ROI exceeded that of Arkansas in 1990. Both the percent of owner-occupied units and the percent of vacant units in the ROI also were higher than the State average. The high percentage of vacant units reflects the seasonal and recreational use of many of the housing units in the ROI.

Table 3-16
Selected Housing Characteristics for the ROI[1]

	Number of Units	Median Value (Owner-Occupied)	Percent Owner-Occupied[2]	Percent Vacant[3]
Cleburne County	13,732	$50,700	81	26
Van Buren County	9,164	$44,300	82	25
Arkansas	1,173,043	$46,000	70	11

[1] Source: USDOC, Census, 1990, except for Number of Units, for which the source is USDOC, Census, 2001.
[2] Represents percent of total occupied units.
[3] Approximately one-half the vacant housing units are for seasonal and recreational use.

3.5.4 Quality of Life

Law Enforcement and Fire Protection Services. Public safety is provided in the ROI by full-time police departments with 24-hour dispatch for each municipality (Clinton Chamber of Commerce, no date; Fairfield Bay Chamber of Commerce, 2001). Outside the city limits, law enforcement is carried out by the Sheriff's department of each county or the State Police. Fire stations in the ROI are manned by volunteer firemen (Clinton Chamber of Commerce, no date; Fairfield Bay Chamber of Commerce, 2001).

Medical Services. The ROI has two hospitals—Baptist Health Systems in Heber Springs and Ozark Health Medical Center in Clinton. Medical, dental, eye, and other specialty clinics also provide medical services in cities and towns throughout the ROI.

Recreation and Shopping. Greers Ferry Lake is a popular resort, recreation, and retirement area. In addition to the water sport and fishing activities offered by the lake and the Little Red River, many other recreational opportunities are available in the ROI. Campgrounds and hiking trails are available around the lake, and the Ozark National Forest, within 30 miles of the lake, offers more hiking and camping opportunities. Seasonal hunting for white-tailed deer and other game is available at Gulf Mountain Wildlife Management Area,[4] an Arkansas Fish and Game Commission property (Clinton Chamber of Commerce, no date). There are numerous golf courses, as well as miniature golf, bowling, movie theaters, and an amusement park with bumper cars, bumper boats, and go-carts, in the ROI (Heber Springs Area Chamber of Commerce, no date).

A variety of shopping is available in the ROI. The towns of Clinton and Heber Springs have picturesque town centers with gift, craft, antique, and general merchandise stores (Clinton

[4] Gulf Mountain Wildlife Management Area is located in Scotland, Arkansas, which is approximately 12 miles southwest of Clinton.

Chamber of Commerce, no date; Heber Springs Area Chamber of Commerce, no date). Antique stores are located along the highways throughout the ROI. There is also the Lakewood Village Mall, with more than 30 businesses and shops, and a Wal-Mart Super Center.

Section 3.7 contains more information on recreation and recreational facilities available at Greers Ferry Lake and in the ROI.

Schools. There are 10 school districts in the ROI (CapitolImpact.com, 2000). The school districts in Cleburne County are Concord, Heber Springs, Quitman, West Side, and Wilburn. Among these five districts are five elementary schools, one middle school, and five high schools, with a total enrollment of 3,308 students. The average student/teacher ratio in the county is 20:1. Van Buren County school districts are Alread, Clinton, Scotland, Shirley, and South Side. Van Buren County has five elementary schools, one middle school, and five high schools, with a total enrollment of 2,388 students. The average student/teacher ratio for the county is about 18:1.

Post-secondary education is available in the ROI at the Arkansas State University branch campus in Heber Springs and the Central Arkansas Adult Education Center, also in Heber Springs. The University of Central Arkansas, in the city of Conway, Faulkner County, is about 60 miles from Greers Ferry Lake. Also located in Conway are Central Baptist College and Hendrix University.

3.5.5 Environmental Justice

The primary objective of environmental justice analysis is to ensure that vulnerable populations do not bear a disproportionate share of high and adverse human health or environmental effects from proposed Federal actions. To address environmental justice concerns, on February 11, 1994, President Clinton issued Executive Order (EO) 12898, *Federal Actions to Address Environmental Justice in Minority and Low-Income Populations,* requiring each Federal agency to "make the achievement of environmental justice part of its mission by identifying and addressing disproportionately high and adverse human health and environmental effects on minority and low-income populations." The EO and accompanying Presidential Memorandum direct Federal agencies to identify and analyze the potential socioeconomic impacts of proposed actions in accordance with health and environmental laws, and to identify alternatives that might mitigate these impacts. In accordance with this EO, the Corps made efforts during the public involvement phase, especially the scoping process, to reach minority and low-income groups (see Section 1.4) to inform them of the Corps action and give them the opportunity to participate in the decision-making process. Demographic information on ethnicity, race, and economic status of the residents of the ROI is provided in Table 3-17 as the baseline against which potential impacts can

be identified and analyzed. Any potential disproportionate risks to minority or low-income groups as a result of the Corps implementing a revised SMP at Greers Ferry Lake are identified in Section 4.0.

Table 3-17
Race, Ethnicity, and Poverty Status for the ROI, Arkansas, and the United States for the Year 2000

	ROI (Percent)	Arkansas (Percent)	United States (Percent)
White	97.5	80.0	75.1
Black or African American	0.2	15.7	12.3
American Indian and Alaskan Native	0.6	0.7	0.9
Asian	0.2	0.8	3.6
Native Hawaiian and Other Pacific Islander	NA	0.1	0.1
Other Race	0.3	1.5	5.5
Two or more races	1.2	1.3	2.4
Hispanic[1]	1.3	3.2	12.5
Living in Poverty[2]	18.0	17.5	13.3

[1] Persons of Hispanic origin may be of any race.
[2] Percent of persons living below poverty is for 1997.
Source: USDOC, Census, 2001.

The ROI has a significantly lower percentage of minority residents compared to Arkansas and the United States, as shown in Table 3-17. This reflects the demographics of the in-migrating population. In 2000, 97.5 percent of the ROI population was white. All other racial groups and ethnic backgrounds accounted for approximately 2.5 percent or less of the ROI population. In Arkansas, 20 percent of the population was of a minority race and 3 percent of Hispanic ethnicity, and in the United States 25 percent of the population was of a minority racial group and 12.5 percent of Hispanic ethnicity.

The Census Bureau bases the poverty status of families and individuals on 48 threshold variables, including income, family size, number of family members under the age of 18 and over 65 years of age, and amount spent on food. In 2000 approximately 18 percent of the ROI residents were classified as living in poverty, approximately the same as the poverty rate for Arkansas but almost 5 percent higher than the rate for the United States as a whole.

3.5.6 Protection of Children

On April 12, 1991, the President issued EO 13045, *Protection of Children from Environmental Health Risks and Safety Risks*. The EO seeks to protect children from disproportionately incurring environmental health or safety risks that might arise as a result of Army policies, programs,

activities, and standards. Historically, children have been present at Greers Ferry Lake as residents and visitors. The Army has taken precautions for their safety at the lake and dam. Above the dam are warning signs to stay out of the restricted area near the dam, and below the dam is a warning siren that signals when water is being discharged. All docks along the shoreline of Greers Ferry Lake are built to building and safety standards, and the Corps checks them routinely for proper maintenance and electrical wiring. Other measures implemented by the Corps as listed in the *Greers Ferry Project Office Safety Plan* (USACE, Greers Ferry Project Office, 2001) to protect the safety of the visiting public include the following:

- Greers Ferry Lake Management Office employees receive training in emergency first aid, CPR, and hazardous and toxic substances.
- Greers Ferry Lake ranger staff performs water safety patrols during the summer recreation season.
- The Greers Ferry Project Office maintains and conducts an active water safety program, and it solicits and sponsors boating and swimming safety activities.
- Swimming and wading areas and boat launching areas are maintained in good condition.
- All areas have guardrails and handrails where necessary.
- General fire inspections are conducted weekly to ascertain whether any fire hazards exist and to ensure that fire-fighting equipment is properly located.
- Marina operators are encouraged to promote public safety and support the project safety program.

3.6 VISUAL AND AESTHETIC RESOURCES

Visual and aesthetic resources are those natural resources, landforms, vegetation, and man-made structures in the environment that generate one or more sensory reactions and evaluations by the observer, particularly with respect to pleasurable responses. These sensory reactions are traditionally categorized as visual, auditory, and olfactory (sight, sound, and smell) responses. The visual sense is so predominant in the observer's reaction and evaluation that visual resources are the focus of this section. The other sensory stimulants, sound and smell, are addressed, to the extent that their presence is perceivable, in the noise, air, and water quality sections.

3.6.1 Greers Ferry Lake

Greers Ferry Lake is a deep, very clear, and rocky impoundment of the Little Red River that drains the southeastern part of the Ozark Mountains in north-central Arkansas. At the top of the conservation pool, at an elevation 461 feet above MSL, the shoreline of the lake has a total length of 276 miles. As the pool rises to the top of the flood control pool, at elevation 487 feet, the shoreline length increases to 343 miles.

The shoreline, which has an irregular shape with numerous arms and coves, consists of sandstone banks characterized by flat shelves that drop vertically into deep water, alternating with gently sloping, heavily vegetated shoreline. The surrounding countryside consists of low, rolling hills forested with a mixture of shortleaf pines, oaks, hickories, and secondary hardwoods. The lake itself, covering some 50 square miles, is almost two separate bodies of water.

The upper end is narrow and riverine in character and is compressed into a long, straight chute of the Little Red River known as the Narrows. At the lake's southeast end, the Narrows opens up into a large expanse of open water as it joins Salt Creek and Cove Creek. Lake elevation is 461 feet above MSL at the dam. Sugar Loaf Mountain, forming an island in the central part of the lake, is the high point at approximately 1,000 feet above MSL. The prominent scenic topographic features of the area include oddly shaped buttes and ledge outcrops that rise above the impounded river valley. At some of the coves in the upper end of the lake, the terrain is less steep and waters are subject to rapid dewatering with only a moderately lower pool stage.

Other than the dam site itself, the lake has 16 developed parks distributed around the shoreline. One park, Sugar Loaf, is on an island in the upper, western part of the lake. Most of these parks offer public boat launching ramps, picnic areas, and public campgrounds. The lake also has become a desirable location for residential home development along and overlooking its shoreline. More than 200 subdivisions adjoin the government-owned land that surrounds the lake.

A total of 19 miles of the lake's shoreline, or approximately 7 percent of the shoreline at the top of the conservation pool, is designated for limited development. The rest of the shoreline, approximately 92 percent, is designated as park, protected, or prohibited (see Section 3.3.1, Land Use and Land Cover). Private floating facilities are permitted in areas designated for limited development. The density of development depends on and is consistent with the ecological and aesthetic characteristics of the particular area. The 1994 SMP and 36 CFR 327.30 stipulate that the density of development will not exceed 50 percent of the shoreline allocated for limited development when the lake level is at the top of the conservation pool. Density is determined by

measuring linear feet of shoreline in the zone and comparing the measurement to the width of the facilities.

For a lake of its size, there are relatively few public vantage points from the surrounding network of public roads and highways and no developed overlook areas.

3.6.2 Scenic Attractiveness

Although not identified or mentioned in any of the standard travel guides covering the United States, or in the Michelin USA Recreational Sites map (Michelin, 1997) as a sight worth visiting, Greers Ferry Lake is mentioned in one guide to the southeastern United States, without any reference to its scenic quality (Mobil, 2001). In Arkansas, however, the lake is noted for its scenic qualities, particularly its largely undeveloped shoreline. The Great Outdoor Recreation Pages (GORP) web site notes that the Sugar Loaf Mountain Nature Trail has received many awards for its scenic beauty (GORP, 2001a) and that it is a designated "National Recreation Trail" (GORP, 2001b). National Recreation Trails are designated by the Secretary of the Interior or the Secretary of Agriculture to recognize exemplary trails of local and regional significance (American Trails, 2001).

QAR, Inc., conducted a visual assessment survey on March 8–10, 2001. Of the 77 representative locations/sites surveyed, 54 were assessed from a boat on the lake and 23 were assessed from roads or other vantage points on land surrounding the lake. Of the 54 water-based visual landscape assessments, 59 percent of the locations/sites were classified as "Class B Typical" in terms of scenic attractiveness, 26 percent were classified as "Class C Indistinctive," and 15 percent were classified as "Class A Distinctive" (QAR, Inc., 2001).

Of the 23 land-based visual landscape assessments, 61 percent of the representative locations/sites were classified as "Class B Typical," 30 percent were classified as "Class A Distinctive," and 9 percent were classified as "Class C Indistinctive" (QAR, Inc., 2001). Table 3-18 provides definitions of the three scenic attractiveness classes identified.

Table 3-18
Scenic Attractiveness Class Definitions

Class A Distinctive: Areas where landform, vegetation patterns, water characteristics, and cultural features combine to provide unusual, unique, or outstanding scenic quality. These landscapes have strong positive attributes of variety, unity, vividness, mystery, intactness, order, harmony, uniqueness, pattern, and balance.
Class B Typical: Areas where landform, vegetation patterns, water characteristics, and cultural features combine to provide ordinary or common scenic quality. These landscapes have generally positive, yet common, attributes of variety, unity, vividness, mystery, intactness, order, harmony, uniqueness, pattern, and balance. Normally they would form the basic matrix within the ecological unit.
Class C Indistinctive: Areas where landform, vegetation patterns, water characteristics, and cultural land use have low scenic quality. Often water and rockform features of any consequence are missing in Class C landscapes. These landscapes have weak or missing attributes of variety, unity, vividness, mystery, intactness, order, harmony, uniqueness, pattern, and balance.

Source: USFS, 1995.

Table 3-19 provides a breakdown of the scenic attractiveness rankings by the lake's principal shoreline designations for the water-based visual landscape assessments. Of note is that each of the three shoreline categories had fairly similar percentages of locations/sites classified as having a "Class B Typical" scenic attractiveness rating (around 60 percent). The Protected and Park Buffer areas, as expected, had a higher percentage of locations/sites classified as having a "Class A Distinctive" scenic attractiveness rating, 20 and 12 percent respectively, and a lower percentage of locations/sites having a "Class C Indistinctive" scenic attractiveness rating (Table 3-19).

Table 3-19
Scenic Attractiveness of Locations/Sites by Shoreline Category
(Water-Based Visual Landscape Assessments)

	Limited Development		Protected		Park Buffer		
	Number	Percent	Number	Percent	Number	Percent	Total
Class A Distinctive	0	0	7	20	1	12	8
Class B Typical	6	55	21	60	5	63	32
Class C Indistinctive	5	45	7	20	2	25	14
Total	11		35		8		54

Source: QAR, Inc., 2001.

Table 3-20 provides a breakdown of the scenic attractiveness rankings by the lake's principal shoreline designations for the land-based visual landscape assessments. Of note is that each of the three shoreline categories in the Protected and Park Buffer areas, as expected, had a higher

percentage of locations/sites classified as having a "Class A Distinctive" scenic attractiveness rating, 50 and 22 percent, respectively, and a much lower percentage of locations/sites having a "Class C Indistinctive" scenic attractiveness rating, 0 and 11 percent, respectively, than the locations/sites in the LDA's (Table 3-20).

Table 3-20
Scenic Attractiveness of Locations/Sites by Shoreline Category
(Land-Based Visual Landscape Assessments)

	Limited Development		Protected		Park Buffer		
	Number	Percent	Number	Percent	Number	Percent	Total
Class A Distinctive	0	0	5	50	2	22	7
Class B Typical	3	75	5	50	6	67	14
Class C Indistinctive	1	25	0	0	1	11	2
Total	4		10		9		23

Source: QAR, Inc., 2001.

Figures 3-10 through 3-12 provide photographic examples of the scenic attractiveness classes at Greers Ferry Lake, both from the water (upper panel) and from the land (lower panel).

3.6.3 Scenic Integrity

Of the 54 water-based visual landscape assessments, 33 percent of the representative locations/sites were classified as having a "Very Low" (Heavily Altered) scenic integrity, 30 percent were classified as having a "Low" (Moderately Altered) scenic integrity, 24 percent were classified as having a "Moderate" (Slightly Altered) scenic integrity, 11 percent were classified as having a "High" (Appears Unaltered) scenic integrity, and 4 percent were classified as having a "Very High" (Unaltered) scenic integrity. Removing the eight marina visual landscape assessments (which account for almost half of the "Very Low" ratings), the distribution among scenic integrity classes would be 22 percent "Very Low" (Heavily Altered), 35 percent "Low" (Moderately Altered), 28 percent "Moderate" (Slightly Altered), 13 percent "High" (Appears Unaltered), and 4 percent "Very High" (Unaltered). None of the locations/sites were judged to have an "Unacceptably Low" scenic integrity rating (QAR, Inc., 2001).

From the Water: East of Spring Hollow, Greers Ferry Lake (Map Reference No. 06, Photo No.06, QAR, Inc., 2001).

From the Land: Greers Ferry Lake and The Narrows from Hwy 16 (Map Reference No. 76, Photo No. 76, QAR, Inc., 2001).

Distinctive Scenic Attractiveness

Figure 3-10

From the Water: Budd Creek, Greers Ferry Lake (Map Reference No. 27, PhotoNo.27, QAR,Inc., 2001).

From the Land: Greers Ferry Lake from Heber Springs Recreation Area (Map Reference No. 61, Photo No. 61, QAR, Inc., 2001).

Typical Scenic Attractiveness

Figure 3-11

From the Water: Hidgen Bay, Greers Ferry Lake (Map Reference No.56, Photo No.56, QAR, Inc., 2001).

From the Land: Greers Ferry Lake from Edgemont (Hwy 16) (Map Reference No. 61, Photo No. 61, QAR, Inc., 2001).

Indistinctive Scenic Attractiveness

Figure 3-12

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Of the 23 land-based visual landscape assessments, 35 percent of the representative locations/sites were classified as having a "Low" (Moderately Altered) scenic integrity, 22 percent were classified as having a "Very Low" (Heavily Altered) scenic integrity, 22 percent were classified as having a "Moderate" (Slightly Altered) scenic integrity, 18 percent were classified as having a "High" (Appears Unaltered) scenic integrity, and 4 percent were classified as having a "Very High" (Unaltered) scenic integrity ranking. None of the locations/sites were judged to have an "Unacceptably Low" scenic integrity rating (QAR, Inc., 2001). Table 3-21 provides definitions of the scenic integrity classes identified.

Table 3-21
Scenic Integrity Definitions

Very High (Unaltered). Landscapes where the valued landscape character "is" intact with only minute if any deviations. The existing landscape character and sense of place are expressed at the highest possible level.
High (Appears Unaltered). Landscapes where the valued landscape "appears" intact. Deviations may be present but must repeat the form, line, color, texture, and pattern common to the landscape character so completely and at such scale that they are not evident.
Moderate (Slightly Altered). Landscapes where the valued landscape "appears slightly altered." Noticeable deviations must remain visually subordinate to the landscape character being viewed.
Low (Moderately Altered). Landscapes where the valued landscape character "appears moderately altered." Deviations begin to dominate the valued landscape character being viewed, but they borrow valued attributes such as size, shape, edge effect, and pattern of natural openings, vegetative type changes, or architectural styles outside the landscape being viewed. They should only appear as valued character outside the landscape being viewed but compatible or complementary to the character within.
Very Low (Heavily Altered). Landscapes where the valued landscape character "appears heavily altered." Deviations may strongly dominate the valued landscape character. They may not borrow from valued attributes such as size, shape, edge effect, and pattern of natural openings, vegetative type changes, or architectural styles within or outside the landscape being viewed.
Unacceptably Low. Landscapes where the valued landscape character being viewed appears extensively altered. Deviations are extremely dominant and borrow little, if any, form, line, color, texture, pattern, or scale from the landscape character.

Source: USFS, 1995.

Table 3-22 provides a breakdown of the scenic integrity ratings by the lake's principal shoreline designations for the water-based visual landscape assessments. As expected, 90 percent of the locations/sites in the LDA's have "Low" or "Very Low" scenic integrity ratings, compared to 48 percent of the Protected Area locations/sites. A total of 52 percent of the locations/sites in the Protected Areas of the shoreline had "Moderate" to "Very High" scenic integrity ratings. The large percentage of locations/sites receiving "Very Low" visual integrity ratings in the Park Buffer areas is due to the fact that these were all marinas in the parks.

Table 3-23 provides a breakdown of the scenic integrity ratings by the lake's principal shoreline designations for the land-based visual landscape assessments. As expected, 100 percent of the

locations/sites in the LDA's have "Low" or "Very Low" scenic integrity ratings, compared to 30 percent of the Protected Area locations/sites. A total of 70 percent of the locations/sites in the Protected Areas of the shoreline had "Moderate" to "Very High" scenic integrity ratings. The large percentage (88 percent) of locations/sites receiving "Very Low" visual integrity ratings in the Park Buffer areas is due to the fact that the visual landscape assessment was conducted at marinas in the parks. None of the locations/sites in any of the shoreline categories received an "Unacceptably Low" scenic integrity rating (QAR, Inc., 2001).

Table 3-22
Scenic Integrity of Locations/Sites by Shoreline Category
(Water-Based Visual Landscape Assessments)

	Limited Development		Protected		Park Buffer		
	Number	Percent	Number	Percent	Number	Percent	Total
Very High (Unaltered)	0	0	2	6	0	0	2
High (Appears Unaltered)	0	0	6	17	0	0	6
Moderate (Slightly Altered)	1	10	11	31	1	13	13
Low (Moderately Altered)	5	50	11	31	0	0	16
Very Low (Heavily Altered)	4	40	6	17	7	87	17
Unacceptably Low	0	0	0	0	0	0	0
Total	10		36		8		54

Source: QAR, Inc., 2001.

Table 3-23
Scenic Integrity of Locations/Sites by Shoreline Category
(Land-Based Visual Landscape Assessments)

	Limited Development		Protected		Park Buffer		
	Number	Percent	Number	Percent	Number	Percent	Total
Very High (Unaltered)	0	0	1	10	0	0	1
High (Appears Unaltered)	0	0	4	40	0	0	4
Moderate (Slightly Altered)	0	0	2	20	3	33	5
Low (Moderately Altered)	3	75	3	30	2	22	8
Very Low (Heavily Altered)	1	25	0	0	4	44	5
Unacceptably Low	0	0	0	0	0	0	0
Total	4		10		9		23

Source: QAR, Inc., 2001.

Figures 3-13 through 3-17 provide photographic examples of the five scenic integrity classes at Greers Ferry Lake, both from the water (upper panel) and from the land (lower panel).

From the Water: Sugar Loaf Mountain, Greers Ferry Lake (Map Reference No. 52, Photo No. 52, QAR, Inc., 2001).

From the Land:Greers Ferry Lake from Midway Bridge (Hwy225) (Map Reference No. 70, Photo No. 70, QAR, Inc.,2001).

Very High Scenic Integrity

Figure 3-13

From the Water: Grand Isle, Greers Ferry Lake (Map Reference No.41, Photo No. 41, QAR, Inc., 2001).

From the Land: Greers Ferry Lake from Sulphur Creek Dike (Map Reference No. 63, Photo No. 63, QAR, Inc., 2001).

High Scenic Integrity

Figure 3-14

From the Water: Lynn Creek, Greers Ferry Lake (Map Reference No. 44, Photo No. 44, QAR, Inc., 2001).

From the Land: Greers Ferry Lake from Cove Creek Recreation Area (Map Reference No. 64, Photo No. 64, QAR, Inc., 2001).

Moderate Scenic Integrity

Figure 3-15

From the Water: Robinson Hollow, Greers Ferry Lake (Map Reference No. 01, Photo No. 01, QAR, Inc., 2001).

From the Land: Greers Ferry Lake from State Hwy 210 (Map Reference No. 59, Photo No. 59, QAR, Inc., 2001).

Low Scenic Integrity

Figure 3-16

From the Water: Bailey Hollow, Greers Ferry Lake (Map Reference No. 50, Photo No. 50, QAR, Inc., 2001).

From the Land: Greers Ferry Lake Narrows Park (Map Reference No. 66, Photo No. 66, QAR, Inc., 2001).

Very Low Scenic Integrity

Figure 3-17

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3.6.4 Landscape Visibility

Landscape visibility is a function of many interconnected considerations, including context of viewers, duration of view, degree of discernible detail, seasonal variations, and number of viewers. Viewers of Greers Ferry Lake shoreline include residents, recreational users (boaters, sailors, fishermen, and waterskiers, and others), and visitors to the area who recreate or drive on the roads that surround the lake. Of these viewers, recreational users and park visitors (campers, picknickers, and hikers) are by far the most numerous. The recreation section (Section 3.7) identifies the number of visitors and recreational users of the lake.

The Lower Lake to the east of Millers Point has the highest concentration of boating activity, with triple the concentration of boats of the two upper parts of the lake, east and west of the Narrows. The number of recreational users in the central part of the lake, including the Narrows, Salt Creek, and the area between the Mill Creek and Devils Fork recreation areas, lies somewhere in between (Hargis, personal communication, March 2001).

Of particular concern is the duration of view and the degree of discernible detail of the private and community docks on the lake's shoreline, both to recreational users of the lake and its parks and to residents of the adjoining subdivisions. These docks are currently contained in the Limited Development Area zones of the lake shoreline, which constitute approximately 7 percent (19 miles) of the lake's total shoreline. Based on a visibility range of 1 mile, Figure 3-18 shows the areas of the lake from which the existing boat docks and marinas are clearly visible. Although this visibility range varies with weather, the amount of sunlight, and aspect, based on observations at Greers Ferry Lake it is a reasonable maximum distance for being able to see the docks and marinas against the varied topography and vegetation of the lake's shoreline. At distances beyond 1 mile, the docks begin to blend in with the shoreline's rock outcrops and vegetation, becoming less noticeable. Using the 1-mile visibility range, at least 1 dock is visible from 38 percent of the lake's surface, with 1 to 10 docks visible from 35 percent of the lake's surface (Table 3-24).

Table 3-24
Acreage of Lake from which Boat Docks are Clearly Visible

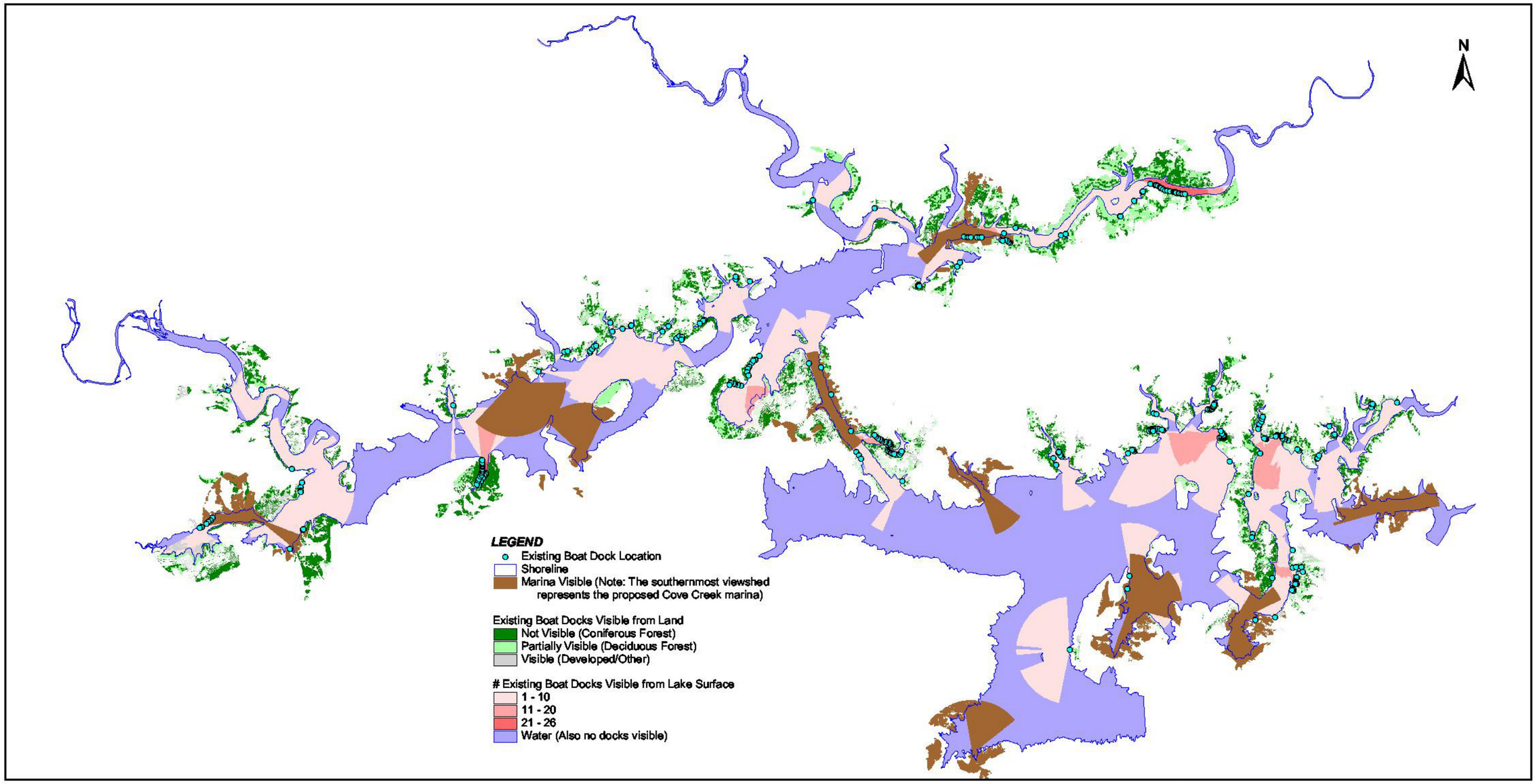
Number of Visible Docks	Lake Acreage	Percent of Lake's Total Surface
1–10	11,068.2	35.1
11–20	868.1	2.8
21–30	99.9	0.3
Total	12,036.2	38.2

Figure 3-18 also shows the area of docks and marinas visible from land, taking into account local topography. The geographic information system (GIS) analysis indicates that at least one dock is potentially visible from land on approximately 7,627 acres around the lake. Of these, 3,952 acres are classified as coniferous tree-covered land, 2,816 acres as deciduous tree-covered land, and 858 acres as "other" tree cover. The term "potentially visible" is used here because vegetative cover introduces an element of uncertainty. Tree cover exists over almost all the lake's shoreline, and the surrounding countryside consists of low, rolling hills forested with a mixture of shortleaf pines, oaks, hickories, and secondary hardwoods. Although it is possible to see through deciduous trees during the winter months, when the trees are in full leaf, views of the lake (and boat docks and marinas) are likely to be blocked. This factor, coupled with the presence of coniferous stands of shortleaf pines, makes the analysis of the lake view problematic at best. Without evaluating individual lots, it is impossible to ascertain the exact area for visible docks and marinas from land, both from areas immediately adjacent to the shoreline and from properties farther back from the lake, even though the land topography alone would seem to allow it. Understory vegetation has been suppressed in areas of public use all over the lake, so views of dock and marina areas would not be materially curtailed from the lake's parks.

3.6.5 Visual Resource Concerns

Both written and verbal public responses during the scoping process identified lake aesthetics and beauty as one of the top issues of concern. The issues identified as important included concerns about preserving the natural beauty, shoreline, or pristine conditions of the lake. Overall, boat dock-related issues were the primary concern of lake property owners and other recreational users of the lake. The environmental and recreational impacts from additional docks on the lake was the primary concern identified. Of special concern was preservation of the unspoiled, uncluttered nature of the shoreline (Tetra Tech, Inc., 2001a).

As noted in Section 3.3, Land Use and Land Cover, private boat docks have been permitted on Greers Ferry Lake since impoundment began in January 1961. The number of private floating facilities on the lake has continued to increase since that time. Figure 3-19 depicts the growth in the number of docks on the lake between 1968 and 2001.



Existing Boat Dock Viewsheds

Sources: GIS calcuations; USACE, Little Rock District, 2001.

Figure 3-18

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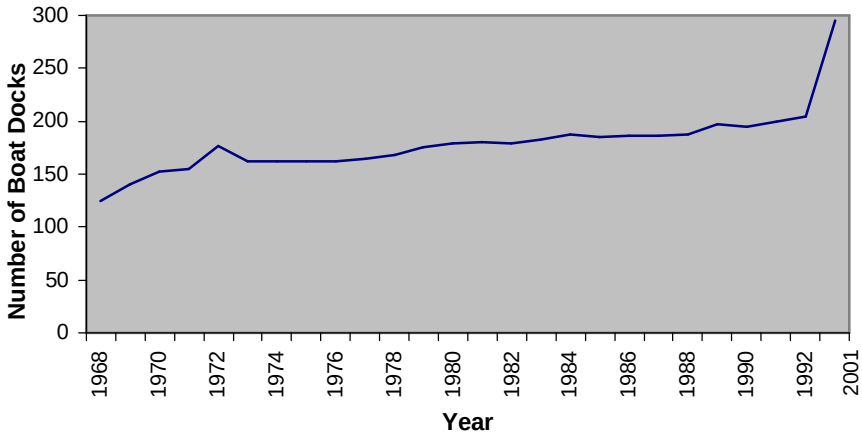

Figure 3-19. Number of Boat Docks, 1968–2001

3.7 RECREATION AND RECREATIONAL FACILITIES

Greers Ferry Lake supports a variety of recreational activities, including camping, boating, fishing, swimming, hiking, and visiting attractions like the dam and visitors center. The lake receives about 5.5 million visitors annually as calculated by the Corps Visitors Estimation Reporting System. Table 3-25 lists the approximate number of visitors to the lake from 1979 through 1999. Designated parks and recreation areas (see Section 3.3.1.1) are managed by the Corps, except for Fairfield Bay Park, which is leased to the city of Fairfield Bay, and Sandy Beach, which is leased to the city of Heber Springs. Salt Creek is an undeveloped tract of Corps property reserved for future park development. South Fork Park is closed to camping, but its boat ramp is open for public use. John F. Kennedy Park is not on the lake proper. In addition to the parks, 191 private docks, 104 community docks, and 23 roads[5] (the roads lead into the lake, so boats can be launched from them) provide access to the lake for adjacent landowners and visitors.

Boaters on the lake use speedboats, cabin cruisers, runabouts, sailboats, PWC, fishing boats, houseboats, pontoon boats, rowboats, windsurfers, canoes, and kayaks. All areas of the lake are well visited by boaters. Table 3-26 lists the number of boats counted on select days in the morning and afternoon in different areas of the lake during the summer of 2001 (Tetra Tech, Inc., 2001b). Refer to Figure 3-20 for lake area designations.

The parks on the lake offer many facilities to visitors for day and extended use. These facilities are listed by park in Table 3-27. Eight of the developed parks have marinas. Refer to Figure 3-7

[5] The access roads were created by lake inundation.

for the locations of these parks on the lake. The total number of slips at these marinas is listed in Table 3-27. Some marinas offer dump stations for sewage. Services to support boaters using the marinas and launch ramps (day users) are also available at many of the parks (see Table 3-27), as well as at many commercial establishments in the local area.

Table 3-25
Visitation Statistics for Greers Ferry Lake

Year	Visitors
1979	4,548,000
1984	5,265,000
1989	4,420,700
1994	5,438,000
1999	5,646,800

Source: Parsons Engineering Science, Inc., 2000.

Table 3-26
Boats Counted in Lake Areas, Summer 2001

Date	Time	Area 1	Area 2	Area 3	Area 4	Area 5	Total
5/26	PM	248	422	128	365	189	**1,352**
5/27	AM	111	77	99	63	95	**445**
5/27	PM	375	193	276	325	277	**1,446**
6/9	PM	282	133	109	97	116	**737**
6/10	PM	206	226	121	141	170	**864**
7/4	AM	124	84	109	55	111	**483**
7/4	PM	470	172	207	158	337	**1,344**
7/5	AM	124	64	108	45	103	**444**
7/5	PM	211	121	133	117	167	**749**
7/6	AM	189	86	121	51	136	**583**
7/6	PM	429	160	289	122	303	**1,303**

Note: See Figure 3-20 for lake area designations.
Source: Tetra Tech, Inc., 2001b.

Private docks are permitted only in LDA's. Currently, about 7 percent of the lake shoreline is designated as LDA. Within LDA's, a maximum development density of 50 percent is allowed. Development density is calculated by comparing the total length of the LDA (at conservation pool level, 461 feet MSL) to the total width (parallel to the shoreline) of permitted facilities within the LDA. Table 3-28 summarizes the number of boat dock permits for the lake by year (1979–2000).

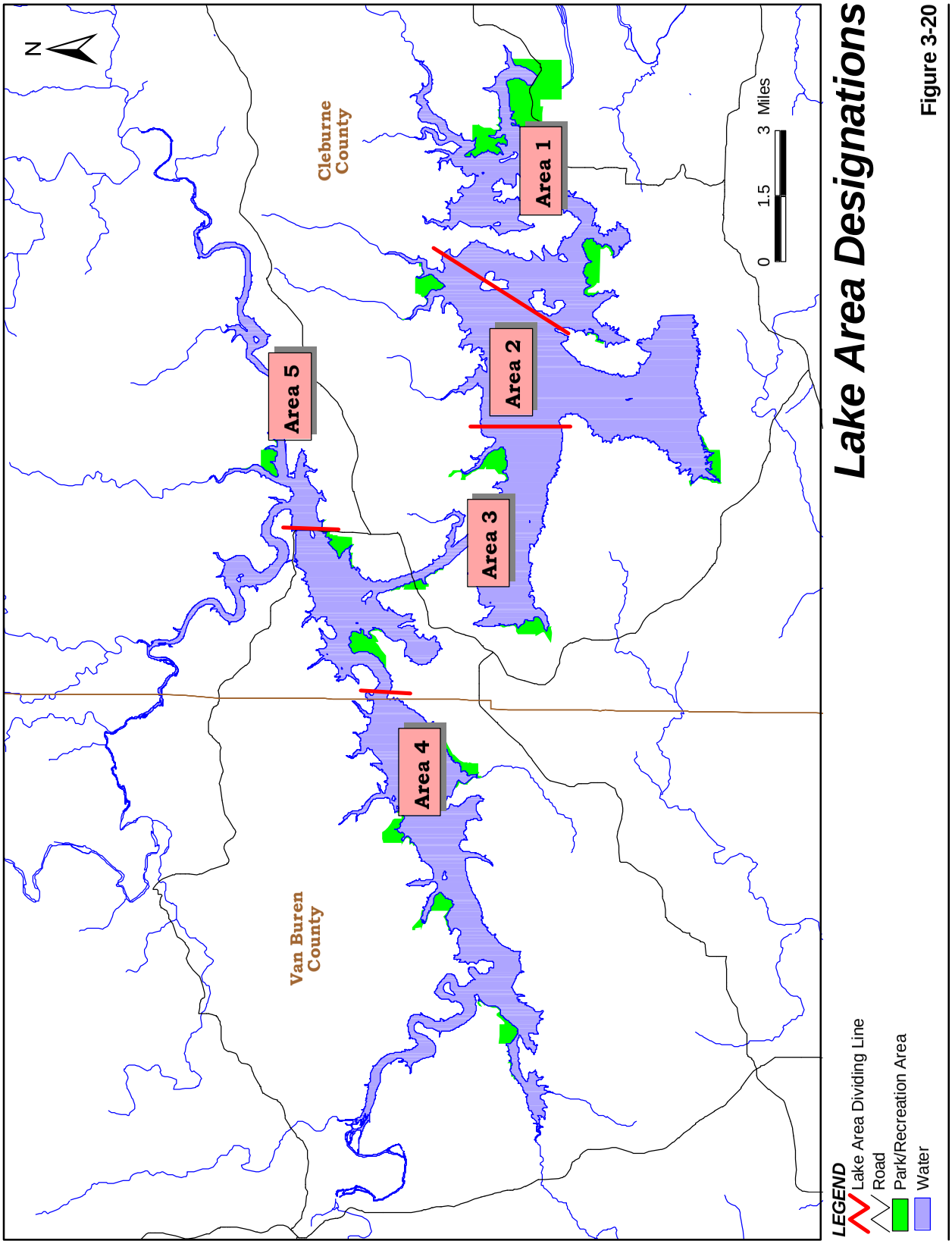
Lake Area Designations
N
Cleburne County
Van Buren County
Area 1
Area 2
Area 3
Area 4
Area 5
0
1.5
3 Miles
LEGEND
Lake Area Dividing Line
Road
Park/Recreation Area
Water

Figure 3-20

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Table 3-27
Greers Ferry Lake Parks And Park Facilities

Park	Acres	Camping Facilities								Day Use Facilities									Marina Facilities		
		Sites in NRRS	Site w/o Electricity	Site w/Electricity	Group Site	Dump Station	Plumbed Toilet	Vault Toilet	Shower	Playground	Swim Area	Vault Toilet	Change House	Picnic Shelter	Picnic Table	Launch Ramp	Launch Lane	Parking Spaces	Slip	Dump Station	Sales & Rental
JFK	232	49		74		1	2		Y	1				1	6	1	1				
Dam Site	428	163	108	156		1	5	3	Y	1	2			3		1	12	1,000	600	1	Y
OH 25	239	54	36	84	1		4	2	Y		1			1	7	3	4	697			
Heber Springs	203	89	36	106		1	2	3	Y	1	1			1	11	4	4	1,221	420		Y
Cherokee	139	20	17	16				1	N							1	2	372			
Cove Creek	108	47	34	31			1	1	Y		1			1	4	1	4	419			
Shiloh	126	72	56	60	1	1	2	2	Y	1	2			1	4	2	6	1,294	568		Y
Narrows	61	44		60		1	1	1	Y			1		2	9	2	2	479	400		Y
Devils Fork	88	34		55		1	1	2	Y	1	3			1	4	3	12	815			
Hill Creek	104	22	17	25		1	1	1	Y		1	1		1		1	10	664; 200 in fishing tournament complex	155		Y
Sugar Loaf	65	46	39	56		1	1	2	Y	1	1			1		2	8	663	200		Y
Choctaw	118	78	68	78			2	2	Y	1	1		1	1	5	1	8	1,049	250	1	Y
Mill Creek	221	39 total						1	N		1		1		2	1					
South Fork[1]	94	Camping prohibited – No camping facilities													2	1	1	177			
Totals		718	411	801	2	8	22	21		7	14	2	2	14	54	25[2]	77[2]	9,635[2]	2,593[2]	2	

[1] South Fork park is closed to camping, though the boat ramp at the park is available for public use.
[2] Includes Fairfield Bay park.
Notes: Sandy Beach area, 168 acres, was leased to the city of Heber Springs, which operates and maintains the land, in 1999.
Fairfield Bay park, 127 acres, was leased to the city of Fairfield Bay, which operates and maintains it, in 1997. The park has 585 parking spaces, and its marina has 354 slips.
Salt Creek area is an undeveloped tract of public property held in reserve for a future park site.
Source: USACE, Greers Ferry Project Office, 2000.

Table 3-28
History of Number of Permitted Boat Docks at Greers Ferry Lake

Year	Permitted Boat Dock
1979	175
1984	187
1989	194
1994	234
1999	256
2000	295

Source: Parsons Engineering Science, Inc., 2000.

Private docks along the shoreline are either individual docks, with a maximum capacity of 2 boat slips, or community docks, with a maximum capacity of 20 boat slips. All docks must be permitted, and approval depends on factors such as slope of land underwater, depth of water, navigation safety, width of cove, and ecological and aesthetic characteristics of the location where the dock is proposed to be installed. All docks must be floating, not fixed to the lakebed, and must be anchored to the shoreline. A minimum of one-third of the width of coves (at conservation pool level, 461 feet MSL) must remain open for navigation; that is, at conservation pool level, docks in coves must not extend more than one-third of the width of the cove from the shoreline.

The number of boaters that use the lake simultaneously is greatest on holiday weekend afternoons. Boat counts were done on the lake in 2001 from Memorial Day weekend, May 26, through July 8. The highest number of boaters counted on the lake simultaneously occurred on the afternoon of May 27, a Sunday, when 1,446 boats were counted. Table 3-29 presents calculations of user capacities for the various areas of the lake and the entire lake based on minimum and maximum acreages estimated to be required for quality recreational experiences and compares these numbers to the boat count (Kusler, 1972; Urban Research and Development Corporation, 1977). The second and third to last rows of the table present overall user capacity information. Allowing a maximum number of acres per user, based on type of activity engaged in, and comparing the number of users that could be accommodated in each area of the lake to the boat count information, it is apparent that Area 1 and Area 5 are currently overused under this scenario. Allowing a minimum number of acres per user, none of the areas are currently overused. The lake overall is still underused, even under the scenario that allows a maximum number of acres per user.

3.8 GEOLOGY

3.8.1 Topography

The topography of the Greers Ferry Lake study area (defined for the purposes of this section as the area within 1 mile of the lake) is rocky and rugged, with a local relief of up to 600 feet. The conservation pool elevation for the lake is 461 feet above sea level. The lake is irregular in shape and is essentially divided in half by a straight channel called the Narrows in the central portion of the lake (Parsons Engineering Science, Inc., 2000).

Table 3-29
Current and Potential Recreational Use of Greers Ferry Lake

Activity	Area 1	Area 2	Area 3	Area 4	Area 5	Total
Acres	5,668	8,604	6,996	7,123	2,689	31,080
Limited Power[1]	69%	66%	74%	75%	66%	
Users, Maximum Acreage Allowance	163	237	216	223	74	913
Users, Minimum Acreage Allowance	391	568	518	534	177	2,188
Unlimited Power[2]	22%	16%	15%	11%	17%	
Users, Maximum Acreage Allowance	37	38	29	22	13	139
Users, Minimum Acreage Allowance	62	69	52	39	23	245
Non-power[3]	9%	18%	11%	14%	17%	
Users, Maximum Acreage Allowance	102	310	154	199	91	856
Users, Minimum Acreage Allowance	170	516	257	332	152	1,427
Total Users, Maximum Acreage Allowance	302	585	399	444	178	1,908
Total Users, Minimum Acreage Allowance	623	1,153	827	905	352	3,860
Boaters Counted, May 27, 2001, PM	375	193	276	325	277	1,446

[1] Includes pleasure boating, jet skiing, and tubing.
[2] Includes water skiing.
[3] Includes fishing and sailing.
Source: Tetra Tech, Inc., 2001b

3.8.2 Physiography

The Greers Ferry Lake study area is bisected by two physiographic provinces of the major Southern Interior Highlands Division. The northern portion of the study area is in the Boston Mountains section of the Ozark Plateaus Province. The Ozark Plateaus cover northern Arkansas

and consist of massively uplifted sedimentary rock that has remained horizontal with minor deformations. The Boston Mountains are a plateau that has been eroded by significant stream dissection, leaving deep, narrow valleys and flat-topped mountains representing the original surface of the plateau (Crutchfield, personal communication, March 2001). Elevations in the study area reach 1,200 feet, with local relief of up to 600 feet.

The southern portion of the study area is in the Arkansas Valley section of the Ouachita Mountains Province. The Ouachita Mountains consist of folded sedimentary rock that creates east-west-oriented parallel ridges and valleys. One of these valleys is the Arkansas Valley, which averages 35 miles in width (Crutchfield, personal communication, March 2001). In this section of the study area, elevations range from 300 feet along the Little Red River downstream of Greers Ferry Lake to 800 feet on the ridgetops.

3.8.3 Structure and Stratigraphy

The Greers Ferry Lake study area is surficially underlain entirely by an outcrop of the Pennsylvanian Atoka Formation (Figure 3-4). The formation is several thousand feet deep, with a maximum reported thickness of almost 10,000 feet near Perryville, about 50 miles south of the study area. The Atoka Formation consists of alternating sequences of marine, mostly tan to gray, silty sandstones and grayish-black shales (AGC, 2001c). The shale beds dominate the formation, and the intervening sandstone layers can range from several inches to 100 feet thick (Crutchfield, personal communication, March 2001).

Beneath the Atoka formation are the Bloyd Shale Formation and the Hale Formation, which is the lowermost of the Pennsylvanian formations. The Bloyd Shale Formation is a black, carbonaceous, fissile clay shale 175 to 200 feet in thickness with two thin but distinct embedded limestone members, the Brentwood and Kessler limestones. The Brentwood is the lower and thicker of the two. The deeper Hale Formation is up to 300 feet thick and consists of two members. The upper Prairie Grove member is a frequently pitted and fossiliferous limy sandstone or sandy limestone. The lower Cane Hill member is a dark gray silty shale interbedded with siltstone and fine-grained sandstone. The Hale Formation is unconformable with the Mississippian Period strata below (AGC, 2001c; Crutchfield, personal communication, March 2001).

From shallowest to deepest and youngest to oldest the Mississippian Period formations consist of Pitkin Limestone, Fayetteville Shale, Batesville Sandstone, Ruddell Shale, Moorefield Shale, and the Boone Limestone/Chert formations.

3.8.4 Mineral Resources

At least two active quarries and one abandoned mine are located in the two-county region around Greers Ferry Lake. The mine, located in northern Van Buren County along the Searcy County line, produced phosphate in the 1960s from an Upper Mississippian phosphate deposit. The two quarries are located in Cleburne County and produce crushed stone, sand, and gravel. Zinc and lead minerals are found in northern Arkansas, but they are not found in quantities large enough for mining in the Greers Ferry Lake region. No other known metal-producing mines are near Greers Ferry Lake (AGC, 2001a).

Black shale layers like those found in the Atoka Formation are known to contain minerals consisting of metals such as zinc, lead, copper, iron, and mercury. Tests have not been performed specifically on the black shales in the Greers Ferry Lake area, but it is conceivable that the high concentrations of these metals found in the surface waters of Greers Ferry Lake are partially contributed by dissolution of naturally occurring minerals in the black shales of the Atoka Formation (Howard, personal communication, October 2001).

3.8.5 Seismicity

The Greers Ferry Lake study area is at moderate risk for earthquake activity because of its proximity to the New Madrid seismic zone, an active seismic zone 125 miles to the east of Greers Ferry Lake in the Mississippi Valley (USGS, 2001d). Arkansas counties have been assigned seismic risk zone values ranging from 1 to 4, with 1 being the least risk and 4 being the greatest. Cleburne County is considered seismic risk zone 2, and Van Buren County is in seismic risk zone 1. The counties in the New Madrid seismic zone are considered seismic risk zone 3 (Crutchfield, personal communication, March 2001).

The most recent earthquake in the vicinity of the study area occurred on May 3, 2001. The earthquake registered 4.4 on the Richter scale, and its epicenter was 25 miles southeast of the study area (Reuters News Service, 2001).

3.8.6 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 (Parsons Engineering Science, Inc., 2000).

The following are the four predominant soil associations that make up two-thirds of the soils occurring in the Greers Ferry Lake study area:

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 (Parsons Engineering Science, Inc., 2000).

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 (USDA, SCS, 1986).

A total of 33 soil series have been identified in the Greers Ferry Lake study area (SSURGO, 2001). These soils are summarized in Table 3-30 and shown in Figure 3-21.

Soils in Table 3-30 listed as having a severe erosion hazard are highly susceptible to water erosion. Twenty-four of the 33 soils listed in Table 3-30 are identified as being highly erodible, and the amount of erosion that occurs depends on the amount of rainfall, the erodibility of a particular soil, and slope (Parsons Engineering Science, Inc., 2000; USDA, SCS, 1986). Figure 3-22 shows that 71,000 acres, or 64 percent, of the soils within 1 mile of Greers Ferry Lake are considered highly erodible, and 38,000 acres, or 34 percent, of the soils within 1 mile of the lake are considered potentially highly erodible. Within Corps property, 5,220 acres (52 percent) and 4,100 acres (41 percent) are considered highly and potentially highly erodible soils respectively (SSURGO, 2001).

Hydric soils are defined as soils characterized by or having an abundance of moisture. Soils considered hydric may impose limitations on agricultural, engineering, or septic tank use due to excess moisture. As shown in Table 3-30, one of the soils in the Greers Ferry Lake study area is considered hydric, and several have hydric inclusions. The hydric soil, Guthrie Silt Loam, is found in three small areas, all of which are at least ½ mile from the lake, and consists of a total of

50 acres. Soils with hydric inclusions within 1 mile of the lake total 4,134 acres, or 3.7 percent of the land within this area.

Prime and Unique Farmlands. Nine of the 33 soil series that occur in the Greers Ferry Lake study area (within 1 mile of the lake) are designated as prime or unique farmland soils (see Table 3-30). Prime farmland soils and unique farmlands are defined as land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is available for these uses. The soil qualities, growing season, and moisture supply are those needed for a well-managed soil to produce a sustained high yield of crops in an economic manner. (The land could be cropland, pasture, rangeland, or other land, but not urban built-up land or water.) Farmland soils of statewide importance include lands, in addition to prime farmland, that are important for the production of food, feed, fiber, forage, and oilseed crops. A total of 3,787 acres of soils considered prime or unique farmlands occur in the Greers Ferry Lake study area (SSURGO, 2001); however, only 307 acres of these soils are actively used for agriculture (USGS, 2001c). No prime and unique farmland soils used for agriculture occur within 200 feet of the lake or within Corps property, except along the tributary coves of the South Fork and Middle Fork of the Little Red River upstream from Corps property.

Prime farmland soils are protected under the Farmland Protection Policy Act (FPPA) of 1981 (7 CFR, Part 658; Natural Resources Conservation Service [NRCS] Final Rule, Farmland Policy, July 5, 1984; proposed revisions published on January 8, 1987). The intent of the FPPA is to minimize the extent to which Federal programs contribute to the unnecessary or irreversible conversion of farmland soils to nonagricultural uses. The act also ensures that Federal programs are administered in a manner that, to the extent practicable, will be compatible with private, State, and local government programs and policies and the rules and regulations for implementation of the act (see 7 CFR, Part 658, July 5, 1984). EPA has also established a policy to protect environmentally significant agricultural lands through its Office of Federal Activities.

The implementing procedures of the FPPA and the NRCS require Federal agencies to evaluate the adverse effects (direct and indirect) of their activities on prime and unique farmland (by preparing the Farmland Conversion Impact Rating Form AD 1006), as well as on farmland of statewide and local importance, and to consider alternative actions that could avoid adverse effects. Potential impacts on prime and unique farmlands are determined by preparing the Farmland Conversion Impact Rating Form AD 1006 and applying criteria established in Section 658.5 of the FPPA (7 CFR, Part 658). Criteria established by the NRCS should be used to select among alternative farmland sites.

Table 3-30
Soils Occurring in the Greers Ferry Lake Study Area

Soil Series	Drainage Class	Hydric	Prime or Unique Farmland	Limitations	Occurrence at Greers Ferry Lake	Acres in Study Area
Barling Silt Loam, occasionally flooded	Moderately well drained	No, but hydric inclusions may be present	Yes, if drained	Seasonal wetness	Along outer perimeter of floodplains	102
Cane Loam, 3%–8% slopes	Moderately well drained	No	No	Moderate wetness; moderate slope; severe erosion hazard	Side and toe slopes of hills	389
Dela Loamy Fine Sand, 0%-2% slopes	Well drained	No, but hydric inclusions may be present	No	Moderate wetness	Natural levees on Little Red River and tributaries	58
Enders Gravelly Fine Sandy Loam, 3%–8% slopes	Well drained	No	No	Low permeability; severe erosion hazard; high shrink-swell potential	Side slopes and ridges	3,045
Enders Gravelly Fine Sandy Loam, 8%–12% slopes	Well drained	No	No	Severe slopes; low permeability; severe erosion hazard; high shrink-swell potential	Side slopes and ridges	770
Enders Stony Fine Sandy Loam, 8%–12% slopes	Well drained	No	No	Severe slopes; low permeability; severe erosion hazard; high shrink-swell potential	Side slopes and ridges	139
Enders-Nella-Steprock Complex, 8%-20% slopes	Well drained	No	No	Severe slopes; severe erosion hazard. Enders-low permeability; high shrink-swell potential	Toe slopes, side slopes, and ridges	6,734
Enders-Nella-Steprock Complex, 20%-40% slopes	Well drained	No	No	Severe slopes; severe erosion hazard. Enders-low permeability; high shrink-swell potential	Toe slopes, side slopes, and ridges	3,857
Enders-Steprock Complex, 8%-20% slopes	Well drained	No	No	Severe slopes; severe erosion hazard. Enders-low permeability; high shrink-swell potential	Side slopes and ridges	22,119
Enders-Steprock Complex, 20%-40% slopes	Well drained	No	No	Severe slopes; severe erosion hazard. Enders-low permeability; high shrink-swell potential	Side slopes and ridges	9,972
Guthrie Silt Loam, occasionally flooded	Poorly drained	Yes	Yes, if drained	Low permeability; seasonal wetness	Upland flats and depression	50
Kenn-Ceda Complex, frequently flooded	Well drained	No, but hydric inclusions may be present	No	Surface gravel; droughtiness; flooding	Floodplains	3,256

Table 3-30
Soils Occurring in the Greers Ferry Lake Study Area (continued)

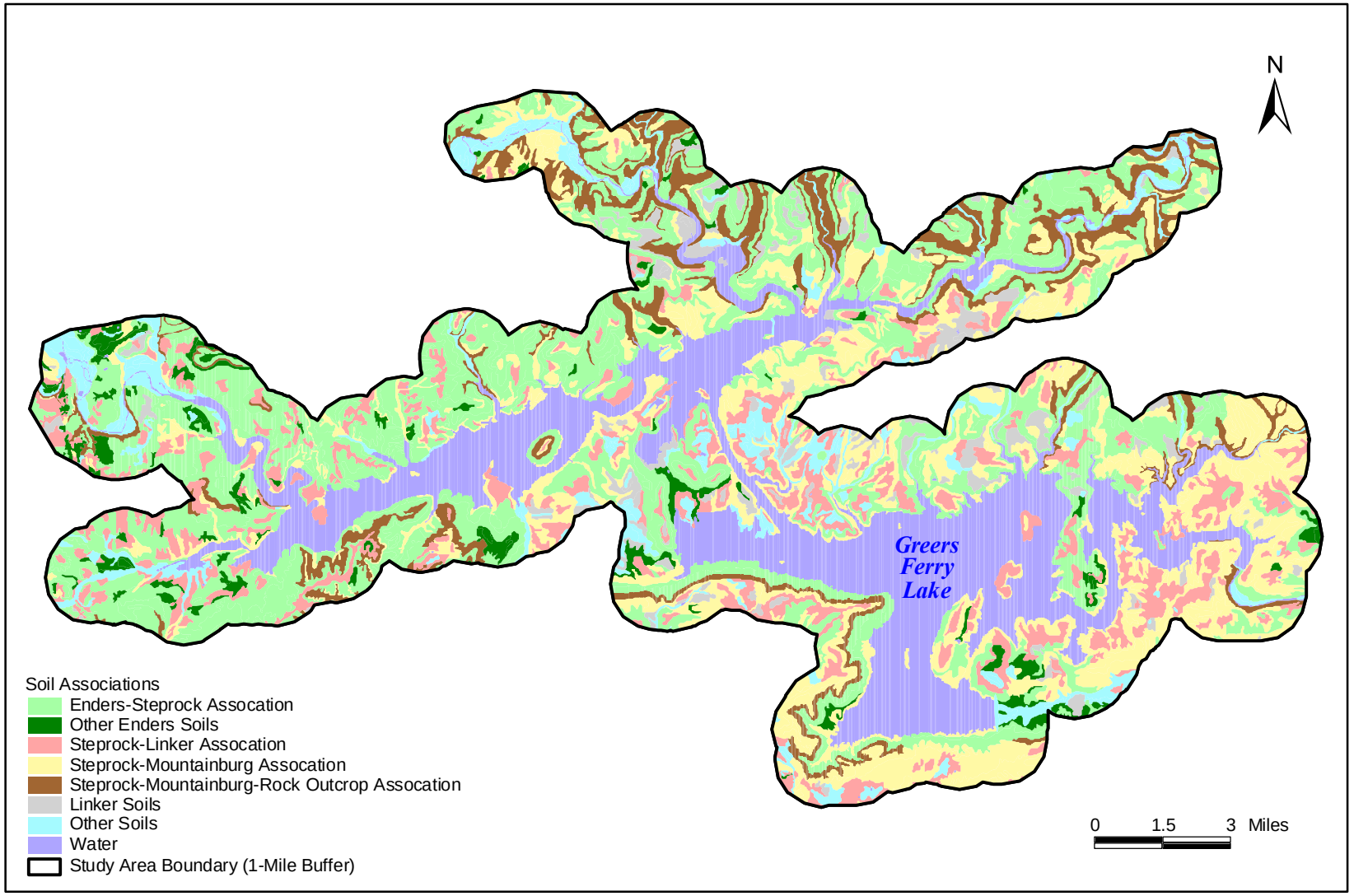
Soil Series	Drainage Class	Hydric	Prime or Unique Farmland	Limitations	Occurrence at Greers Ferry Lake	Acres in Study Area
Leadvale Silt Loam, 1%–3% slopes	Moderately well drained	No, but hydric inclusions may be present	Yes	Moderately low permeability; moderate erosion hazard	Colluvial foot slopes and old stream terraces	355
Leadvale Silt Loam, 3%–8% slopes	Moderately well drained	No	No	Moderately low permeability; severe erosion hazard	Colluvial foot slopes and old stream terraces	222
Linker Fine Sandy Loam, 3%–8% slopes	Well drained	No	Yes	Severe erosion hazard	Hillsides, ridgetops, and benches	418
Linker Gravelly Fine Sandy Loam, 3%–8% slopes	Well drained	No	Yes	Severe erosion hazard	Hillsides, ridgetops, and benches	815
Linker Gravelly Fine Sandy Loam, 8%–12% slopes	Well drained	No	No	Severe slopes; severe erosion hazard	Hillsides, ridgetops, and benches	14
Linker-Mountainburg Complex, 3%–8% slopes	Well drained	No	No	Shallow depth to bedrock; severe erosion hazard	Hillsides, ridgetops, and benches	3,361
Linker-Mountainburg Complex, 8%-20% slopes	Well drained	No	No	Shallow depth to bedrock; severe slopes; severe erosion hazard	Hillsides, ridgetops, benches, and ledges	311
Mountainburg-Rock Outcrop Complex, 1%-12% slopes	Well drained	No	No	Shallow depth to bedrock; severe erosion hazard	Ridgetops and ledges	68
Nauvoo Fine Sandy Loam, 3%–8% slopes	Well drained	No	Yes	Shallow depth to bedrock; severe erosion hazard	Hillsides and ridgetops	463
Nella-Steprock Complex, 8%-20% slopes	Well drained	No	No	Moderate slopes; severe erosion hazard	Toe slopes and side slopes	561
Nella-Steprock Complex, 20%-40% slopes	Well drained	No	No	Severe slopes; severe erosion hazard	Toe slopes and side slopes	63
Sidon Fine Sandy Loam, 1%–3% slopes	Moderately well drained	No	Yes	Low permeability; seasonal wetness	Upland plateaus and broad benches	597
Sidon Fine Sandy Loam, 3%–8% slopes	Moderately well drained	No	No	Low permeability; seasonal wetness; severe erosion hazard	Upland plateaus and broad benches	978
Spadra Loam, occasionally flooded	Well drained	No, but hydric inclusions may be present	Yes	Seasonal wetness	Stream terraces	781
Spadra-Dela Complex, 0%–5% slopes	Well drained	No, but hydric inclusions may be present	No	Moderate erosion hazard; seasonal wetness	Terraces and natural levees on Little Red River and tributaries	6

1

Table 3-30
Soils Occurring in the Greers Ferry Lake Study Area (continued)

Soil Series	Drainage Class	Hydric	Prime or Unique Farmland	Limitations	Occurrence at Greers Ferry Lake	Acres in Study Area
Steprock-Linker Complex, 3%–8% slopes	Well drained	No	No	Shallow depth to bedrock; severe erosion hazard	Upper hillsides and ridgetops	14,862
Steprock-Mountainburg Complex, 3%–8% slopes	Well drained	No	No	Severe erosion hazard	Low ridges	14,584
Steprock-Mountainburg Complex, 8%-20% slopes	Well drained	No	No	Severe slopes, severe erosion hazard	Lower slopes of hillsides and ridgetops	8,874
Steprock-Mountainburg-Rock Outcrop Complex, 40%-60% slopes	Well drained	No	No	Severe slopes, severe erosion hazard	Steep sides of hills, mountains, and ridges	10,980
Steprock-Nella-Mountainburg Complex, 20%-40% slopes	Well drained	No	No	Severe slopes, severe erosion hazard	Upper side slopes and ridgetops	4,590
Taft Silt Loam, 0%–2% slopes	Somewhat poorly drained	No, but hydric inclusions may be present	Yes	Low permeability; seasonal wetness	Stream terraces, upland flats, and depressions	206

Source: SSURGO, 2001.



Soils of the Greers Ferry Lake Study Area

Source: SSURGO, 2001.

Figure 3-21

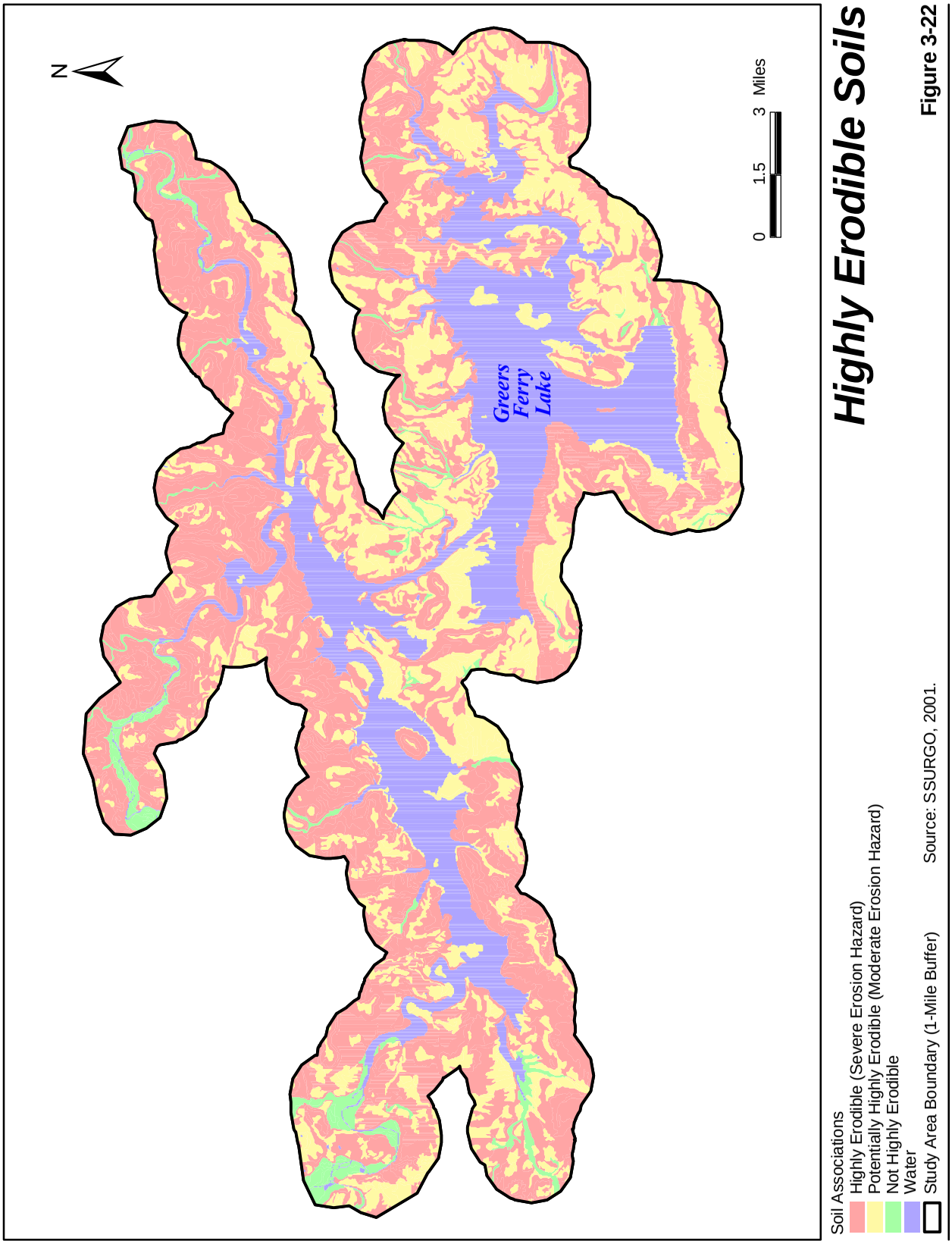

N
0
1.5
3 Miles
Greers Ferry Lake
Highly Erodible Soils
Soil Associations
Highly Erodible (Severe Erosion Hazard)
Potentially Highly Erodible (Moderate Erosion Hazard)
Not Highly Erodible
Water
Study Area Boundary (1-Mile Buffer)
Source: SSURGO, 2001.

Figure 3-22

3.9 ECOLOGICAL SYSTEMS

The U.S. Fish and Wildlife Service (USFWS), the Arkansas Natural Heritage Commission, and the Arkansas Game and Fish Commission were consulted regarding issues in the vicinity of Greers Ferry Lake within their respective areas of responsibility, including those involving sensitive species and habitats. Response letters from these agencies are provided in Appendix G. USFWS was contacted for the purpose of informal consultation under Section 7 of the Endangered Species Act (ESA).

3.9.1 Vegetative Communities

Vegetation around Greers Ferry Lake can be most broadly classified as humid temperate mixed forest; evergreen pine trees and deciduous oaks are important overstory species in uplands. Table 3-31 is a list of common plant species found in the vicinity of the lake. Tree species growing together predictably in the same habitat are often referred to as vegetative communities. The Greers Ferry Lake shoreline and adjacent uplands support several distinct vegetative communities, which are described.

Oak-Hickory-Pine Uplands. Upland habitats are dominated by the oak-hickory-pine vegetative community (USACE, Little Rock District, no date). The species composition of these communities varies according to slope and prior disturbance. Drier, south-facing slopes feature post oak (*Quercus stellata*), pignut hickory (*Carya glabra*), and red cedar (*Juniperus virginiana*). North-facing slopes have white oak (*Quercus alba*) and northern red oak (*Quercus rubra*) and other species that favor more mesic soils (Parsons Engineering Science, Inc., 2000). Southern red oak (*Quercus falcata*) and shortleaf pine (*Pinus echinata*) are also important components of this community.

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

Table 3-31
Common Plant Species in the Vicinity of Greers Ferry Lake

Common Name	Scientific Name
American elm	*Elmus americana*
Black gum	*Nyssa sylvatica*
Black hickory	*Carya texana*
Black willow	*Salix nigra*
Bracken fern	*Pteridium aquilinum*
Broomsedge	*Andropogon virginicus*
Buttonbush	*Cephalanthus occidentalis*
Chinquapin oak	*Quercus muehlenbergii*
Devils walking stick	*Aralia spinosa*
Downy serviceberry	*Amelanchier arborea*
Flowering dogwood	*Cornus florida*
Green ash	*Fraxinus pennsylvanica*
Muscadine grape	*Vitis rotundifolia*
Northern red oak	*Quercus rubra*
Persimmon	*Diospyros virginiana*
Pignut hickory	*Carya glabra*
Poison ivy	*Toxicodendron radicans*
Post oak	*Quercus stellata*
Red buckeye	*Aesculus pavia*
Red cedar	*Juniperus virginiana*
Red maple	*Acer rubrum*
Red mulberry	*Morus rubra*
River birch	*Betula nigra*
Sassafras	*Sassafras albidum*
Shortleaf pine	*Pinus echinata*
Southern red oak	*Quercus falcata*
Sweetgum	*Liquidambar styraciflua*
Sycamore	*Platanus occidentalis*
Virginia creeper	*Parthenocissus quinquefolia*
White oak	*Quercus alba*

Wetlands and Floodplains. Palustrine wetland communities are found adjacent to lake tributaries. Palustrine forests, shrub-scrub, and emergent vegetation were identified by the National Wetlands Inventory (Parsons Engineering Science, Inc., 2000). Palustrine wetlands are important areas for wildlife and for the interception of sediments and other upstream contaminants. Lacustrine littoral wetlands were also identified in some lakeshore areas. Buttonbush (*Cephalanthus occidentalis*) and black willow are dominant species in coves and flats around the lake. The littoral zone in Greers Ferry Lake is not well developed because much of the lakeshore is steeply-sloped, with little transition area between shoreline and deep-water habitat. Wetlands are rare at Greers Ferry Lake because steeply-sloped shorelines are poor sites for wetland formation. Wetlands are found mostly at the mouths of major tributaries on the west side of the lake (Figure 3-23). Floodplains are located along lake tributaries in the Greers Ferry Lake

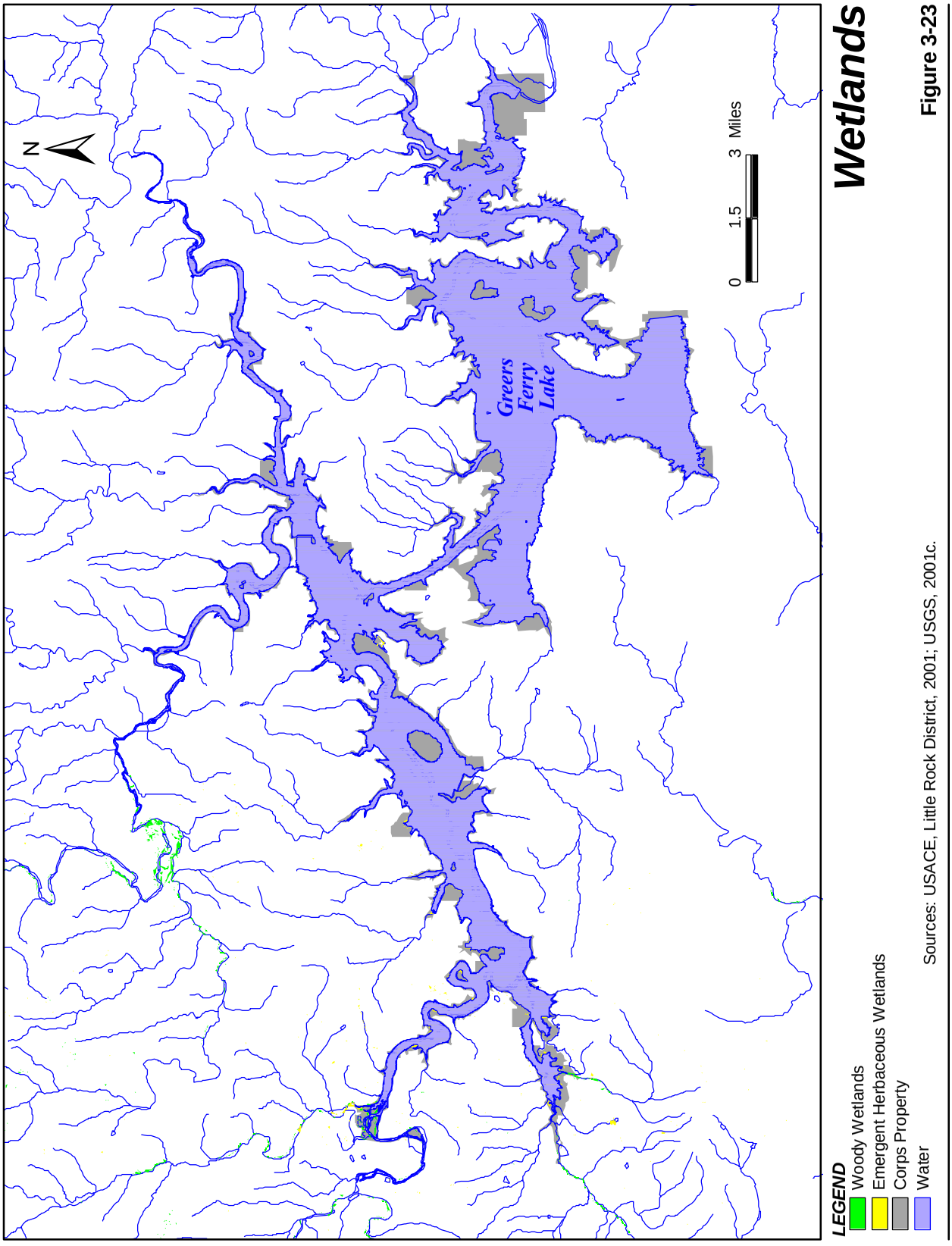

Greers Ferry Lake
N
0
1.5
3 Miles
Wetlands
LEGEND
Woody Wetlands
Emergent Herbaceous Wetlands
Corps Property
Water
Sources: USACE, Little Rock District, 2001; USGS, 2001c.

Figure 3-23

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watershed. The EIS scoping inquiry failed to elucidate any known conflicts between real estate development and wetlands in the Greers Ferry Lake shoreline or watershed.

Old Fields. Row crop agriculture declined in the lake watershed more than 30 years ago. Some open areas are maintained as pasture. Many old fields are gradually being invaded by red cedar, sweetgum (*Liquidambar styraciflua)*, persimmon (*Diospyros virginiana*), and American elm *(Ulmus americana*). Broomsedge (*Andropogon virginicus*) is the predominant grass found on the old field sites (USACE, Greers Ferry Project Office, 2000).

3.9.2 Wildlife

Common terrestrial wildlife species are found in natural and disturbed areas around Greers Ferry Lake. Table 3-32 features a list of mammal and bird species found in the vicinity of the lake. Wildlife watching is an activity enjoyed by many area residents. The 2001 *Scoping Report for the Greers Ferry Lake Environmental Impact Statement* included comments from residents noting many common wildlife species seen around the lake and on private property (Tetra Tech, Inc., 2001a). The scoping report is included as Appendix D.[6]

Black bear (*Ursus americanus*) is the largest predator species known to visit the area. Raccoon (*Procyon lotor*), gray squirrel (*Sciurus carolinensis*), opossum (*Didelphis virginiana*), and other mammals common to rural Arkansas are found in natural areas and near habitable structures. Neotropical migrant songbirds are frequently observed during the summer months. Migratory waterfowl such as mallards (*Anas platyrhynchos*) and wood ducks (*Aix sponsa*) also use the lake and tributary habitats. A population of resident Canada geese (*Branta canadensis*) have made the lake their year-round home. A list of all birds known from Arkansas is available in Appendix H.

Sportfishing is an important pastime for lake residents and visitors. Native and introduced sport fish include black bass (*Micropterus* spp.), sunfish (*Lepomis* spp.), catfish (*Ictalurus* spp.), walleye (*Stizostedion vitreum*), lake trout (*Salvelinus namaycush*), and hybrid striped bass (*Morone chrysops* × *saxatilis*). Table 3-33 lists more than 80 fish species known from the lake watershed. Some non-sport fish species intolerant of lake conditions have not been observed since the reservoir was created in the 1960s.

[6] Only the main document of the scoping report is provided. The attachments to the report are not included, but they can be viewed at http://www.swl.usace.army.mil/projmgt/gfreport.html.

1

Table 3-32
Common Wildlife Species in the Vicinity of Greers Ferry Lake

Common Name	Scientific Name
Birds	
American kestrel	*Falco sparverius*
Barred owl	*Strix varia*
Black vulture	*Coragyps atratus*
Blue jay	*Cyanocitta cristata*
Bobwhite quail	*Colinus virginianus*
Canada goose	*Branta canadensis*
Cardinal	*Cardinalis cardinalis*
Common yellowthroat	*Geothlypis trichas*
Eastern phoebe	*Sayornis phoebe*
Eastern wood-pewee	*Contopus virens*
Great horned owl	*Bubo virginianus*
Kentucky warbler	*Oporornis formosus*
Mallard	*Anas platyrhynchos*
Mockingbird	*Mimus polyglottos*
Mourning dove	*Zenaida macroura*
Prothonotary warbler	*Protonotaria citrea*
Red-headed woodpecker	*Melanerpes erythrocephalus*
Red-tailed hawk	*Buteo jamaicensis*
Robin	*Turdus migratorius*
Turkey vulture	*Cathartes aura*
Wild turkey	*Meleagris gallopavo*
Wood duck	*Aix sponsa*
Mammals	
Black bear	*Ursus americanus*
Gray squirrel	*Sciurus carolinensis*
Opossum	*Didelphis virginiana*
Raccoon	*Procyon lotor*
White-tailed deer	*Odocoileus virginianus*

2

3

1

Table 3-33
Fish Species Reported from the Greers Ferry Lake Watershed

Common Name	Scientific Name
American eel[1]	*Anguilla rostrata*
Arkansas saddled darter	*Etheostoma euzonum*
Banded darter	*Etheostoma zonale*
Bigeye chub[1]	*Hybopis amblops*
Bigeye shiner	*Notropis boops*
Bigmouth buffalo	*Ictiobus cyprinellus*
Black buffalo	*Ictiobus niger*
Black crappie	*Pomoxis nigromaculatus*
Black redhorse	*Moxostoma duquesnei*
Blackside darter	*Percina maculata*
Blackspotted topminnow	*Fundulus olivaceous*
Blacktail shiner	*Notropis venustus*
Blue catfish	*Ictalurus furcatus*
Bluegill	*Lepomis macrochirus*
Bluntnose minnow	*Pimephales notatus*
Brindled madtom	*Noturus miurus*
Brook silverside	*Labidesthes sicculus*
Brown trout	*Salmo trutta*
Bullhead minnow	*Pimephales vigilax*
Central stoneroller	*Campostoma anomalum*
Channel catfish	*Ictalurus punctatus*
Chestnut lamprey	*Icthyomyzon castaneus*
Common carp	*Cyprinus carpio*
Creek chub	*Semotilus atromaculatus*
Creek chubsucker	*Erimyzon oblongus*
Cypress darter	*Etheostoma proeliare*
Duskystripe shiner	*Notropis pilsbryi*
Fathead minnow[1]	*Pimephales promelas*
Flathead catfish	*Pylodictus olivarus*
Freckled madtom	*Noturus nocturnus*
Freshwater drum	*Aplodinotus grunniens*
Gizzard shad	*Dorosoma cepedianum*
Golden redhorse	*Moxostoma erythrurum*
Golden shiner	*Notemigonus crysoleucas*
Goldfish	*Carassius auratus*
Gravel chub[1]	*Hybopis x-punctata*
Green sunfish	*Lepomis cyanellus*
Greenside darter	*Etheostoma blennoides*
Hornyhead chub	*Nocomis biguttatus*
Hybrid striped bass (i)	*Morone chrysops* × *saxatilis*
Lake trout (i)	*Salvelinus namaycush*
Largemouth bass	*Micropterus salmoides*
Largescale stoneroller	*Campostoma oligolepis*
Logperch	*Percina caproides*
Longear sunfish	*Lepomis megalotis*
Longnose darter	*Percina nasuta*

2

3

Table 3-33
Fish Species Reported from the Greers Ferry Lake Watershed (continued)

Common Name	Scientific Name
Longnose gar	*Lepisosteus osseus*
Mississippi silvery minnow[1]	*Hybognathus nuchalis*
Northern hogsucker	*Hypentelium nigricans*
Northern studfish	*Fundulus catenatus*
Ozark madtom	*Noturus albater*
Rainbow darter	*Etheostoma caeruleum*
Rainbow trout (i)	*Oncorhynchus mykiss*
Redear sunfish	*Lepomis microlophus*
Redfin darter	*Etheostoma whipplei*
Redfin shiner	*Notropis umbratilis*
River redhorse	*Moxostoma carinatum*
Scaly sand darter [1]	*Ammocrypta vivax*
Shadow bass	*Ambloplites ariommus*
Shorthead redhorse	*Moxostoma macrolepidotum*
Silver chub[1]	*Hybopis storeriana*
Slender madtom	*Noturus exilis*
Slim minnow	*Pimephales tenellus*
Smallmouth buffalo	*Ictiobus bubalus*
Smallmouth bass	*Micropterus dolomieui*
Speckled darter	*Etheostoma stigmaeum*
Spotted bass	*Micropterus punctulatus*
Spotted gar	*Lepisosteus oculatus*
Spotted sucker	*Minytrema melanops*
Spotted sunfish	*Lepomis punctatus*
Steelcolor shiner	*Notropis whipplei*
Stippled darter	*Etheostoma punctulatum*
Streamline chub	*Hybopis dissimilis*
Striped shiner	*Notropis chrysocephalus*
Threadfish shad	*Dorosoma petenense*
Walleye (i)	*Stizostedion vitreum*
Warmouth	*Lepomis gulosus*
Wedgespot shiner	*Notropis greenei*
White bass	*Morone chrysops*
White crappie	*Pomoxis annularis*
Whitetail shiner	*Notropis galacturus*
Yellow bullhead	*Ictalurus natalis*
Yellowcheek darter	*Etheostoma moorei*

[1] Has not been collected since impoundment of lake.
i = introduced sport fish.
Source: Adapted from USACE, Little Rock District, no date.

Migratory Birds. On January 10, 2001, President Clinton signed Executive Order (EO) 13186, *Responsibilities of Federal Agencies to Protect Migratory Birds*. The EO recognizes that migratory birds have ecological and economic value to the United States and other countries. Migratory birds are valued for hunting, scientific research, and aesthetic enjoyment. International conventions signed in Canada, Russia, Japan, and Mexico have been ratified by the U.S. government to promote the protection of migratory birds and their habitat. Although migratory

bird conservation measures dictated by these international conventions have already been implemented at the Federal level, the EO directs Federal agencies to take further action to protect migratory birds.

Each Federal agency taking actions that have or could have a measurable negative effect on migratory bird populations is directed to develop and implement a Memorandum of Understanding (MOU) with the USFWS to promote conservation of migratory bird populations. Federal agencies have 2 years to develop and implement the MOU.

Elements of the MOU are expected to be carried out, in part, by integration into agency formal planning processes such as NEPA analysis, integrated resource management plans, and land use compatibility guidelines. Each agency, subject to availability of funds, to the extent permitted by law, and in harmony with agency missions, is directed to:

- Avoid or minimize adverse impacts on migratory bird resources and restore and enhance migratory bird habitat as practicable.
- Prevent or abate pollution of the environment so as to benefit migratory birds.
- Incorporate migratory bird conservation principles into agency planning processes (such as NEPA) as practicable, and coordinate with other agencies and nonfederal partners.
- Ensure that agency plans and actions promote recommendations of comprehensive migratory bird conservation efforts, such as Partners-in-Flight and the North American Waterfowl Management Plan.
- Minimize take of migratory birds and provide advance notice to the USFWS if agency actions would result in take of migratory birds.
- Provide training to employees on avoiding or minimizing take of migratory birds and promote migratory bird conservation in international activities.

The EO provides for the creation of an interagency council for the conservation of migratory birds to guide implementation of the EO. The order and the MOUs to be developed do not require changes to the agencies' current contracts, permits, or other third-party agreements. Because the order was recently signed and agency MOUs are not required to be completed until January 2003.

3.9.3 Threatened and Endangered Species

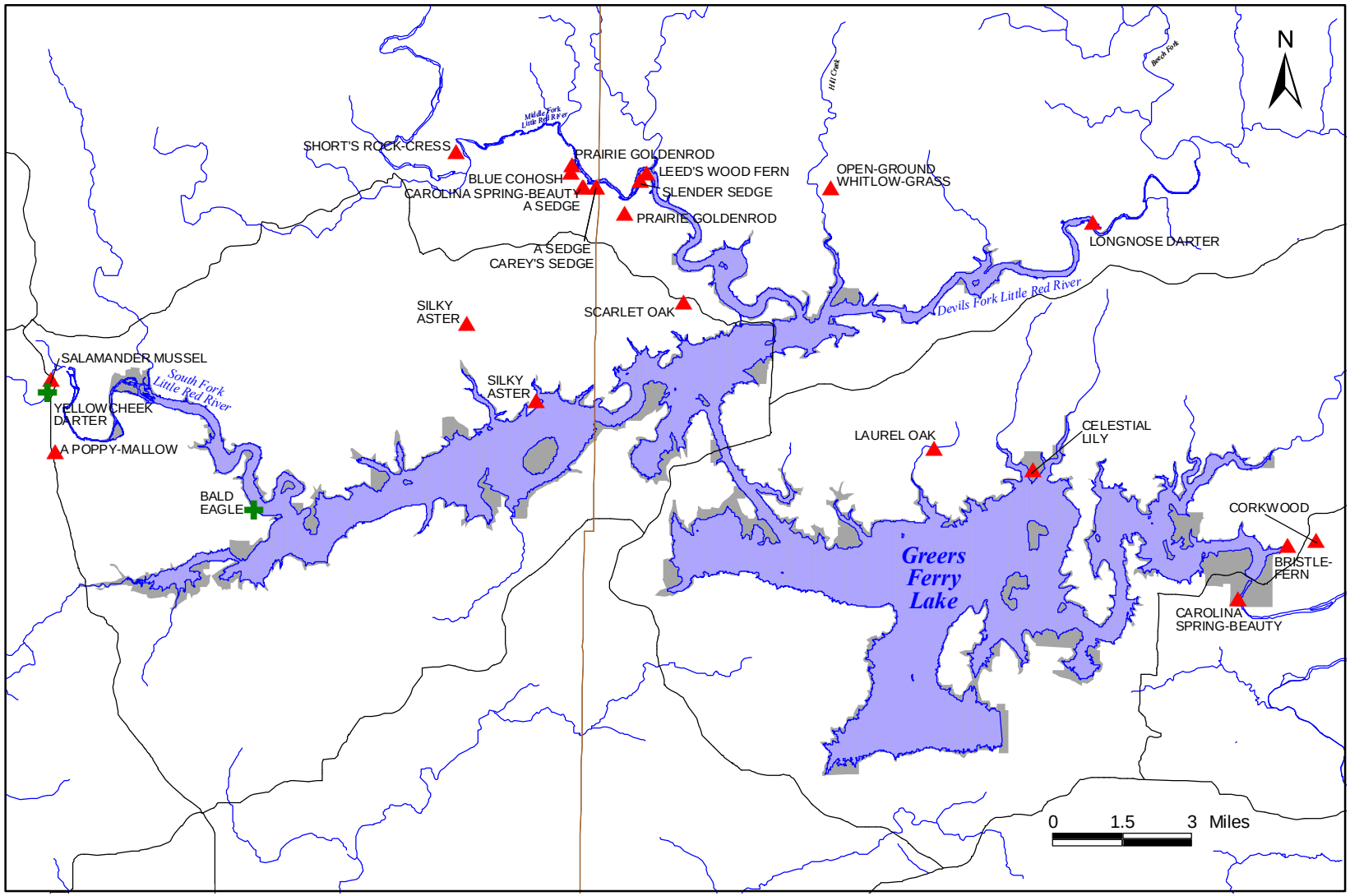
Available biological data do not show the presence of Federally listed species in the shoreline area except for the bald eagle nest known from the west side of the lake. However, several State-listed plants are known to occur in a handful of shoreline locations (Figure 3-24).

Species of Federal Concern. The ESA was passed in 1973 to address concerns about the decline in populations of many unique wildlife species. Supporters of the ESA argued that America's natural heritage was of aesthetic, ecological, educational, recreational, and scientific value to the Nation and worthy of protection. The purpose of the ESA is to rebuild populations of protected species and conserve "the ecosystems upon which endangered and threatened species depend" (USFWS, 2001). The law offers two classes of protection for rare species in decline: endangered and threatened. Endangered means a species is in danger of extinction throughout all or a significant portion of its range. Threatened status indicates that a species is likely to become endangered within the foreseeable future. All species of plants and animals, except pest insects, are eligible for listing as endangered or threatened (USFWS, 2001). USFWS and Arkansas wildlife agencies provided lists of rare, threatened, and endangered species known from the Greers Ferry Lake vicinity (Appendix G). The following species found in the vicinity of Greers Ferry Lake are protected or considered for protection under the ESA.

3.9.3.1 Federally Listed Species

Bald Eagle. The bald eagle (*Haliaeetus leucocephalus*) is a Federally listed threatened species that USFWS has proposed for delisting. Bald eagles are widespread in North America but suffered population declines in the middle of the 20th century due to adverse effects of the pesticide DDT. More recently, the bald eagle population has increased to the point where the species is no longer threatened with extinction in the 48 contiguous States. Bald eagles nest in large trees near rivers and lakes, and they feed on fish and carrion. Bald eagles are sensitive to disturbance during the breeding season, and development within 1,500 feet of a nest is likely to have adverse effects (Tobin, 2001). Greers Ferry Lake provides suitable winter (nonbreeding) habitat for bald eagles. There are two documented eagle nests in the vicinity of Greers Ferry Lake (Parsons Engineering Science, Inc., 2000).

Gray Bat. The gray bat (*Myotis grisescens*) is a Federally listed endangered species known from Oklahoma east to Kentucky and southeast to northwestern Florida. The species declined in abundance by at least 50 percent from the 1960s to the 1980s (ABI, 2001a). The gray bat is a small bat, weighing 8 to 10 grams on average, with uniformly colored gray fur on the back and a wing membrane that attaches at the ankle. The oldest gray bat observed was 16 years old. Female gray



LEGEND

- State-Listed Species Location
- Federally Listed Species Location
- Road
- Water
- Corps Property

Threatened, Endangered, and Sensitive Species

Sources: Osborne, 2001; USACE, Little Rock District, 2001.

Figure 3-24

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bats give birth to one young in late May or early June. Young can fly within 20 to 35 days and are weaned shortly thereafter. Gray bats feed on flying insects, including mayflies and beetles. Individual bats forage along rivers or reservoir shorelines up to approximately 12 miles from their summer roosts. There is evidence that juvenile and adult bats use forested areas for protection from predators, such as owls.

Gray bats use caves to hibernate in winter and raise young in summer. Hibernation and maternity caves are in different locations and might be as many as 300 miles apart. Light and noise from humans entering caves during critical hibernation periods disturb bats and can lead to bat mortality. Disturbance to active maternity caves can result in mother bats abandoning their young. Because gray bats congregate in large numbers in relatively few caves, disturbance to any one cave could result in the loss of a significant portion of the population. Hibernation and maternity caves are also vulnerable to natural disturbances, such as flooding, cave-ins, or debris blocking cave entrances. Cave protection and improved cave gating techniques have helped to stabilize population levels (ABI, 2001a).

The gray bat is also adversely affected by deforestation, water pollution, and the use of some pesticides. Deforestation reduces the quantity of foraging habitat for gray bats, according to some sources. Gray bats have been observed to favor forested habitat over nonforested habitat during foraging and when moving between caves and foraging areas (Tuttle, 1979). Water pollution and sedimentation can affect the reproduction of aquatic insects, such as mayflies, on which the gray bat feeds. The pesticides dieldrin, aldrin, and heptaclor have been found to have toxic effects on young gray bats that receive pesticide residues through the milk of mother bats that forage on insects sprayed with these chemicals (ABI, 2001a). (Deldrin was banned in 1974, and many farmers have switched from aldrin to heptachlor.)

USFWS reports that the gray bat is known from Van Buren County and feeds in riparian areas (Tobin, 2001). Little is known about gray bat activity in the vicinity of Greers Ferry Lake. No gray bat caves have been reported within a mile of the lake. However, there is one cave in Van Buren County, about 8 miles north of the lake on the Middle Fork of the Little Red River, that is used by a small colony of male gray bats during the summer months (Sasse, 2001). This colony was at one time observed to have as many as 8,000 bats in it. When last surveyed in 1995, only 35 gray bats were found. It is not known exactly where the bats from this colony forage, but given what is known about species behavior, gray bats are likely to forage along the river in the vicinity of the cave. Gray bats that venture down to Greers Ferry Lake will most likely be found over slabrock bottom along areas of the main river channel that are bordered by forest (Sasse, 2001).

They will generally be within 5 meters (16.4 feet) of the lake surface near shore in other areas (Sasse, 2001).

Speckled Pocketbook Mussel. The speckled pocketbook mussel (*Lampsilis streckeri*) is a Federally listed endangered bivalved mollusk found only in the Middle Fork of the Little Red River watershed, in Van Buren and Stone Counties. Total range for the species is limited to 9 river miles in the Middle Fork of the Little Red River, from Greers Ferry Lake upstream to the confluence of Meadow Creek.

The speckled pocketbook mussel is a thin, elliptical mussel, about 3 inches long, with yellow or brown spots and chain-like rays. It is similar in appearance to other mussels of the same genus. The speckled pocketbook mussel is a stationary filter feeder that has been found in streams with coarse to muddy sand and a constant flow of water (USFWS, 1991). The mussel is not tolerant of still water, and habitat for the species was eliminated when the river was impounded to create Greers Ferry Lake. The speckled pocketbook mussel had been known from waters downstream of Greers Ferry Lake, but cold, hypolimnetic water flowing from the dam has eliminated the population (USFWS, 1991).

Major threats to the mussel include hazardous materials spills within the watershed (especially along U.S. Highway 65), any additional attempts at channelization, gravel mining operations, and nonpoint pollution sources that result from poor land use practices (USACE, Greers Ferry Project Office, 2000). Recovery strategies include restoration of historic habitat and reestablishment of individuals in restored habitat. Without restoration, the species is vulnerable to extinction from a natural disaster or man-made impact on the one short stretch of river it inhabits (USFWS, 1991).

3.9.3.2 Candidate Species for Federal Listing

Yellowcheek Darter. The yellowcheek darter (*Etheostoma moorei*) is a rare fish species listed as a candidate for protection under the ESA. The yellowcheek darter is found only in the South and Middle Forks of the Little Red River, in Cleburne and Van Buren Counties. Much of the yellowcheek darter's habitat in its restricted native home range was destroyed by the creation of Greers Ferry Lake.

The yellowcheek darter is a small fish in the perch family that grows to just over 2 inches long. Its primary foods are aquatic insect larvae, especially dipteran larvae. The species prefers the faster sections of small rivers with gravel, rubble, and boulder bottoms. The yellowcheek darter spawns from late May through June and is sexually mature in 1 year. Its total life span is 4 years (ABI, 2001b). Major threats to the yellowcheek darter are similar to threats to the speckled

pocketbook mussel. Both species are extremely vulnerable to natural disasters or man-made disturbances within their very small range.

Species of State Concern. Seventeen plant species and six animal species in the vicinity of Greers Ferry Lake (Table 3-34) are considered rare and of conservation concern in Arkansas. Four of the species in Table 3-34 are also species of Federal concern, as described previously. Many of the species of State concern are common elsewhere but are scarce within the political boundaries of Arkansas. Figure 3-24 shows the location of species of State concern in the vicinity of Greers Ferry Lake.

Table 3-34
Rare, Threatened, and Endangered Species in the Vicinity of Greers Ferry Lake

Common Name	Scientific Name	Global Heritage Rank[1,2,3]	State Heritage Rank[4,5]	Federal Status[6]	State Status[7]
Plants					
Blue cohosh	*Caulophyllum thalictroides*	G5	S2		INV
Bristle-fern	*Trichomanes boschianum*	G4	S2S3		ST
Carey's sedge	*Carex careyana*	G5	S2		INV
Carolina spring-beauty	*Claytonia caroliniana*	G5	S2S3		INV
Celestial lily	*Nemastylis geminiflora*	G4	S3		INV
Corkwood	*Leitneria floridana*	G3	S3		INV
Laurel oak	*Quercus laurifolia*	G5	S2S3		INV
Leed's wood fern	*Dryopteris × leedsii*	HYB	S1		INV
Open-ground whitlow-grass	*Draba aprica*	G3	S2		ST
A poppy-mallow	*Callirhoe bushii*	G3	S3		INV
Prairie goldenrod	*Solidago ptarmicoides*	G5	S1S2		INV
Scarlet oak	*Quercus coccinea*	G5	S2S3		INV
Sedge	*Carex sparganioides*	G5	S3		INV
Sedge	*Carex laxiculmis*	G5	S1		INV
Short's rock-cress	*Arabis shortii* var *shortii*	G5T5	S1		INV
Silky aster	*Aster sericeus*	G5	S2		INV
Slender sedge	*Carex tenera*	G5	S1		INV
Bird					
Bald eagle	*Haliaeetus leucocephalus*	G4	S2B,S4N	LT-PD	INV
Invertebrate					
Salamander mussel	*Simpsonaias ambigua*	G3	S1?		INV
Speckled pocketbook mussel	*Lampsilis streckeri*	G1Q	S1	LE	INV
Fish					
Longnose darter	*Percina nasuta*	G3	S2		INV

Table 3-34
Rare, Threatened, and Endangered Species in the Vicinity of Greers Ferry Lake (cont.)

Common Name	Scientific Name	Global Heritage Rank[1,2,3]	State Heritage Rank[4,5]	Federal Status[6]	State Status[7]
Yellowcheek darter	*Etheostoma moorei*	G1	S1	C	INV
Mammal					
Gray bat	*Myotis grisescens*	G3	S2	LE	INV

[1] Global Heritage Rank. This is a conservation rank used by State Heritage Programs and The Nature Conservancy. The rank indicates the relative rarity of an element throughout its range. The following codes are used: G1 = critically imperiled globally because of extreme rarity (5 or fewer occurrences); G2 = imperiled globally because of rarity (6 to 20 occurrences); G3 = either very rare and local throughout its range or found locally (21 to 100 occurrences); G4 = apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery; and G5 = demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery.

[2] A "T" subrank is given to a global rank when a subspecies, variety, or race is considered at the State level. The subrank is made up of a "T" plus a number or letter (1, 2, 3, 4, 5, H, U, X) with the same ranking rules as a full species.

[3] A "Q" in the global rank indicates the element's taxonomic classification as a species is a matter of conjecture among scientists. HYB means "species is of hybrid origin."

[4] State Heritage Rank. This is a conservation rank used by State Heritage Programs and The Nature Conservancy. The rank indicates the relative rarity of an element throughout Arkansas. The following codes are used: S1 = extremely rare (5 or fewer occurrences in the State); S2 = very rare (5 to 20 occurrences in the State); S3 = rare to uncommon (20 to 100 occurrences in the State); S4 = common (100 or more occurrences in the State); and S5 = demonstrably widespread, common, and secure in the State.

[5] A question mark (?) is used temporarily when there is some indecision regarding the rank assignment or when an element has not been ranked. "B" stands for "breeding status"; "N" is "nonbreeding status."

[6] Federal status under the ESA. This field provides information on whether the species is listed as endangered or threatened by the USFWS. The following codes are used: LE = Listed Endangered; the USFWS has listed the species as endangered under the ESA. LT = Listed Threatened; the USFWS has listed the species as threatened under the ESA. C = Candidate Species. PD = Proposed for Delisting; the USFWS has proposed the species for delisting as endangered or threatened.

[7] State Status. Arkansas does not have a law providing special State protection to species considered endangered or threatened. However, lists of species of special concern have been developed. The following codes have been used in this column: INV = Inventory Element; the Arkansas Natural Heritage Commission is currently conducting active inventory work on these elements; available data suggest these elements are of conservation concern. ST = State Threatened; the Arkansas Natural Heritage Commission applies this term to native plant taxa that are believed likely to become endangered in Arkansas in the foreseeable future, based on current inventory information.

3.9.4 Sensitive Habitats

Sensitive habitats are defined as areas that feature scientifically documented occurrences of federally listed threatened and endangered species, as well as natural vegetative communities identified by the Arkansas Natural Heritage Commission as rare in Arkansas. There are no known sensitive habitats or rare natural communities within the area directly affected by the SMP, with the exception of the area adjacent to the bald eagle nest on the west side of the lake. However, some sensitive habitats are present on the periphery of the affected environment. Reaches of the Middle Fork, South Fork, Archey Fork, and Turkey Fork of the Little Red River upstream of Greers Ferry Lake are home to sensitive fish and mussel species. The gray bat is likely to forage

near lake tributary streams and wooded lake shores, but its use of specific lakeshore habitats is not well understood. The Arkansas Game and Fish Commission manages a conservation easement on the east bank of the Little Red River, 5 miles east of Heber Springs and downstream of the Greers Ferry Lake Dam. The 63-acre Cow Shoals Riverfront Natural Area easement protects a rare vegetative community, River Birch–Sycamore Riverfront Forest. This riparian forest, in turn, protects a principal spawning area for an introduced but naturally reproducing population of brown trout (Department of Arkansas Heritage, 2000). This easement is outside the scope of the SMP.

3.10 CULTURAL RESOURCES

The Arkansas Historic Preservation Program, Department of Arkansas Heritage, was consulted regarding cultural resources issues in the vicinity of Greers Ferry Lake. The response letter is provided in Appendix G.

Prehistoric and historic period sites and standing structures that are listed on the National Register of Historic Places (NRHP) are present in the project area (National Park Service, 2001a). One prehistoric site, the Edgemont Rockshelter, near Shirley, Van Buren County, is listed. Standing structures are listed in Table 3-35. A total of 134 archeological sites and 20 historic structures are on record for the Greers Ferry Lake area (Grunewald, 2001). Fifty-one archeological sites are under the lake, and 69 additional sites have been identified along the shoreline. None of these sites have been assessed for the NRHP as yet; all are considered potentially eligible for NRHP listing. The State Historic Preservation Officer (SHPO) has recommended that eligibility of archeological sites not underwater be determined so that those determined to be significant can be taken into account in shoreline management decisions (Grunewald, 2001).

3.10.1 Prehistoric Period Resources

Prehistoric occupation in Arkansas is divided into these major periods: the Paleo-Indian Period (circa [ca.] 12,000 before the present [B.P.] to ca. 10,500 B.P.), the Dalton Period (ca. 10,500 B.P. to ca. 9,500 B.P), the Archaic Period (ca. 9,500 B.P. to ca. 2,500 B.P), the Woodland Period (ca. 2,500 B.P. to ca. 1,100 B.P), and the Mississippian Period (ca. 1,100 B.P. to ca. 300 B.P). This last period overlaps with the earliest historic periods (Sabo, III et al., 1990). A detailed discussion of these periods and specific sites in Arkansas can be found in *Human Adaptation in the Ozark and Ouachita Mountains* (Sabo, III et al., 1990). Prehistoric sites from all periods might be present in the project area, particularly on bluffs overlooking streams or in higher areas where two bodies of water meet. The Edgemont Rockshelter is listed on the NRHP.

Table 3-35
Standing Structures on the NRHP Within the Project Area

Structure	County	Address
Cleburne County Courthouse	Cleburne	Courthouse Square, Heber Springs
Dr. Cyrus F. Crosby House	Cleburne	202 North Broadway Street, Heber Springs
Clarence Frauenthal House	Cleburne	210 North Broadway Street, Heber Springs
Hugh L. King House	Cleburne	110 West Spring Street, Heber Springs
T.E. Olmstead & Son Funeral Home	Cleburne	108 South Fourth Street, Heber Springs
Woman's Community Club Band Shell	Cleburne	Northeast corner of Spring Park, Heber Springs
Walter Patterson Filling Station	Van Buren	Arkansas Route 65, between Griggs and Court Streets, Clinton
Van Buren County Courthouse	Van Buren	Junction of Griggs and Main Streets, Clinton
Titan II ICBM Launch Complex 374-7 Site	Van Buren	West of US 65; 1.7 miles north of junction with Arkansas Route 124, south side

Paleo-Indian Period (ca. 12,000 B.P. to ca. 10,500 B.P.). The Paleo-Indian Period is the earliest evidence of humans in the New World. The climate during this time period was cooler than the present environment, and large animals, such as mammoth and sloth, flourished. Paleo-Indian peoples were nomadic hunters and gatherers who lived in small groups and ate wild plants and animals. A low population density distinguishes this period, with groups residing in seasonal or base camps; as a result, Paleo-Indian sites are rare and usually very small. The Paleo-Indian Period is also noted for diagnostic fluted projectile points and exploitation of Pleistocene megafauna. Remains of Paleo-Indian people in the region are limited to surface finds of fluted projectile points (stone tools used as spear points and knives) (Sabo, III et al., 1990).

Dalton Period (ca. 10,500 B.P. to ca. 9,500 B.P.). This period is considered to be a transition between the Paleo-Indian and Archaic cultures, as well as part of the Early Archaic Period. Changes were caused, in part, by the changing climate, which was becoming warmer and drier, allowing different fauna and flora to flourish. Dalton Period sites appear along stream valleys, both in rockshelters and on river terraces. Based on the archeological evidence, people of this period continued to live in hunting and gathering "band" societies similar to the types of societies that existed during the previous Paleo-Indian Period. Dalton Period artifacts and sites are found throughout Arkansas. The most identifiable artifact from this time period is the Dalton point, which was used as a spear point and knife.

Archaic Period (ca. 9,500 B.P. to ca. 2,500 B.P.). The Archaic Period is divided into three time frames: Early, Middle, and Late. Between 12,000 B.P. and 7,000 B.P., substantial ecological changes occurred across the North American continent. These changes were accompanied by a change from Paleo-Indian to Archaic traditions. During the Archaic Period, the cold, dry climate

that had existed during the Paleo-Indian Period changed to a warmer and wetter climate, resulting in increasing forestation and growth of new varieties of plants. Smaller mammals, such as deer, increased in number, as did birds. Groups responded to these changes, and archeological evidence shows an increasing use of the new environment. For example, grinding stones appear for processing plant foods and are found in the archeological record. During the Late Archaic Period, the ecology and climate became much the same as they are today, with a higher sea level and wetter climate than the previous period. This change led to greater floral and faunal diversity, and the archeological remains of people from this period show their use of this increasing ecological diversity. Early and Middle Archaic sites have been identified at Greers Ferry Reservoir (Sabo, III et al., 1990).

Woodland Period (ca. 2,500 B.P. to ca. 1,100 B.P.). This period is also divided into Early, Middle, and Late time frames. During the Early Woodland Period the climate changed somewhat, allowing the growth of an open oak/hickory forest, changing to more closed oak/hickory/pine forests in the region. Evidence for domesticated plants, including sunflower (*Helianthus*) and goosefoot (*Chenopodium*), appears from ca. 2,000 B.P, indicating the beginnings of horticulture in the region (Sabo, III et al., 1990). The Woodland Period is also marked by the presence of true-fired ceramics. There is little evidence to date for the Early Woodland Period in the region of the project area.

Mississippian Period (ca. 1,100 B.P. to ca. 300 B.P.). This period was similar to the previous period in climate and ecology. However, dramatic changes in social structure occurred at this time, especially a change from somewhat egalitarian, nomadic hunter-gatherers, who relied primarily on wild plants and animals, to more settled villagers, who practiced agriculture and lived in stratified, hierarchical societies with "chiefs." This period witnessed the introduction of maize horticulture. Archeological remains include ceramic pottery, storage pits and hearths, and small triangular stone projectile points. Rock art carvings and paintings found along the Little Red River drainage area also might be related to the Mississippian Period (Sabo, III et al., 1990).

Mississippian peoples lived in permanent villages, often with thousands of inhabitants. They developed town centers with central plazas, cemeteries, and mounds. Other types of settlements include smaller multiseasonal camps or small permanent homes. Their food economy was based on domesticated maize, beans, and squash, along with hunting, fishing, and the collection of edible wild plants, including nuts such as hickory and black walnut. They also are distinguished by their ceramic traditions. These people also developed a large trade network, identified archeologically by goods from as far away as the Great Lakes region. The late Mississippian

Period overlapped with the arrival of the first Europeans, the Spanish explorers led by Hernando de Soto (Sabo, III et al., 1990).

3.10.2 Historic Period Resources

Contact Period. Historic Native Americans who lived in the region in which the project area is located at the time of first contact among Europeans, Africans, and Native Americans were probably the Kaskinampo, Osage, and Quapaw. These groups, in turn, were decimated by disease and warfare associated with Europeans, and by the end of the 19th Century very few lived in the region. In addition, Arkansas was a state on the Trail of Tears; additional tribes, including the Cherokee and Chickasaw, passed through the state. Other tribes that lived in the state historically are the Caddo, Cahinnio, Choctaw, Illinois, and Ofo (Swanton, 2001).

Historic Period. The first Europeans to arrive in what is now the project area were the Spanish explorers, led by Hernando de Soto. They reached what is today known as Arkansas in July 1541, coming across northeastern Arkansas from the Mississippi River. They encountered groups of Mississippian Indians along their route. The next Europeans to enter the area were French explorers, led by Louis Joliet, in July 1673. Father Jacques Marquette (Society of Jesus or Jesuits) was also in the party. The first Native Americans they met were the Quapaw or Arkansas Indians. In 1762, under the Treaty of Fontainebleau, the region became the property of the Spanish. The earliest settlers who followed these explorers were frontiersmen, hunters, and farmers. The colony was next returned to France, on October 1, 1800, as a result of the Treaty of San Ildefonso. Finally, in 1804 the area was ceded to the United States as part of the Louisiana Purchase. The area developed as an area of rural agriculture but maintained its frontier character well into the 19th Century. Arkansas became a state on June 15, 1836. The project area remained rural, with small farming communities existing along the river. Heber Springs, for example, was a community of farmers, ranchers, and storeowners (Greers Ferry Area Chamber of Commerce, 2001; Cleburne County Historical Society, 2001).

3.10.3 Historic Architectural Resources

Standing structures within the project area that are identified as listed on the NRHP are located in Cleburne and Van Buren Counties (National Park Service, 2001b). Table 3-35 lists the properties with their location. Twenty additional sites are potentially eligible for the NRHP. These structures are generally located in the towns that surround the lake. Exceptions are as follows: in Cleburne County, the St. Albert Statue (CE0052S), the Christ in the Garden of Gethsemene Statue (CE0053S), the Wilbur D. Mills Statue (CE0058S), the John F. Kennedy Memorial (CE0059S); in Van Buren County, the Rainwater House (VB0002), the Stobaugh Place (VB0003), and the

Evins-Huie House (VB0004). The Wilbur D. Mills Statue, the John F. Kennedy Memorial, and the Evins-Huie House are adjacent to the lake itself (Grunewald, 2001).

3.10.4 American Indian Resources

No American Indian resources, including traditional cultural properties, have been identified within the project area, apart from archeological sites. Three federally recognized American Indian tribes are identified for Arkansas: the Caddo Indian Tribe of Oklahoma; the Osage Nation of Oklahoma; and the Quapaw Tribe of Indians, Oklahoma (National Park Service, 2001b). These tribes have been contacted by letter regarding this EIS. A copy of the letter is provided in Appendix G of this document.

3.11 AIR QUALITY

Greers Ferry Lake lies within the Northwest Arkansas Intrastate Air Quality Control Region (AQCR), AQCR 021, which includes Cleburne and Van Buren Counties. Air quality in the entire AQCR 021 and in Arkansas is designated as being unclassifiable or in attainment for all criteria pollutants. Criteria pollutants include ozone, carbon monoxide, nitrogen dioxide, sulphur dioxide, particulate matter, and lead.

Pollutant sources in the area include automobiles and local industries. Automobile traffic in the region is typical of rural areas and is not a significant contributor of air pollutants. Automobile traffic during the summer recreational season is much heavier than it is the rest of the year, and some air quality degradation is certain to occur during that period. The amount of degradation is unknown, however, because criteria air pollutants are not monitored in the region (USEPA, 2001b). For comparison, air quality monitoring in Little Rock, Arkansas, the major metropolitan area of the State, indicates that air quality standards for criteria pollutants were not exceeded in the city in 2001 (USEPA, 2001b). Summer traffic in the region around Greers Ferry Lake—which is not as heavy as normal traffic in the Little Rock area—is, therefore, most likely not a significant contributor to air quality degradation.

Local area industries that emit toxic air pollutants include producers of industrial equipment, consumer goods, lumber, asphalt, and rock products; government installations; utilities; and hospitals. All these facilities hold air emissions permits and are regulated by Arkansas. Most facilities are in compliance with their permits (USEPA, 2001b).

3.12 HAZARDOUS AND TOXIC SUBSTANCES

The Arkansas Department of Pollution Control and Ecology is the State agency responsible for implementing RCRA and handling hazardous waste issues that might occur in the Greers Ferry Lake area (USEPA, 1998b). There are no known leaking underground storage tanks or other hazardous waste issues on USACE property at Greers Ferry (Hargis, personal communication, May 2001). Any chemicals or other hazardous and toxic substances owned by the Corps are located in the powerhouse. Several permitted hazardous waste-generating facilities are within the study area, but outside Corps property, in the Heber Springs and Greers Ferry areas (USEPA, 2001c).

Potential hazardous spill areas at Greers Ferry Lake include the marinas, boat ramps, and parking lots. Oil and fuel from powerboats can be discharged into the lake if proper care is not taken when maintaining and fueling. Hazardous and toxic substances also can be generated through the cleaning, painting, or repair of boats in the lake. The dam also could be a possible source.

Private contractors complete most of the maintenance work performed at Greers Ferry and are responsible for disposing of any hazardous waste generated during such activities (pesticides, oils, and the like) according to applicable State regulations. Use of chemicals for managing vegetation along the shoreline of Greers Ferry Lake is prohibited (USACE, Little Rock District, 1994).

3.13 NOISE

Noise and *sound* are often used interchangeably. The sensation of sound is produced when pressure variations having a certain range of characteristics reach a responsive ear. Sound is the term describing pressure variations that are pleasant or useful for communication. Noise is usually defined as unwanted sound, often made up of different frequency components.

Noise is among the most pervasive pollutants today. Unwanted sounds from road traffic, jet planes, jet skis, garbage trucks, construction equipment, manufacturing processes, lawn mowers, leaf blowers, and boom boxes, to name a few sources, are among the noise routinely broadcast into the air. Noise negatively affects the health and well-being of both humans and wildlife in many ways (Noise Pollution Clearinghouse, 2001). Responses to noise vary, depending on the type and characteristics of the noise, expected level of noise, distance between the noise source and the receptor, the receptor's sensitivity, and the time of day. The most conspicuous problems related to noise are hearing loss, and hearing impairment due to masking. Other health impacts include stress and exacerbation of mental health problems; high blood pressure and ischemic heart disease; sleep loss, distraction, and loss of productivity; and a general reduction in the quality of life and opportunities for tranquility. Noise can provoke annoyance responses and

changes in social behavior. The effects of noise can be immediate or latent due to long-term exposure (Plog, 1993; USEPA, 1974; WHO, 2001).

Sources of noise that have the potential to affect wildlife include aircraft overflights; recreational activities like motor boating and snowmobiling; domestic sources such as leaf blowers, lawnmowers, and chainsaws; automobile traffic; and heavy machinery and equipment. Responses vary among species of wildlife, as well as among individuals of a particular species (Busnel and Fletcher, 1978 cited in Radle, no date) although the problems are similar to those found in humans. Increased noise levels mask sounds used by wildlife for communication; for example, they mask the squeaking of babies that parents use to locate their young or calls used to locate a mate (Dooling, no date; Schubert and Smith, 2000). Disturbed mammals sometimes trot short distances; birds might walk around flapping their wings. Panic and escape behavior results from more severe disturbances. Behavioral and physiological responses have a potential to cause injury, energy loss (from movement away from the noise source), decreased food intake, habitat avoidance and abandonment, and reproductive losses (National Park Services, 1994; Nature Sounds Society, 2000).

Sound levels, reported in decibels (dB), are used to summarize how people hear sound and to determine the impact of noise on public health and welfare. Table 3-36 presents a range of sound levels by various sources of noise. USEPA recommends use of the day-night equivalent sound level to quantify the intrusiveness of nighttime noise. The day-night equivalent sound level is the A-weighted sound level[7] that, if continuous for a 24-hour period, would contain the same sound energy as the actual environmental noise, with an additional 10-dB weighting added to all sounds recorded between 10 p.m. and 7 a.m. to account for the extra sensitivity people have to noise during typical sleeping hours. Table 3-37 presents examples of outdoor day-night average (L_{dn}) sound levels in decibels measured at various locations.

[7] "A-weighted sound level" means the sound pressure level in decibels as measured on a sound level meter using the A-weighing network. The level is designated dB(A) or dBA.

Table 3-36
Sounds Levels of Various Sources

Source	Sound Level (dB)
Near jet plane at takeoff	140
Gun muzzle blast	140
Threshold of pain	120
Loud rock music	115
Car horn	115
Thunder	110
Racing boat – 283-ci engine with exhaust below waterline at 50 feet	105
Chainsaw	100
Inboard/outboard boat – 352-ci engine with exhaust above waterline at 50 feet	90
Lawn mower at 50 feet	90
Inboard/outboard boat – 350-ci engine with exhaust below waterline at 50 feet	85
Personal watercraft – 750-cc engine in the water at 50 feet	81
Watercraft with single 175-hp outboard engine at 50 feet	81
Pop-up toaster	75
Alarm clock	75
Normal conversation	60
Rainfall	50
Light traffic	50
Refrigerator	40
Rustle of leaves	20
Normal breathing	10
Threshold of hearing	0

Note: ci = cubic inch, cc = cubic centimeter, hp = horsepower
Sources: Bearden, 2000; Oskam and Mitchell, no date; PWIA, no date; USEPA, 1974.

Table 3-37
Examples of Outdoor Day-Night Average Sound Levels

Outdoor Location	Sound Level (L_{dn}) in dB
Apartment next to freeway	88
0.75 mile from touchdown location at major airport	86
Urban high-density apartment	83
Urban row housing on major avenue	69
Old urban residential area	59
Wood residential	51
Agricultural cropland	45
Rural residential	40
Wilderness background noise	35

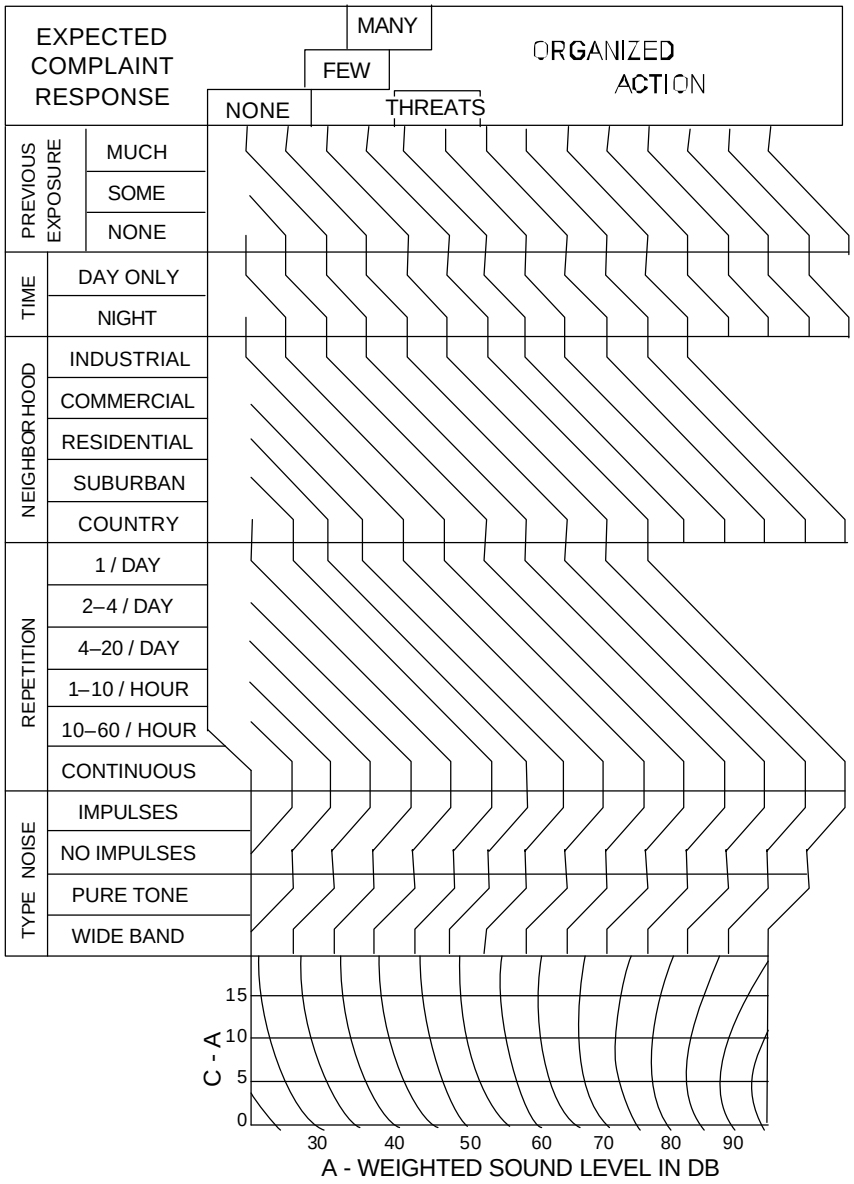
Source: USEPA, 1974.

One significant response to noise is annoyance. A person's expectation of a sound level associated with an activity has a direct bearing on the level of annoyance. For example, noise is tolerated at a bowling alley, but it is not tolerated at a library. The annoyance might be personal or experienced as a group. The five factors identified as being indicators for estimating community complaint reaction to noise are type of noise, amount of repetition, type of

neighborhood, time of day, and amount of previous exposure. Watercraft that produce wide-band noise passing approximately 10 to 20 times an hour during the day in a rural setting will produce few to no complaints, whereas watercraft that generate impulse sounds passing at the same frequency in the same setting, at the same time of day, and at the same sound level will produce community complaints and threats (Figure 3-25).

Public comments received during the scoping process indicated concern about noise from some motorboats, jet skis, and early morning aircraft overflights. Noise is divided into two groups: that associated with occupational exposure and that associated with daily living, often referred to as environmental or community noise. The Noise Control Act of 1972 (Public Law 92-574) and several other laws require the Federal government to set and enforce uniform noise control standards for aircraft and airports, interstate motor carriers and railroads, workplace activities, medium- and heavy-duty trucks, motorcycles, portable air compressors, and Federally assisted housing projects located in noise-exposed areas. The control of environmental or community noise is left to State and local agencies. As early as 1987, USACE, Little Rock District presented information to members of the Cleburne County Quorum Court in support of an ordinance on motorboat noise level control. To this date, no action has been initiated by the Cleburne County Quorum Court. A review of Arkansas ordinances revealed there are no local or State ordinances on noise level control with the exception of ordinances pertaining to rifle ranges and roadhouses.

Many Federal agencies, such as the Environmental Protection Agency, Federal Highway Administration, Department of Housing and Urban Development, Federal Aviation Administration, and Department of Defense, use the day-night sound level to protect the public from the impact of community noise (Cavanaugh and Tocci, 1998) and apply an L_{dn} of 55 dB as a recommended outdoor limit (USEPA, 1974). These agencies recognize 65 dB as the noise level at which residential land use becomes questionable, and areas where the level exceeds 75 dB are considered unacceptable for residential use. The World Health Organization (WHO) has identified the range of noise between 50 and 55 dB for a period of 16 hours as the annoyance threshold (WHO, 2001). Although some Federal agencies use these values, the values are only guidance values, not regulatory criteria.



Source: Botsford, 1969.

Note: To use the chart, locate in the curved grid at the bottom the point corresponding to the sound levels of the noise under consideration (C-A is the difference between the C-weighted and A-weighted sound levels). From this point, project directly upward into the first of the six correction sections. After entering a correction section, follow the lane entered until reaching a position opposite the condition listed at the left that applies to the neighborhood noise under consideration. Then proceed vertically, disregarding lanes, until the next section is reached. In this way, work up through the lanes of correction sections until reaching the top, where the community reaction to be expected is shown.

FIGURE 3-25. CHART FOR ESTIMATING COMMUNITY COMPLIANT REACTION TO NOISE

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